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SECTION 221116 - DOMESTIC WATER PIPING

1. GENERAL
	* + 1. SUMMARY
				1. Section Includes:

Piping joining materials - domestic water.

Encasement for piping.

Dielectric fittings - domestic water.

* + - * 1. Related Requirements:

Retain subparagraph below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.

Section 331415 "Site 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. ACTION SUBMITTALS

Action submittals are submittals requiring responsive action and return of reviewed documents to Contractor.

* + - * 1. Product Data:

Copper tube and fittings - domestic water.

Ductile-iron pipe and fittings - domestic water.

Galvanized-steel pipe and fittings - domestic water.

Stainless steel piping and fittings - domestic water.

CPVC piping - domestic water.

PEX tube and fittings - domestic water.

PEX-AL-PEX tube and fittings - domestic water.

PEX-AL-HDPE tube and fittings - domestic water.

PVC pipe and fittings - domestic water.

Polypropylene (PP-R and PP-RCT) pipe and fittings - domestic water.

Piping joining materials - domestic water.

Encasement for piping.

Transition fittings - domestic water.

Dielectric fittings - domestic water.

* + - 1. INFORMATIONAL SUBMITTALS

Informational submittals are submittals that require review by Architect but do not require Architect's responsive action and return of reviewed documents to Contractor, provided submittals comply with requirements. If rejected, submittals with responsive action must be returned to Contractor.

Retain "Coordination Drawings" Paragraph below for situations where coordination is required for installation of products and materials by separate installers. Preparation of coordination drawings requires participation of each trade involved; coordinate with other Sections specifying products and materials to be included. See Section 013100 "Project Management and Coordination."

* + - * 1. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
				2. System purging and disinfecting activities report.

Retain "Field quality-control reports" Paragraph below if Contractor is responsible for field quality-control testing and inspecting.

* + - * 1. Field quality-control reports.
			1. QUALITY ASSURANCE

Retain "Installer Qualifications" Paragraph below for pressure-sealed joints in copper or steel piping.

* + - * 1. Installer Qualifications: Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
			1. FIELD CONDITIONS

Retain this article if interruption of existing water service is required.

* + - * 1. 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 in accordance with requirements indicated:

Notify [**Architect**] [**Construction Manager**] [**Owner**] no fewer than [**two**] <**Insert number**> days in advance of proposed interruption of water service.

Do not interrupt water service without [**Architect's**] [**Construction Manager's**] [**Owner's**] written permission.

* + - 1. WARRANTY

Delete this article if not retaining polypropylene (PP-R and PP-RCT) pipe and fittings.

When warranties are required and available, verify with Owner's counsel that special warranties stated in this article are not less than remedies available to Owner under prevailing local laws. Most manufacturers offer 10-year extended warranties on their equipment. Verify available warranty periods.

* + - * 1. Polypropylene (PP-R and PP-RCT) Pipe and Fittings Manufacturer's Warranty: Manufacturer agrees to repair or replace PP-R and PP-RCT pipe and fittings that fail in materials or workmanship within 10 years from date of Substantial Completion.

Warranty is to cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of piping system due to defects in materials or manufacturing.

Warranty is to be in effect only upon submission by Contractor to manufacturer of valid pressure/leak documentation indicating that the system was tested and passed manufacturer's pressure/leak test.

1. PRODUCTS
	* + 1. PERFORMANCE REQUIREMENTS

The U.S. Safe Drinking Water Act has required national compliance with less than or equal to 0.25 percent weighted average lead content at wetted surfaces for pipe, fittings, and devices intended to convey or dispense water for human consumption since January 2014. The International Plumbing Code and Uniform Plumbing Code have the same requirements. Items in compliance with NSF 61 and NSF 372 also comply with this requirement. Some manufacturers choose to meet this requirement through independent testing and have "certified lead-free products," which may or may not have NSF 61 or NSF 372 certification.

* + - * 1. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
			1. PIPING MATERIALS

See "Writing Guide" Article in the Evaluations for a discussion of how this Section is organized and the most efficient way to revise this Section. See "Piping Materials and Standards" Article in the Evaluations for a discussion of piping materials covered by referenced standards.

* + - * 1. Potable-water piping and components are to comply with NSF 14, NSF 61, and NSF 372.[ **Include marking "NSF-pw" on piping.**]
			1. PIPING JOINING MATERIALS - DOMESTIC WATER
				1. Pipe-Flange Gasket Materials:

AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.

Full-face or ring type unless otherwise indicated.

