

# CHAPTER 6

## WATER SUPPLY AND DISTRIBUTION

### 601.0 Running Water Required.

**601.1** Except where not deemed necessary for safety or sanitation by the Authority Having Jurisdiction, each plumbing fixture shall be provided with an adequate supply of potable running water piped thereto in an approved manner, so arranged as to flush and keep it in a clean and sanitary condition without danger of backflow or cross-connection. Water closets and urinals shall be flushed by means of an approved flush tank or flushometer valve. In jurisdictions that adopt Chapter 16, water closets, urinals, and trap primers in designated non-residential buildings may be provided with reclaimed water as defined and regulated by Chapter 16 of this code.

**Exception:** Listed fixtures that do not require water for their operation and are not connected to the water supply.

**601.2 Identification of a Potable and Nonpotable Water System.** In all buildings where potable water and nonpotable water systems are installed, each system shall be clearly identified. Each system shall be color coded as follows:

**601.2.1 Potable Water** – Green background with white lettering.

**601.2.2 Nonpotable Water** – Yellow background with black lettering, with the words “Caution: Nonpotable water, do not drink.”

Each system shall be identified with a colored band to designate the liquid being conveyed, and the direction of normal flow shall be clearly shown. The minimum size of the letters and length of the color field shall conform to Table 6-1.

A colored identification band shall be indicated every twenty (20) feet (6096 mm) but at least once per room, and shall be visible from the floor level.

Where vacuum breakers or backflow preventers are installed with fixtures listed in Table 14-1, identification of the discharge side may be omitted. Each outlet on the nonpotable water line that could be used for special purposes shall be posted as follows:

“Caution: Nonpotable water, do not drink.”

**601.2.3 Reclaimed Water** – Purple (Pantone color #512) background and shall be imprinted in nominal 1/2-inch (12.7 mm) high, black upper-case letters, with the words “Caution: Reclaimed water, do not drink.”

**601.3** Faucets and diverters shall be connected to the water distribution system so that hot water corresponds to the left side of the fittings.

**TABLE 6-1**

**Minimum Length of Color Field and Size of Letters**

Outside Diameter of Pipe or Covering		Minimum Length of Color Field		Minimum Size of Letters	
inches	(mm)	inches	(mm)	inches	(mm)
1/2 to 1-1/4	(15 to 32)	8	(203)	1/2	(12.7)
1-1/2 to 2	(40 to 50)	8	(203)	3/4	(19.1)
2-1/2 to 6	(65 to 150)	12	(305)	1-1/4	(32)
8 to 10	(200 to 250)	24	(619)	2-1/2	(64)
Over 10	(Over 250)	32	(813)	3-1/2	(89)

### 602.0 Unlawful Connections

**602.1** No installation of potable water supply piping or part thereof shall be made in such a manner that it will be possible for used, unclean, polluted, or contaminated water, mixtures, or substances to enter any portion of such piping from any tank, receptor, equipment, or plumbing fixture by reason of back-siphonage, suction, or any other cause, either during normal use and operation thereof, or when any such tank, receptor, equipment, or plumbing fixture is flooded or subject to pressure in excess of the operating pressure in the hot or cold water piping.

**602.2** No person shall make a connection or allow one to exist between pipes or conduits carrying domestic water supplied by any public or private water service system, and any pipes, conduits, or fixtures containing or carrying water from any other source or containing or carrying water that has been used for any purpose whatsoever, or any piping carrying chemicals, liquids, gases, or any substances whatsoever, unless there is provided a backflow prevention device approved for the potential hazard and maintained in accordance with this code. Each point of use shall be separately protected when potential cross-contamination of individual units exists.

**602.3** No plumbing fixture, device, or construction shall be installed or maintained or shall be connected to any domestic water supply when such installation or connection may provide a possibility of polluting such water supply or may provide a cross-connection between a distributing system of water for drinking and domestic purposes and water that

may become contaminated by such plumbing fixture, device, or construction unless there is provided a backflow prevention device approved for the potential hazard.

**602.4** No water piping supplied by any private water supply system shall be connected to any other source of supply without the approval of the Authority Having Jurisdiction, Health Department, or other department having jurisdiction.

**603.0 Cross-Connection Control.**

Cross-connection control shall be provided in accordance with the provisions of this chapter.

No person shall install any water-operated

equipment or mechanism, or use any water-treating chemical or substance, if it is found that such equipment, mechanism, chemical, or substance may cause pollution or contamination of the domestic water supply. Such equipment or mechanism may be permitted only when equipped with an approved backflow prevention device or assembly.

**603.1 Approval of Devices or Assemblies.** Before any device or assembly is installed for the prevention of backflow, it shall have first been approved by the Authority Having Jurisdiction. Devices or assemblies shall be tested for conformity with recognized standards or other standards acceptable to the Authority Having Jurisdiction that are consistent with the intent of this code.

**TABLE 6-2  
Backflow Prevention Devices, Assemblies, and Methods**

Device, Assembly, or Method <sup>1</sup>	Degree of Hazard				Installation <sup>2,3</sup>
	Pollution (Low Hazard)		Contamination (High Hazard)		
	Back- Siphonage	Back- Pressure	Back- Siphonage	Back- Pressure	
Airgap	x		x		See Table 6-3 in this chapter.
Atmospheric Vacuum Breaker	x		x		Upright position. No valve downstream. Minimum of six (6) inches (152 mm) or listed distance above all downstream piping and flood-level rim of receptor. <sup>4,5</sup>
Spill-Resistant Pressure-Type Vacuum Breaker	x		x		Upright position. Minimum of six (6) inches (152 mm) or listed distance above all downstream piping and flood-level rim of receptor. <sup>5</sup>
Double Check Valve Backflow Preventer	x	x			Horizontal, unless otherwise listed. Requires one (1) foot (305 mm) minimum clearance at bottom for maintenance. May need platform/ladder for test and repair. Does not discharge water.
Pressure Vacuum Breaker	x		x		Upright position. May have valves downstream. Minimum of twelve (12) inches (305 mm) above all downstream piping and flood-level rim of receptor. May discharge water.
Reduced Pressure Principle Backflow Preventer	x	x	x	x	Horizontal unless otherwise listed. Requires one (1) foot (305 mm) minimum clearance at bottom for maintenance. May need platform ladder for test and repair. May discharge water.

<sup>1</sup> See description of devices and assemblies in this chapter.

<sup>2</sup> Installation in pit or vault requires previous approval by the Authority Having Jurisdiction.

<sup>3</sup> Refer to general and specific requirement for installation.

<sup>4</sup> Not to be subjected to operating pressure for more than 12 hours in any 24-hour period.

<sup>5</sup> For deck-mounted and equipment-mounted vacuum breaker, see Section 603.4.15.

All devices or assemblies installed in a potable water supply system for protection against backflow shall be maintained in good working condition by the person or persons having control of such devices or assemblies. Such devices or assemblies shall be tested at the time of installation, repair, or relocation and at least on an annual schedule thereafter, or more often when required by the Authority Having Jurisdiction. If found to be defective or inoperative, the device or assembly shall be repaired or replaced. No device or assembly shall be removed from use or relocated or other device or assembly substituted, without the approval of the Authority Having Jurisdiction.

Testing shall be performed by a certified backflow assembly tester.

**603.2 Backflow Prevention Devices, Assemblies, and Methods.**

**603.2.1 Airgap.** The minimum airgap to afford

backflow protection shall be in accordance with Table 6-3.

**603.2.2 Atmospheric Vacuum Breaker (AVB).** An atmospheric vacuum breaker consists of a body, a checking member, and an atmospheric opening.

**603.2.3 Hose Connection Backflow Preventer.** A hose connection backflow preventer consists of two independent check valves with an independent atmospheric vent between and a means of field testing and draining.

**603.2.4 Double Check Valve Backflow Prevention Assembly (DC).** A double check valve backflow prevention assembly consists of two independently acting internally loaded check valves, four properly located test cocks, and two isolation valves.

**603.2.5 Pressure Vacuum Breaker Backflow Prevention Assembly (PVB).** A pressure vacuum breaker backflow prevention assembly

**TABLE 6-3  
Minimum Airgaps for Water Distribution<sup>4</sup>**

Fixtures	When not affected by sidewalls <sup>1</sup>		When affected by sidewall <sup>2</sup>	
	Inches	(mm)	Inches	(mm)
Effective openings <sup>3</sup> not greater than one-half (1/2) inch (12.7 mm) in diameter	1	(25.4)	1-1/2	(38)
Effective openings <sup>3</sup> not greater than three-quarters (3/4) inch (20 mm) in diameter	1-1/2	(38)	2-1/4	(57)
Effective openings <sup>3</sup> not greater than one (1) inch (25 mm) in diameter	2	(51)	3	(76)
Effective openings <sup>3</sup> greater than one (1) inch (25 mm) in diameter	Two (2) times diameter of effective opening		Three (3) times diameter of effective opening	

<sup>1</sup> Sidewalls, ribs, or similar obstructions do not affect airgaps when spaced from the inside edge of the spout opening a distance greater than three times the diameter of the effective opening for a single wall, or a distance greater than four times the effective opening for two intersecting walls.

<sup>2</sup> Vertical walls, ribs, or similar obstructions extending from the water surface to or above the horizontal plane of the spout opening other than specified in Note 1 above. The effect of three or more such vertical walls or ribs has not been determined. In such cases, the airgap shall be measured from the top of the wall.

<sup>3</sup> The effective opening shall be the minimum cross-sectional area at the seat of the control valve or the supply pipe or tubing that feeds the device or outlet. If two or more lines supply one outlet, the effective opening shall be the sum of the cross-sectional areas of the individual supply lines or the area of the single outlet, whichever is smaller.

<sup>4</sup> Airgaps less than one (1) inch (25.4 mm) shall be approved only as a permanent part of a listed assembly that has been tested under actual backflow conditions with vacuums of 0 to 25 inches (635 mm) of mercury.

consists of a loaded air inlet valve, an internally loaded check valve, two (2) properly located test cocks, and two (2) isolation valves. This device shall be installed indoors only if provisions for spillage are provided.

**603.2.6 Pressure Vacuum Breaker Spill-Resistant-Type Backflow Prevention Assembly (SVB).** A pressure-type vacuum breaker backflow prevention assembly consists of one (1) check valve force-loaded closed and an air inlet vent valve force-loaded open to atmosphere, positioned downstream of the check valve, and located between and including two (2) tightly closing shutoff valves and test cocks.

**603.2.7 Reduced-Pressure Principle Backflow Prevention Assembly (RP).** A reduced-pressure principle backflow prevention assembly consists of two independently acting internally loaded check valves, a differential pressure-relief valve, four properly located test cocks, and two isolation valves.

### 603.3 General Requirements.

**603.3.1** All assemblies shall conform to listed standards and be acceptable to the Authority Having Jurisdiction, with jurisdiction over the selection and installation of backflow prevention assemblies.

**603.3.2** Where more than one (1) backflow prevention valve is installed on a single premise, and the valves are installed in one location, each separate valve shall be permanently identified by the permittee in a manner satisfactory to the Authority Having Jurisdiction.

**603.3.3** The premise owner or responsible person shall have the backflow prevention assembly tested by a certified backflow assembly tester at the time of installation, repair, or relocation and at least on an annual schedule thereafter, or more often when required by the Authority Having Jurisdiction. The periodic testing shall be performed in accordance with the procedures referenced in Table 14-1 by a tester qualified in accordance with those standards.

**603.3.4** Access and clearance shall be provided for the required testing, maintenance, and repair. Access and clearance shall require a minimum of one (1) foot (305 mm) between the lowest portion of the assembly and grade, floor, or platform. Installations elevated more than five (5) feet (1524 mm) above the floor or grade shall be provided with a permanent platform capable of supporting a tester or maintenance person.

**603.3.5** Direct connections between potable water piping and sewer-connected wastes shall not exist under any condition with or without backflow protection. Where potable water is

discharged to the drainage system, it shall be by means of an approved airgap of two (2) pipe diameters of the supply inlet, but in no case shall the gap be less than one (1) inch (25 mm). Connection may be made to the inlet side of a trap provided that an approved vacuum breaker is installed not less than six (6) inches (152 mm), or the distance according to the device's listing, above the flood-level rim of such trapped fixture, so that at no time will any such device be subjected to any back-pressure.

**603.3.6** Backflow preventers for hot water over 110°F (43.3°C) shall be a type designed to operate at temperatures of 110°F (43.3°C) or more without rendering any portion of the assembly inoperative.

**603.3.7** Fixtures, appliances, or appurtenances with integral backflow preventers or integral airgaps manufactured as a unit shall be installed in accordance with their listing requirements and the manufacturers' instructions.

**603.3.8** In cold climate areas, backflow assemblies and devices shall be protected from freezing with an outdoor enclosure or by a method acceptable to the Authority Having Jurisdiction.

**603.3.9** All drain lines serving backflow devices or assemblies shall be sized in accordance with the discharge rates of the manufacturers' flow charts of such devices or assemblies.