* + - * 1. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
				2. Solder Filler Metals: ASTM B32, lead-free alloys.
				3. Flux: ASTM B813, water flushable.
				4. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
				5. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493.

Subparagraph below applies to LEED v4, IgCC/ASHRAE 189.1, and Green Globes. VOC content limit is that for CPVC welding compounds.

Solvent cement shall have a VOC content of 490 g/L or less.

Subparagraph below applies to LEED v4.

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."

Subparagraph below applies to IgCC/ASHRAE 189.1.

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." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.

Subparagraph below applies to Green Globes.

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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

* + - * 1. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer in accordance with ASTM F656.

Subparagraph below applies to LEED v4, IgCC/ASHRAE 189.1, and Green Globes. VOC content limit is that for PVC welding compounds.

Solvent cement shall have a VOC content of 510 g/L or less.

Subparagraph below applies to LEED v4, IgCC/ASHRAE 189.1, and Green Globes. VOC content limit is that for adhesive primers for plastic.

Adhesive primer shall have a VOC content of 550 g/L or less.

Subparagraph below applies to LEED v4.

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."

Subparagraph below applies to IgCC/ASHRAE 189.1.

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." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.

Subparagraph below applies to Green Globes.

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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

Subparagraph below applies to LEED v4.

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."

Subparagraph below applies to IgCC/ASHRAE 189.1.

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." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.

Subparagraph below applies to Green Globes.

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." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit or 33 mcg/cu. m and that of acetaldehyde shall not exceed 9 mcg/cu. m.

* + - * 1. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.
			1. ENCASEMENT FOR PIPING
				1. Standard: ASTM A674 or AWWA C105/A21.5.
				2. Form: [**Sheet**] [**or**] [**tube**].
				3. Color: [**Black**] [**or**] [**natural**] <**Insert color**>.
			2. DIELECTRIC FITTINGS - DOMESTIC WATER
				1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

Flanges in "Dielectric Flanges - Domestic Water" Paragraph below are available in at least NPS 1-1/2 to NPS 4 (DN 40 to DN 100).

* + - * 1. Dielectric Flanges - Domestic Water:

Retain "Basis-of-Design Product" Subparagraph and list of manufacturers below to identify a specific product or a comparable product from manufacturers listed.

Basis-of-Design Product: Subject to compliance with requirements, provide **Zurn Industries, LLC; Model DUXLC** or comparable product by one of the following:

<**Insert manufacturer's name**>

Source Limitations: Obtain dielectric flanges from single manufacturer.

Standard: ASSE 1079.

Factory-fabricated, bolted, companion-flange assembly.

Revise pressure rating and temperature in "Pressure Rating" Subparagraph below to suit Project, or insert other options for specific applications.

Pressure Rating: 175 psig.

End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

1. EXECUTION
	* + 1. PIPING APPLICATIONS
				1. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
				2. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

Retain "Fitting Option" Paragraph below unless prohibited by authorities having jurisdiction.

* + - * 1. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

This article is organized to first present the service and pipe size or size range; then, present optional piping materials and joining methods. Retain the services and sizes and size ranges applicable to Project; then, retain the selected piping materials and joining methods. Coordinate selection of piping materials and joining methods with piping materials described in Part 2.

Piping for this application matches exterior underground water-service piping specified in Section 331415 "Site Water Distribution Piping."

* + - * 1. Under-building-slab, domestic water, building-service piping, NPS 3 (DN 80) and smaller is to be the following:

Annealed-temper copper tube, [**ASTM B88, Type K**] [**ASTM B88, Type L**]; [**wrought-copper, solder-joint fittings; and brazed**] [**copper pressure-seal fittings; and pressure-sealed**] joints.

PVC, [**Schedule 40**] [**Schedule 80**]; socket fittings; and solvent-cemented joints.

Polypropylene (PP-R and PP-RCT), [**SDR 7.4**] [**SDR 11**] pipe and socket fusion, butt fusion, fusion outlet, or electrofusion fittings and joints.

Piping for this application matches exterior underground water-service piping specified in Section 331415 "Site Water Distribution Piping."

* + - * 1. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 (DN 100 to DN 200) and larger is to be the following:

Annealed-temper copper tube, [**ASTM B88, Type K**] [**ASTM B88, Type L**]; wrought-copper, solder-joint fittings; and brazed joints.

Caution: Ductile-iron pipe in first two subparagraphs below must be installed with restrained joints.

Mechanical-joint, ductile-iron pipe; [**standard-**] [**or**] [**compact-**]pattern, mechanical-joint fittings; and mechanical joints.