**603.3.10 Design and Installation of Plumbing Fixtures.** Plumbing fixtures shall be installed such that fixture fittings, complying with the backflow prevention requirements of ASME A112.18.1, do not have these requirements compromised by the designated fixture fitting mounting surface.

### 603.4 Specific Requirements.

**603.4.1** Water closet and urinal flushometer valves shall be equipped with an atmospheric vacuum breaker. The vacuum breaker shall be installed on the discharge side of the flushometer valve with the critical level at least six (6) inches (152 mm), or the distance according to its listing, above the overflow rim of a water closet bowl or the highest part of a urinal.

**603.4.2** Water closet and urinal tanks shall be equipped with a ballcock. The ballcock shall be installed with the critical level at least one (1) inch (25.4 mm) above the full opening of the overflow pipe. In cases where the ballcock has no hush tube, the bottom of the water supply inlet shall be installed one (1) inch (25.4 mm) above the full opening of the overflow pipe.

**603.4.3** Water closet flushometer tanks shall be protected against backflow by an approved backflow prevention assembly, device, or method.

**603.4.4 Heat Exchangers.**

**603.4.4.1** Heat exchangers used for heat transfer, heat recovery, or solar heating shall protect the potable water system from being contaminated by the heat transfer medium. Single-wall heat exchangers used in indirect-fired water heaters shall meet the requirements of Section 506.4.2. Double-wall heat exchangers shall separate the potable water from the heat-transfer medium by providing a space between the two walls that is vented to the atmosphere.

**603.4.5** Water supply inlets to tanks, vats, sumps, swimming pools, and other receptors shall be protected by one of the following means:

- (1) An approved airgap.
- (2) A listed vacuum breaker installed on the discharge side of the last valve with the critical level not less than six (6) inches (152 mm) or in accordance with its listing.
- (3) A backflow preventer suitable for the contamination or pollution, installed in accordance with the requirements for that type of device or assembly as set forth in this chapter.

**603.4.6 Protection from Lawn Sprinklers and Irrigation Systems.**

**603.4.6.1** Potable water supplies to systems having no pumps or connections for pumping equipment, and no chemical injection or provisions for chemical injection, shall be protected from backflow by one of the following devices:

- (1) Atmospheric vacuum breaker
- (2) Pressure vacuum breaker
- (3) Spill-resistant pressure vacuum breaker
- (4) Reduced-pressure backflow preventer

**603.4.6.2** Where sprinkler and irrigation systems have pumps, connections for pumping equipment, or auxiliary air tanks, or are otherwise capable of creating back-pressure, the potable water supply shall be protected by the following type of device if the backflow device is located upstream from the source of back-pressure:

- (1) Reduced-pressure backflow preventer

**603.4.6.3** Where systems have a backflow device installed downstream from a potable water supply pump or a potable water supply pump connection, the device shall be one of the following:

- (1) Atmospheric vacuum breaker
- (2) Pressure vacuum breaker
- (3) Spill-resistant pressure vacuum breaker
- (4) Reduced-pressure backflow preventer

**603.4.6.4** Where systems include a chemical injector or any provisions for chemical injection, the potable water supply shall be protected by the following:

- (1) Reduced-pressure backflow preventer

**603.4.7** Potable water outlets with hose attachments, other than water heater drains, boiler drains, and clothes washer connections, shall be protected by a nonremovable hose-bibb-type backflow preventer, a nonremovable hose bibb-type vacuum breaker, or by an atmospheric vacuum breaker installed at least six (6) inches (152 mm) above the highest point of usage located on the discharge side of the last valve. In climates where freezing temperatures occur, a listed self-draining frost-proof hose bibb with an integral backflow preventer or vacuum breaker shall be used.

**603.4.8** Water-cooled compressors, degreasers, or any other water-cooled equipment shall be protected by a backflow preventer installed in accordance with the requirements of this chapter.

**Note:**

Water-cooled equipment that produces back-pressure shall be equipped with the appropriate protection.

**603.4.9** Water inlets to water-supplied aspirators shall be equipped with a vacuum breaker installed in accordance with its listing requirements and this chapter. The discharge shall drain through an airgap. When the tailpiece of a fixture to receive the discharge of an aspirator is used, the airgap shall be located above the flood-level rim of the fixture.

**603.4.10** Potable water makeup connections to steam or hot water boilers shall be provided with a listed backflow protection assembly.

**603.4.11 Nonpotable Water Piping.** In cases where it is impractical to correct individual cross-connections on the domestic waterline, the line supplying such outlets shall be considered a nonpotable water line. No drinking or domestic water outlets shall be connected to the nonpotable waterline. Whenever possible, all portions of the nonpotable waterline shall be exposed, and all exposed portions shall be properly identified in a manner satisfactory to the Authority Having Jurisdiction. Each outlet on the nonpotable waterline that may be used for drinking or domestic purposes shall be posted: "Caution: Nonpotable water, do not drink."

**603.4.12** Potable water supply to carbonators shall be protected by either an airgap or a vented backflow preventer for carbonated beverage dispensers installed within the carbonated beverage dispenser. The carbonated beverage dispenser shall bear the label of an approved testing agency, certifying and attesting that such equipment has been tested and inspected and meets the requirements of the approved applicable standard. Carbonated beverage dispensers without an approved internal airgap or vented backflow preventer for carbonated beverage dispensers and carbonated beverage dispensing systems shall have the water supply protected with a vented backflow preventer for carbonated beverage dispensers.

**603.4.13 Water Treatment Units.** Reverse osmosis drinking water treatment units shall meet the requirements of the appropriate standards referenced in Table 14-1. Waste or discharge from reverse osmosis or other types of water treatment units shall enter the drainage system through an airgap.

**603.4.14** Backflow preventers shall not be located in any area containing fumes that are toxic, poisonous, or corrosive.

**603.4.15** Deck-mounted or equipment-mounted vacuum breakers shall be installed in accordance with their listing and the manufacturers' instructions, with the critical level not less than one (1) inch (25.4 mm) above the flood-level rim.

**603.4.16 Protection from Fire Systems.**

**603.4.16.1** Except as provided under Sections 603.4.16.2 and 603.4.16.3, potable water supplies to fire protection systems that are normally under pressure, including but not limited to standpipes and automatic sprinkler systems, except in one- or two-family residential sprinkler systems, piped in materials approved for potable water distribution systems shall be protected from back-pressure and back-siphonage by one of the following testable devices:

- (1) Double check valve assembly
- (2) Double check detector assembly
- (3) Reduced pressure backflow preventer
- (4) Reduced pressure detector assembly

Potable water supplies to fire protection systems that are not normally under pressure shall be protected from backflow and shall meet the requirements of the appropriate standards referenced in Table 14-1.

**603.4.16.2** Where fire protection systems supplied from a potable water system

include a fire department (siamese) connection that is located less than seventeen hundred (1,700) feet (518.2 m) from a non-potable water source that could be used by the fire department as a secondary water supply, the potable water supply shall be protected by one of the following:

- (1) Reduced pressure backflow preventor
- (2) Reduced pressure detector assembly

**Note:**

Nonpotable water sources include fire department vehicles carrying water of questionable quality or water that is treated with antifreeze, corrosion inhibitors, or extinguishing agents.

**603.4.16.3** Where antifreeze, corrosion inhibitors, or other chemicals are added to a fire protection system supplied from a potable water supply, the potable water system shall be protected by one of the following:

- (1) Reduced pressure backflow preventer
- (2) Reduced pressure detector assembly

**603.4.16.4** Whenever a backflow device is installed in the potable water supply to a fire protection system, the hydraulic design of the system shall account for the pressure drop through the backflow device. If such devices are retrofitted for an existing fire protection system, the hydraulics of the sprinkler system design shall be checked to verify that there will be sufficient water pressure available for satisfactory operation of the fire sprinklers.

**603.4.16.5 Residential Sprinkler Systems.**

When residential sprinkler systems are installed using the potable water system, they shall be installed in accordance with the standards listed in Table 14-1.

**603.4.17 Special Equipment, Water Supply Protection.**

Vacuum breakers for washer-hose bedpans shall be located not less than five (5) feet (1,524 mm) above the floor. Hose connections in health care or laboratory areas shall not be less than six (6) feet (1,829 mm) above the floor.

**603.4.18** Portable cleaning equipment, dental vacuum pumps, and chemical dispensers shall be protected from backflow by an airgap, an atmospheric vacuum breaker, a spill-proof vacuum breaker, or a reduced pressure principle backflow preventer.

**603.4.19 Water Heater Connectors.** Flexible metallic water heater connectors or reinforced

flexible water heater connectors connecting water heaters to the piping system shall be in compliance with the appropriate standards listed in Table 14-1.

**603.4.20** Combination stop-and-waste valves or cocks shall not be installed underground.

**603.4.21 Pure Water Process Systems.** The water supply to a pure water process system, such as dialysis water systems, semiconductor washing systems, and similar process piping systems, shall be protected from back-pressure and back-siphonage by a reduced-pressure principle backflow preventer.

**603.4.21.1 Dialysis Water Systems.** The individual connections of the dialysis related equipment to the dialysis pure water system do not require additional backflow protection.

**603.4.22 Plumbing Fixture Fittings.** Plumbing fixture fittings with integral backflow protection shall comply with ASME A112.18.1.

**604.0 Materials.**

**604.1** All pipe, tube, and fittings carrying water used in potable water systems intended to supply drinking water shall meet the requirements of NSF 61 as found in Table 14-1. All materials used in the water supply system, except valves and similar devices, shall be of a like material, except where otherwise approved by the Authority Having Jurisdiction.

Materials for building water piping and building supply piping shall be in accordance with Table 6-4 and the standards in Table 14-1.

**604.2** Copper tube for water piping shall have a weight of not less than Type L.

**Exception:** Type M copper tubing may be used for water piping when piping is aboveground in, or on, a building or underground outside of structures.

**604.3** All hard-drawn copper tubing for water supply and distribution in addition to the required incised marking, shall be marked in accordance with ASTM B 88 *Seamless Copper Water Tube* as listed in Table 14-1. The colors shall be: Type K, green; Type L, blue; Type M, red.

**604.4** Listed flexible copper water connectors shall be installed in readily accessible locations, unless otherwise listed.

**604.5** Cast-iron fittings up to and including two (2) inches (51 mm) in size, when used in connection with potable water piping, shall be galvanized.

**604.6** All malleable iron water fittings shall be

galvanized.

**604.7** Piping and tubing that has previously been used for any purpose other than for potable water systems shall not be used.

**604.8** Approved plastic materials may be used in water service piping, provided that where metal water service piping is used for electrical grounding purposes, replacement piping therefore shall be of like materials.

**Exception:** Where a grounding system acceptable to the Authority Having Jurisdiction is installed, inspected, and approved, metallic pipe may be replaced with nonmetallic pipe.

**604.9** Solder shall conform to the requirements of Section 316.1.3.

**604.10** Water pipe and fittings with a lead content which exceeds eight (8) percent shall be prohibited in piping systems used to convey potable water.

**604.11 PEX.** Cross-linked polyethylene (PEX) tubing shall be marked with the appropriate standard designation(s) listed in Table 14-1 for which the tubing has been approved. PEX tubing shall be installed in compliance with the provisions of this section.

**604.11.1 PEX Fittings.** Metal insert fittings, metal compression fittings, and cold expansion fittings used with PEX tubing shall be manufactured to and marked in accordance with the standards for the fittings in Table 14-1.

**604.11.2 Water Heater Connections.** PEX tubing shall not be installed within the first eighteen (18) inches (457 mm) of piping connected to a water heater.

**604.12 Flexible Corrugated Connectors.** Flexible corrugated connectors of copper or stainless steel shall be limited to the following connector lengths:

**Water Heater Connectors** – twenty-four (24) inches (609 mm).

**Fixture Connectors** – thirty (30) inches (762 mm).

**Washing Machine Connectors** – seventy-two (72) inches (1827 mm).

**Dishwasher and Icemaker Connectors** – one hundred twenty (120) inches (3048 mm).

**604.13 PEX-AL-PEX and PE-AL-PE.** Crosslinked polyethylene-aluminum-crosslinked polyethylene (PEX-AL-PEX) and polyethylene-aluminum-polyethylene (PE-AL-PE) composite pipe shall be marked with the appropriate standard designations listed in Table 14-1 for which the piping has been listed or approved. PEX-AL-PEX and PE-AL-PE piping shall be installed in compliance with the provisions of this section.

**604.13.1 PEX-AL-PEX and PE-AL-PE.** Fittings used with PEX-AL-PEX and PE-AL-PE piping

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TABLE 6-4

Material	Water Distribution Pipe and Fittings		Building Supply Pipe and Fittings
	Hot	Cold	
Asbestos – Cement			X
Brass	X	X	X
Copper	X	X	X
Cast Iron	X	X	X
CPVC	X	X	X
Galvanized Malleable Iron	X	X	X
Galvanized Wrought Iron	X	X	X
Galvanized Steel	X	X	X
PE			X
PE-AL-PE	X	X	X
PEX	X	X	X
PEX-AL-PEX	X	X	X
PVC			X

shall be manufactured to and marked in accordance with the standard for the fittings in Table 14-1.