Push-on joint, ductile-iron pipe; [**standard-**] [**or**] [**compact-**]pattern, push-on joint fittings; and gasketed joints.

Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

PVC, [**Schedule 40**] [**Schedule 80**]; socket fittings; and solvent-cemented joints.

Polypropylene (PP-R and PP-RCT), [**SDR 7.4**] [**SDR 11**] pipe and socket fusion, butt fusion, fusion outlet, or electrofusion fittings and joints.

Piping for this application matches exterior underground combined water-service and fire-service-main piping specified in Section 331415 "Site Water Distribution Piping."

* + - * 1. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12 (DN 150 to DN 300) is to be the following:

Caution: Ductile-iron pipe in first two subparagraphs below must be installed with restrained joints.

Mechanical-joint, ductile-iron pipe; [**standard-**] [**or**] [**compact-**]pattern, mechanical-joint fittings; and mechanical joints.

Push-on joint, ductile-iron pipe; [**standard-**] [**or**] [**compact-**]pattern, push-on joint fittings; and gasketed joints.

Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

* + - * 1. Under-building-slab, domestic water piping, NPS 2 (DN 50) and smaller is to be the following:

[**Drawn-temper**] [**or**] [**annealed-temper**] copper tube, ASTM B88, Type L; [**wrought-copper, solder-joint fittings; and brazed**] [**copper pressure-seal-joint fittings; and pressure-sealed**] joints.

PVC, [**Schedule 40**] [**Schedule 80**]; socket fittings; and solvent-cemented joints.

Polypropylene (PP-R and PP-RCT), [**SDR 7.4**] [**SDR 11**] pipe and socket fusion, butt fusion, fusion outlet, or electrofusion fittings and joints.

* + - * 1. Aboveground domestic water piping, NPS 2 (DN 50) and smaller is to be the following:

Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.

Drawn-temper copper tube, [**ASTM B88, Type L**] [**ASTM B88, Type M**]; [**cast-**] [**or**] [**wrought-**]copper, solder-joint fittings; and [**brazed**] [**soldered**] joints.

Drawn-temper copper tube, [**ASTM B88, Type L**] [**ASTM B88, Type M**]; copper pressure-seal-joint fittings; and pressure-sealed joints.

Drawn-temper copper tube, [**ASTM B88, Type L**] [**ASTM B88, Type M**]; copper push-on joint fittings; and push-on joints.

Stainless steel, [**Schedule 5**] [**or**] [**Schedule 10**] pipe; pressure-seal-joint fittings; and pressure-sealed joints.

CPVC, [**Schedule 40**] [**Schedule 80**]; socket fittings; and solvent-cemented joints.

CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.

CPVC Tubing System: CPVC tube; CPVC socket fittings; and solvent-cemented joints.[ **NPS 1-1/2 and NPS 2 CPVC pipe with CPVC socket fittings may be used instead of tubing.**]

Tube in first three subparagraphs below is available only in NPS 1 (DN 25) and smaller.

PEX tube, NPS 1 and smaller.

Fittings for PEX tube:

ASTM F1807, metal insert and copper crimp rings.

ASTM F1960, cold expansion fittings and reinforcing rings.

ASSE 1061, push-fit fittings.

PEX-AL-PEX tube, NPS 1 and smaller; fittings for PEX-AL-PEX tube; and crimped joints.

PVC, [**Schedule 40**] [**Schedule 80**]; socket fittings; and solvent-cemented joints.

Polypropylene (PP-R and PP-RCT), [**SDR 7.4**] [**SDR 11**] pipe and socket fusion, butt fusion, fusion outlet, or electrofusion fittings and joints.

* + - * 1. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100) is to be the following:

Drawn-temper copper tube, [**ASTM B88, Type L**] [**ASTM B88, Type M**]; [**cast-**] [**or**] [**wrought-**]copper, solder-joint fittings; and [**brazed**] [**soldered**] joints.

Drawn-temper copper tube, [**ASTM B88, Type L**] [**ASTM B88, Type M**]; copper pressure-seal-joint fittings; and pressure-sealed joints.

Drawn-temper copper tube, [**ASTM B88, Type L**] [**ASTM B88, Type M**]; grooved-joint, copper-tube appurtenances; and grooved joints.

Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.

Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

Stainless steel, [**Schedule 5**] [**Schedule 10**] [**Schedule 40**] pipe; grooved-joint fittings, and grooved joints.

CPVC, [**Schedule 40**] [**Schedule 80**]; socket fittings; and solvent-cemented joints.

CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.