**604.13.2 Water Heater Connections.** PEX-AL-PEX or PE-AL-PE tubing shall not be installed within the first eighteen inches (18) (457 mm) of piping connected to a water heater.

**604.14 Water Heater Connectors.** Flexible metallic water heater connectors or reinforced flexible water heater connectors connecting water heating to the piping system shall be in compliance with the appropriate standards listed in Table 14-1.

#### 605.0 Valves.

**605.1** Valves up to and including two (2) inches (51 mm) in size shall be brass or other approved material. Sizes over two (2) inches (51 mm) may have cast-iron or brass bodies. Each gate or ball valve shall be a fullway type with working parts of non-corrosive material.

**605.2** A fullway valve controlling all outlets shall be installed on the discharge side of each water meter and on each unmetered water supply. Water piping supplying more than one building on any one premises shall be equipped with a separate fullway valve to each building, so arranged that the water supply can be turned on or off to any individual or separate building provided; however, that supply piping to a single-family residence and building accessory thereto may be controlled on one valve. Such shutoff valves shall be accessible at all times. A fullway valve shall be installed on the discharge piping from water supply tanks at or near the tank. A fullway valve shall be installed on the cold water supply pipe to each water heater at or near

the water heater.

**605.3** In multidwelling units, one (1) or more shutoff valves shall be provided in each dwelling unit so that the water supply to any plumbing fixture or group of fixtures in that dwelling unit can be shut off without stopping water supply to fixtures in other dwelling units. These valves shall be accessible in the dwelling unit that they control.

**605.4** All valves used to control two (2) or more openings shall be fullway gate valves, ball valves, or other approved valves designed and approved for the service intended.

**605.5** A control valve shall be installed immediately ahead of each water-supplied appliance and immediately ahead of each slip joint or appliance supply.

Parallel water distribution systems shall provide a control valve either immediately ahead of each fixture being supplied or installed at the manifold and shall be identified with the fixture being supplied.

**605.6** All required shutoff or control valves shall be accessible.

**605.7** A single control valve shall be installed on a water supply line ahead of any automatic metering valve that supplies a battery of fixtures.

#### 606.0 Joints and Connections.

##### 606.1 Types of Joints.

**606.1.1 Flared Joints.** Flared joints for soft copper water tubing shall be made with fittings meeting approved standards. The tubing shall

be reamed to the full bore, resized to round, and expanded with a proper flaring tool.

**606.1.2 Mechanical Joints.** Mechanical joints for cast-iron water pipe shall conform to nationally recognized standards.

**606.1.3 Mechanically Formed Tee Fittings.** Mechanically extracted collars shall be formed in a continuous operation consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height not less than three (3) times the thickness of the branch tube wall.

The branch tube shall be notched to conform with the inner curve of the run tube and shall have two (2) dimple/depth stops to ensure that penetration of the branch tube into the collar is of sufficient depth for brazing and that the branch tube does not obstruct the flow in the main line tube. Dimple/depth stops shall be in line with the run of the tube. The second dimple shall be one quarter (1/4) inch (6.35 mm) above the first and shall serve as a visual point of inspection.

All joints shall be brazed in accordance with Section 316.1.7. Soldered joints shall not be allowed.

**606.2 Use of Joints.**

**606.2.1 Copper Water Tube.** Joints in copper tubing shall be made by the appropriate use of approved fittings properly soldered or brazed together as provided in Section 316.1.3 or 316.1.7 or by means of approved flared or compression fittings in Section 606.1.1 or 316.1.5. Solder and soldering flux shall conform to the requirements of Section 316.1.3. Mechanically formed tee fittings shall be made by brazing only and shall conform to the requirements of Section 316.1.7.

**606.2.2 Plastic Fittings.** Female PVC screwed fittings for water piping shall be used with plastic male fittings and plastic male threads only.

**606.2.3 Slip Joints.** In water piping, slip joints may be used only on the exposed fixture supply.

**607.0 Gravity Supply Tanks.**

Gravity tanks for potable water shall be tightly covered, and have not less than a sixteen (16) square-inch (10,323 mm<sup>2</sup>) overflow screened with copper screen having not less than fourteen (14) nor more than eighteen (18) openings per linear inch (25.4 mm).

**608.0 Water Pressure, Pressure Regulators, Pressure Relief Valves, and Vacuum Relief Valves.**

**608.1 Inadequate Water Pressure.** Whenever the water pressure in the main or other source of supply

will not provide a residual water pressure of at least fifteen (15) pounds per square inch (103.4 kPa), after allowing for friction and other pressure losses, a tank and a pump or other means that will provide said fifteen (15) pound (103.4 kPa) pressure shall be installed. Whenever fixtures and/or fixture fittings are installed that require residual pressure higher than fifteen (15) pounds per square inch (103.4 kPa), that minimum residual pressure shall be provided.

**608.2 Excessive Water Pressure.** Where static water pressure in the water supply piping is in excess of eighty (80) pounds per square inch (552 kPa), an approved-type pressure regulator preceded by an adequate strainer shall be installed and the static pressure reduced to eighty (80) pounds per square inch (552 kPa) or less. Such regulator(s) shall control the pressure to all water outlets in the building unless otherwise approved by the Authority Having Jurisdiction. Each such regulator and strainer shall be accessibly located aboveground or in a vault equipped with a properly sized and sloped bore-sighted drain to daylight, shall be protected from freezing, and shall have the strainer readily accessible for cleaning without removing the regulator or strainer body or disconnecting the supply piping. All pipe size determinations shall be based on eighty (80) percent of the reduced pressure when using Table 6-6.

**608.3** Any water system provided with a check valve, backflow preventer, or any other normally closed device that prevents dissipation of building pressure back into the water main shall be provided with an approved, listed, and adequately sized expansion tank or other approved device having a similar function to control thermal expansion. Such expansion tank or other approved device shall be installed on the building side of the check valve, backflow preventer, or other device and shall be sized and installed in accordance with the manufacturer's recommendation.

Any water system containing storage water heating equipment shall be provided with an approved, listed, adequately sized combination pressure and temperature relief valve, except for listed nonstorage instantaneous heaters having an inside diameter of not more than three (3) inches (80 mm). Each such approved combination temperature and pressure relief valve shall be installed on the water-heating device in an approved location based on its listing requirements and the manufacturer's instructions. Each such combination temperature and pressure relief valve shall be provided with a drain as required in Section 608.5.

**608.4** Each pressure relief valve shall be an approved automatic type with drain, and each such

relief valve shall be set at a pressure of not more than one hundred fifty (150) pounds per square inch (1035 kPa). No shutoff valve shall be installed between the relief valve and the system or in the drain line.

**608.5** Relief valves located inside a building shall be provided with a drain, not smaller than the relief valve outlet, of galvanized steel, hard-drawn copper piping and fittings, CPVC, or listed relief valve drain tube with fittings that will not reduce the internal bore of the pipe or tubing (straight lengths as opposed to coils) and shall extend from the valve to the outside of the building, with the end of the pipe not more than two (2) feet (610 mm) nor less than six (6) inches (152 mm) above the ground or the flood level of the area receiving the discharge and pointing downward. Such drains may terminate at other approved locations. Relief valve drains shall not terminate in a building's crawl space. No part of such drain pipe shall be trapped or subject to freezing. The terminal end of the drain pipe shall not be threaded.

**608.6** Any water-heating device connected to a separate storage tank and having valves between said heater and tank shall be provided with an approved water pressure relief valve.

**608.7 Vacuum Relief Valves.** Where a hot-water storage tank or an indirect water heater is located at an elevation above the fixture outlets in the hot-water system, a vacuum relief valve shall be installed on the storage tank or heater.

#### **609.0 Installation, Testing, Unions, and Location.**

**609.1 Installation.** All water piping shall be adequately supported in accordance with Section 314.0. Burred ends shall be reamed to the full bore of the pipe or tube. Changes in direction shall be made by the appropriate use of fittings, except that changes in direction in copper tubing may be made with bends, provided that such bends are made with bending equipment that does not deform or create a loss in the cross-sectional area of the tubing. Changes in direction are allowed with flexible pipe and tubing without fittings in accordance with the manufacturer's installation instructions. Provisions shall be made for expansion in hot-water piping. All piping, equipment, appurtenances, and devices shall be installed in a workmanlike manner in conformity with the provisions and intent of the code. All water service yard piping shall be at least twelve (12) inches (305 mm) below the average local frost depth. The minimum cover shall be twelve (12) inches (305 mm) below finish grade.

**609.2** Water pipes shall not be run or laid in the same trench as building sewer or drainage piping constructed of clay or materials that are not approved for use within a building unless both of

the following conditions are met:

**609.2.1** The bottom of the water pipe, at all points, shall be at least twelve (12) inches (305 mm) above the top of the sewer or drain line.

**609.2.2** The water pipe shall be placed on a solid shelf excavated at one side of the common trench with a minimum clear horizontal distance of at least twelve (12) inches (305 mm) from the sewer or drain line.

Water pipes crossing sewer or drainage piping constructed of clay or materials that are not approved for use within a building shall be laid a minimum of twelve (12) inches (305 mm) above the sewer or drain pipe.

**609.3** Water piping installed within a building and in or under a concrete floor slab resting on the ground shall be installed in accordance with the following requirements:

**609.3.1** Ferrous piping shall have a protective coating of an approved type, machine applied and conforming to recognized standards. Field wrapping shall provide equivalent protection and shall be restricted to those short sections and fittings necessarily stripped for threading. Zinc coating (galvanizing) shall not be deemed adequate protection for piping or fittings. Approved nonferrous piping shall not be required to be wrapped.

**609.3.2** Copper tubing shall be installed without joints where possible. Where joints are permitted, they shall be brazed, and fittings shall be wrought copper.

**Note:** For the purpose of this section, "within the building" shall mean within the fixed limits of the building foundation.

**609.4 Testing.** Upon completion of a section or of the entire hot and cold water supply system, it shall be tested and proved tight under a water pressure not less than the working pressure under which it is to be used. The water used for tests shall be obtained from a potable source of supply. Except for plastic piping, a fifty (50) pound-per-square-inch (344.5 kPa) air pressure may be substituted for the water test. In either method of test, the piping shall withstand the test without leaking for a period of not less than fifteen (15) minutes.

**609.5 Unions.** Unions shall be installed in the water supply piping within twelve (12) inches (305 mm) of regulating equipment, water heating, conditioning tanks, and similar equipment that may require service by removal or replacement in a manner that will facilitate its ready removal.

**609.6 Location.** Except as provided in Section 609.7, no building supply shall be located in any lot other than the lot that is the site of the building or

structure served by such building supply.

**609.7** Nothing contained in this code shall be construed to prohibit the use of all or part of an abutting lot to:

**609.7.1** Provide access to connect a building supply to an available public water service when proper cause and legal easement not in violation of other requirements have been first established to the satisfaction of the Authority Having Jurisdiction.

**609.7.2** Provide additional space for a building supply when proper cause, transfer of ownership, or change of boundary not in violation of other requirements have been first established to the satisfaction of the Authority Having Jurisdiction. The instrument recording such action shall constitute an agreement with the Authority Having Jurisdiction, which shall clearly state and show that the areas so joined or used shall be maintained as a unit during the time they are so used. Such an agreement shall be recorded in the office of the County Recorder as a part of the conditions of ownership of said properties, and shall be binding on all heirs, successors, and assigns to such properties. A copy of the instrument recording such proceedings shall be filed with the Authority Having Jurisdiction.

**609.8 Low-Pressure Cutoff Required on Booster Pumps for Water Distribution Systems.** When a booster pump – excluding a fire pump – is connected to a water service or underground water pipe, a low-pressure cutoff switch on the inlet side of the pump shall be installed within five (5) feet (1,524 mm) of the inlet. The cutoff switch shall be set for not less than ten (10) psi (68.9 kPa). A pressure gauge shall be installed between the shutoff valve and the pump.

**609.9 Disinfection of Potable Water System.** New or repaired potable water systems shall be disinfected prior to use whenever required by the Authority Having Jurisdiction. The method to be followed shall be that prescribed by the Health Authority or, in case no method is prescribed by it, the following:

**609.9.1** The pipe system shall be flushed with clean, potable water until only potable water appears at the points of outlet.

**609.9.2** The system or parts thereof shall be filled with a water-chlorine solution containing at least fifty (50) parts per million of chlorine, and the system or part thereof shall be valved-off and allowed to stand for twenty-four (24) hours; or, the system or part thereof shall be filled with a water-chlorine solution containing at least two hundred (200) parts per million of chlorine and allowed to stand for three (3) hours.

**609.9.3** Following the allowed standing time, the system shall be flushed with clean, potable water until the chlorine residual in the water coming from the system does not exceed the chlorine residual in the flushing water.

**609.9.4** The procedure shall be repeated if it is shown by bacteriological examination made by an approved agency that contamination persists in the system.