PVC, [**Schedule 40**] [**Schedule 80**]; socket fittings; and solvent-cemented joints.

Polypropylene (PP-R and PP-RCT), [**SDR 7.4**] [**SDR 11**] pipe and socket fusion, butt fusion, fusion outlet, or electrofusion fittings and joints.

* + - * 1. Aboveground domestic water piping, NPS 5 to NPS 8 (DN 125 to DN 200), is to be the following:

Drawn-temper copper tube, [**ASTM B88, Type L**] [**ASTM B88, Type M**]; [**cast-**] [**or**] [**wrought-**]copper, solder-joint fittings; and [**brazed**] [**soldered**] joints.

Drawn-temper copper tube, [**ASTM B88, Type L**] [**ASTM B88, Type M**]; grooved-joint, copper-tube appurtenances; and grooved joints.

Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.

Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

Stainless steel [**Schedule 5**] [**Schedule 10**] [**Schedule 40**] pipe, grooved-joint fittings, and grooved joints.

Schedule 40 pipe fittings in first subparagraph below are available only in NPS 6 (DN 150) and smaller.

CPVC, [**Schedule 40**] [**Schedule 80**]; socket fittings; and solvent-cemented joints.

CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.

PVC, [**Schedule 40**] [**Schedule 80**]; socket fittings; and solvent-cemented joints.

Polypropylene (PP-R and PP-RCT) [**SDR 7.4**] [**SDR 11**] pipe and socket fusion, butt fusion, fusion outlet, or electrofusion fittings and joints.

* + - * 1. Aboveground, combined domestic water-service and fire-service-main piping, NPS 6 to NPS 12 (DN 150 to DN 300) is to be the following:

Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.

Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

Stainless steel [**Schedule 5**] [**Schedule 10**] [**Schedule 40**] pipe, grooved-joint fittings, and grooved joints.

* + - 1. EARTHWORK
				1. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.
			2. INSTALLATION OF PIPING

Coordinate piping installations and specialty arrangements with Drawings. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. 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.
				2. Install copper tubing under building slab in accordance with CDA's "Copper Tube Handbook."
				3. Install ductile-iron piping under building slab with restrained joints in accordance with AWWA C600 and AWWA M41.
				4. Install underground [**copper tube**] [**and**] [**ductile-iron pipe**] in PE encasement in accordance with ASTM A674 or AWWA C105/A21.5.
				5. Install valves in accordance with Section 220523 "General-Duty Valves for Plumbing Piping."

Retain first paragraph below if booster pumps are not required.

* + - * 1. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
				2. Install domestic water piping level [**with 0.25 percent slope downward toward drain**] [**without pitch**] and plumb.

Retain first paragraph below if water meters are inside the building.

* + - * 1. Rough-in domestic water piping for water-meter installation in accordance with utility company's requirements.

Retain first paragraph below if piping is required to withstand seismic design loads.

* + - * 1. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
				2. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
				3. 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.
				4. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
				5. Install piping to permit valve servicing.
				6. 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.
				7. Install piping free of sags and bends.
				8. Install fittings for changes in direction and branch connections.
				9. Install PEX tube with loop at each change of direction of more than 90 degrees.
				10. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
				11. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 220500 "Common Work Results for Plumbing."

Retain first paragraph below if hot-water circulation pumps are controlled by thermostats.

* + - * 1. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123.21 "Inline, Domestic Water Pumps."
				2. Install thermometers on[ **inlet and**] outlet piping from each water heater. Comply with requirements for thermometers in Section 220500 "Common Work Results for Plumbing."
				3. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."

Retain first paragraph below for piping that penetrates an exterior concrete wall or concrete slab.

* + - * 1. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."
				2. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."
			1. JOINT CONSTRUCTION
				1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
				2. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
				3. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

Apply appropriate tape or thread compound to external pipe threads.

Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

* + - * 1. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
				2. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings in accordance with ASTM B828 or CDA's "Copper Tube Handbook."
				3. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
				4. 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.
				5. Extruded-Tee Connections: Form tee in copper tube in accordance with ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
				6. Joint Construction for Grooved-End Copper Tubing: Make joints in accordance with AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
				7. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints in accordance with 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.
				8. Joint Construction for Grooved-End Steel Piping: Make joints in accordance with 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.
				9. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts in accordance with ASME B31.9.
				10. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:

Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.

CPVC Piping: Join in accordance with ASTM D2846/D2846M.

PVC Piping: Join in accordance with ASTM D2855.