**609.10 Water Hammer.** All building water supply systems in which quick-acting valves are installed shall be provided with devices to absorb the hammer caused by high pressures resulting from the quick closing of these valves. These pressure-absorbing devices shall be approved mechanical devices. Water pressure-absorbing devices shall be installed as close as possible to quick-acting valves.

**609.10.1 Mechanical Devices.** When listed mechanical devices are used, the manufacturers' specifications as to location and method of installation shall be followed.

**610.0 Size of Potable Water Piping.**

**610.1** The size of each water meter and each potable water supply pipe from the meter or other source of supply to the fixture supply branches, risers, fixtures, connections, outlets, or other uses shall be based on the total demand and shall be determined according to the methods and procedures outlined in this section. Water piping systems shall be designed to ensure that the maximum velocities allowed by the code and the applicable standard are not exceeded.

**610.2** Whenever a water filter, water softener backflow prevention device, or similar device is installed in any water supply line, the pressure loss through such devices shall be included in the pressure loss calculations of the system, and the water supply pipe and meter shall be adequately sized to provide for any such pressure loss.

No water filter, water softener, backflow prevention device, or similar device regulated by this code shall be installed in any potable water supply piping when the installation of such device produces an excessive pressure drop in any such water supply piping. In the absence of specific pressure drop information, the diameter of the inlet or outlet of any such device or its connecting piping shall not be less than the diameter of such water distribution piping to the fixtures served by the device.

All such devices shall be of a type approved by the Authority Having Jurisdiction and shall be tested for flow rating and pressure loss by an approved laboratory or recognized testing agency to standards consistent with the intent of this chapter.



**610.3** The quantity of water required to be supplied to every plumbing fixture shall be represented by fixture units, as shown in Table 6-5. Equivalent fixture values shown in Table 6-5 include both hot and cold water demand.

**610.4** Systems within the range of Table 6-6 may be sized from that table or by the method set forth in Section 610.5.

Listed parallel water distribution systems shall be installed in accordance with their listing, but at no time shall any portion of the system exceed the maximum velocities allowed by the code.

**610.5** Except as provided in Section 610.4, the size of each water piping system shall be determined in accordance with the procedure set forth in Appendix A. For alternate methods of sizing water supply systems, see Appendix L.

**610.6** Except where the type of pipe used and the water characteristics are such that no decrease in capacity due to length of service (age of system) may be expected, all friction-loss data shall be obtained from the "Fairly Rough" or "Rough" charts in Appendix A of this code. Friction or pressure losses in water meter, valve, and fittings shall be obtained from the same sources. Pressure losses through water-treating equipment, backflow prevention devices, or other flow-restricting devices shall be computed as required by Section 610.2.

**610.7** On any proposed water piping installation sized using Table 6-6, the following conditions shall be determined:

- (1) Total number of fixture units as determined from Table 6-5, Equivalent Fixture Units, for the fixtures to be installed.
- (2) Developed length of supply pipe from meter to most remote outlet.
- (3) Difference in elevation between the meter or other source of supply and the highest fixture or outlet.
- (4) Pressure in the street main or other source of supply at the locality where the installation is to be made.
- (5) In localities where there is a fluctuation of pressure in the main throughout the day, the water piping system shall be designed on the basis of the minimum pressure available.

**610.8 Size of Meter and Building Supply Pipe Using Table 6-6.** The size of the meter and the building supply pipe shall be determined as follows:

- (1) Determine the available pressure at the water meter or other source of supply.
- (2) Subtract one-half (1/2) pound per square inch pressure (3.4 kPa) for each foot (305

mm) of difference in elevation between such source of supply and the highest water supply outlet in the building or on the premises.

- (3) Use the "pressure range" group within which this pressure will fall using Table 6-6.
- (4) Select the "length" column that is equal to or longer than the required length.
- (5) Follow down the column to a fixture unit value equal to or greater than the total number of fixture units required by the installation.
- (6) Having located the proper fixture unit value for the required length, sizes of meter and building supply pipe as found in the two left-hand columns shall be applied.

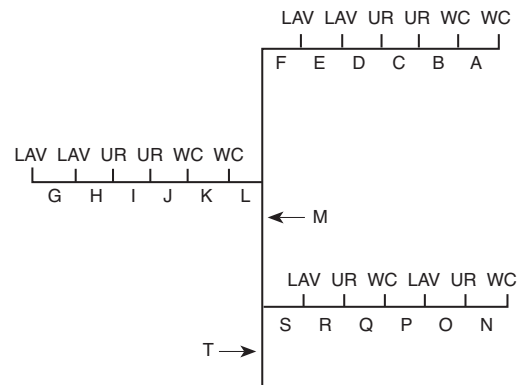
No building supply pipe shall be less than three-quarter (3/4) inch (20 mm) in diameter.

**610.9 Size of Branches.** When Table 6-6 is used, the minimum size of each branch shall be determined by the number of fixture units to be served by that branch, the total developed length of the system, and the meter and street service size as per Section 610.8. No branch piping is required to be larger in size than that required by Table 6-6 for the building supply pipe.

**610.10 Sizing for Flushometer Valves.** When using Table 6-6 to size water supply systems serving flushometer valves, the number of flushometer fixture units assigned to every section of pipe, whether branch or main, shall be determined by the number and category of flushometer valves served by that section of pipe, in accordance with Table 6-7. Piping supplying a flushometer valve shall not be less in size than the valve inlet.

When using Table 6-7 to size water piping, care must be exercised to assign flushometer fixture units based on the number and category of fixtures served. In the example below, fixture units assigned to each

Sizing Method  
**Example Using TABLE 6-7**  
 Public Use Fixtures



section of pipe are computed as follows: Note: Each capital letter refers to the section of pipe above it, unless otherwise shown.

- A: 1 WC = 40 F.U.  
 B: 2 WC = 70 F.U.  
 C: 2 WC (70) + 1 UR (20) = 90 F.U.  
 D: 2 WC (70) + 2 UR (35) = 105 F.U.  
 E: 2 WC (70) + 2 UR (35) + 1 LAV (1) = 106 F.U.  
 F: 2 WC (70) + 2 UR (35) + 2 LAV (2) = 107 F.U.  
 G: 1 LAV = 1 F.U.  
 H: 2 LAV = 2 F.U.  
 I: 2 LAV (2) + 1 UR (20) = 22 F.U.  
 J: 2 LAV (2) + 2 UR (35) = 37 F.U.  
 K: 2 LAV (2) + 2 UR (35) + 1 WC (40) = 77 F.U.  
 L: 2 LAV (2) + 2 UR (35) + 2 WC (70) = 107 F.U.  
 M: 4 WC (105) + 4 UR (53) + 4 LAV (4) = 162 F.U.  
 N: 1 WC = 40 F.U.  
 O: 1 WC (40) + 1 UR (20) = 60 F.U.  
 P: 1 WC (40) + 1 UR (20) + 1 LAV (1) = 61 F.U.  
 Q: 2 WC (70) + 1 UR (20) + 1 LAV (1) = 91 F.U.  
 R: 2 WC (70) + 2 UR (35) + 1 LAV (1) = 106 F.U.  
 S: 2 WC (70) + 2 UR (35) + 2 LAV (2) = 107 F.U.  
 T: 6 WC (125) + 6 UR (63) + 6 LAV (6) = 194 F.U.