If retaining PEX in Part 2, retain "Joints for PEX Tubing, ASTM" or "Joints for PEX Tubing, ASSE" Paragraph below, or both. If retaining both, indicate where each type is to be used in "Piping Applications" Article.

* + - * 1. Joints for PEX Tubing, ASTM: Join in accordance with ASTM F1807 for metal insert and copper crimp ring fittings and ASTM F1960 for cold expansion fittings and reinforcing rings.
				2. Joints for PEX Tubing, ASSE: Join in accordance with ASSE 1061 for push-fit fittings.
				3. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.
			1. INSTALLATION OF TRANSITION FITTINGS
				1. Install transition couplings at joints of dissimilar piping.
				2. Transition Fittings in Underground Domestic Water Piping:

Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.

Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.

* + - * 1. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition [**fittings**] [**or**] [**unions**].
			1. INSTALLATION OF DIELECTRIC FITTINGS
				1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
				2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric [**couplings**] [**couplings or nipples**] [**nipples**] [**unions**].
				3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric [**flanges**] [**flange kits**] [**nipples**].
				4. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.
			2. INSTALLATION OF HANGERS AND SUPPORTS

Retain first paragraph below for projects in areas that require seismic restraints.

* + - * 1. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
				2. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
				3. Install hangers for [**copper**] [**ductile iron**] [**galvanized steel**] [**and**] [**stainless steel**] [**tube**] [**and**] [**pipe**], with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
				4. Install vinyl-coated hangers for [**CPVC**] [**PVC**] [**and**] [**PP-R/PP-RCT**] pipe, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
				5. Install vinyl-coated hangers for PEX tube, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
				6. Support horizontal piping within [**12 inches**] <**Insert dimension**> of each fitting.
				7. Support vertical runs of [**copper**] [**ductile iron**] [**galvanized steel**] [**and**] [**stainless steel**] [**tube**] [**and**] [**pipe**] to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
				8. Support vertical runs of [**CPVC**] [**PVC**] [**and**] [**PP-R/PP-RCT**] pipe to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
				9. Support vertical runs of PEX tube to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
			1. PIPING CONNECTIONS

Coordinate piping installations and specialty arrangements with Drawings. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. Drawings indicate general arrangement of piping, fittings, and specialties.
				2. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
				3. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
				4. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

Domestic Water Booster Pumps: Cold-water suction and discharge piping.

Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.

Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

* + - 1. IDENTIFICATION
				1. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
			2. CLEANING

Portions of disinfecting requirements in this article are taken from model plumbing codes; revise if requirements vary by authorities having jurisdiction.

* + - * 1. Clean and disinfect potable domestic water piping as follows:

Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

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:

Flush piping system with clean, potable water until dirty water does not appear at outlets.

Fill and isolate system in accordance with either of the following:

Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.

Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

Repeat procedures if biological examination shows contamination.

Submit water samples in sterile bottles to authorities having jurisdiction.

Retain first paragraph below if disinfection of non-potable domestic water piping is required by authorities having jurisdiction.

* + - * 1. Clean non-potable domestic water piping as follows:

Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

Flush piping system with clean, potable water until dirty water does not appear at outlets.

Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

* + - * 1. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
				2. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
			1. ADJUSTING
				1. Perform the following adjustments before operation:

Close drain valves, hydrants, and hose bibbs.

Open shutoff valves to fully open position.

Open throttling valves to proper setting.

Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.

Adjust calibrated balancing valves to flows indicated.

Remove plugs used during testing of piping and for temporary sealing of piping during installation.

Remove and clean strainer screens. Close drain valves and replace drain plugs.

Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.

Check plumbing specialties and verify proper settings, adjustments, and operation.

* + - 1. FIELD QUALITY CONTROL

Retain "Tests and Inspections" Paragraph below to require Contractor to perform tests and inspections.

* + - * 1. Tests and Inspections:

Portions of testing and inspecting requirements in this article are taken from model plumbing codes. Verify that requirements are applicable to location of this Project.

Piping Inspections:

Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.

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:

Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after installation and before setting fixtures.

Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

Piping Tests:

Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

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.

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.

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 it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

Retain first subparagraph below for hydrostatic testing if required for manufacturer's piping warranty.

Hydrostatic testing and documentation of test results for polypropylene (PP-R and PP-RCT) pipe to be in accordance with manufacturer's written instructions and submitted to manufacturer upon successful completion per warranty requirements.

Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

Prepare reports for tests and for corrective action required.

See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

* + - * 1. Domestic water piping will be considered defective if it does not pass tests and inspections.
				2. Prepare test and inspection reports.

END OF SECTION 221116