#### 610.11 Sizing Systems for Flushometer Tanks.

The size of branches and mains serving flushometer tanks shall be consistent with the sizing procedures for flush tank water closets.

**610.12 Sizing for Velocity.** Water piping systems shall not exceed the maximum velocities listed in this section or Appendix A.

**610.12.1 Copper Tube Systems.** Maximum velocities in copper and copper alloy tube and fitting systems shall be limited to a maximum of eight (8) feet per second (fps) (2.4 mps) in cold water and five (5) fps in hot water (1.52 mps).

**610.12.2 Tubing Systems Using Copper Alloy Fittings.** Maximum velocities through copper alloy fittings in tubing other than copper shall be limited to a maximum of eight (8) feet per second (fps) (2.4 mps) in cold water and five (5) fps in hot water (1.52 mps).

**610.13 Exceptions.** The provisions of this section relative to size of water piping shall not apply to the following:

- (1) Water supply piping systems designed in

accordance with recognized engineering procedures acceptable to the Authority Having Jurisdiction.

- (2) Alteration of or minor additions to existing installations, provided the Authority Having Jurisdiction finds that there will be an adequate supply of water to operate all fixtures.
- (3) Replacement of existing fixtures or appliances.
- (4) Piping that is part of fixture equipment.
- (5) Unusual conditions where, in the judgment of the Authority Having Jurisdiction, an adequate supply of water is provided to operate fixtures and equipment.
- (6) Nonpotable waterlines as defined in Sections 601.2.2 and 601.2.3.
- (7) The size and material of irrigation water piping installed outside of any building or structure and separated from the potable water supply by means of an approved airgap or backflow prevention device is not regulated by this code. The potable water piping system supplying each such irrigation system shall be adequately sized as required elsewhere in this chapter to deliver the full connected demand of both the domestic use and the irrigation systems.

#### 611.0 Drinking Water Treatment Units.

**611.1 Compliance with Standard.** Drinking water treatment units shall meet the requirements of the appropriate standard referenced in Table 14-1.

**611.2 Airgap Discharge.** Discharge from all drinking water treatment units shall enter the drainage system through an airgap or an airgap device that meets the requirements of the appropriate standards referenced in Table 14-1.

**611.3 Connection Tubing.** The tubing to and from drinking water treatment units shall be of a size and material as recommended by the manufacturer. The tubing shall comply with the requirements of the appropriate standards referenced in Table 14-1.

**611.4 Sizing of Residential Softeners.** Residential-use water softeners shall be sized per Table 6-8.

Inch	mm
1/2	15
3/4	20
1	25

**TABLE 6-5**  
**Water Supply Fixture Units (WSFU) and Minimum Fixture Branch Pipe Sizes<sup>3</sup>**

	Minimum Fixture Branch Pipe Size <sup>1,4</sup>	Private	Public	Assembly <sup>6</sup>
<b>Appliances, Appurtenances or Fixtures<sup>2</sup></b>				
Bathtub or Combination Bath/Shower (fill) .....	1/2"	4.0	4.0	
3/4" Bathtub Fill Valve .....	3/4"	10.0	10.0	
Bidet .....	1/2"	1.0		
Clothes washer .....	1/2"	4.0	4.0	
Dental Unit, cuspidor .....	1/2"		1.0	
Dishwasher, domestic .....	1/2"	1.5	1.5	
Drinking Fountain or Watercooler .....	1/2"	0.5	0.5	0.75
Hose Bibb .....	1/2"	2.5	2.5	
Hose Bibb, each additional <sup>8</sup> .....	1/2"	1.0	1.0	
Lavatory .....	1/2"	1.0	1.0	1.0
Lawn Sprinkler, each head <sup>5</sup> .....		1.0	1.0	
Mobile Home, each (minimum) .....		12.0		
<b>Sinks</b>				
Bar .....	1/2"	1.0	2.0	
Clinic Faucet .....	1/2"		3.0	
Clinic Flushometer Valve .....				
with or without faucet .....	1"		8.0	
Kitchen, domestic .....	1/2"	1.5	1.5	
Laundry .....	1/2"	1.5	1.5	
Service or Mop Basin .....	1/2"	1.5	3.0	
Washup, each set of faucets .....	1/2"		2.0	
Shower, per head .....	1/2"	2.0	2.0	
Urinal, 1.0 GPF Flushometer Valve .....	3/4"	See Footnote <sup>7</sup>		
Urinal, greater than 1.0 GPF Flushometer Valve .....	3/4"	See Footnote <sup>7</sup>		
Urinal, flush tank .....	1/2"	2.0	2.0	3.0
Washfountain, circular spray .....	3/4"		4.0	
Water Closet, 1.6 GPF Gravity Tank .....	1/2"	2.5	2.5	3.5
Water Closet, 1.6 GPF Flushometer Tank .....	1/2"	2.5	2.5	3.5
Water Closet, 1.6 GPF Flushometer Valve .....	1"	See Footnote <sup>7</sup>		
Water Closet, greater than 1.6 GPF Gravity Tank .....	1/2"	3.0	5.5	7.0
Water Closet, greater than 1.6 GPF Flushometer Valve .....	1"	See Footnote <sup>7</sup>		

**Notes:**

- <sup>1</sup> Size of the cold branch pipe, or both the hot and cold branch pipes.
- <sup>2</sup> Appliances, Appurtenances or Fixtures not included in this Table may be sized by reference to fixtures having a similar flow rate and frequency of use.
- <sup>3</sup> The listed fixture unit values represent their load on their cold water service. The separate cold water and hot water fixture unit value for fixtures having both hot and cold water connections may each be taken as three-quarter ( 3/4) of the listed total value of the fixture.
- <sup>4</sup> The listed minimum supply branch pipe sizes for individual fixtures are the nominal (I.D.) pipe size.
- <sup>5</sup> For fixtures or supply connections likely to impose continuous flow demands, determine the required flow in gallons per minute (GPM), and add it separately to the demand (in GPM) for the distribution system or portions thereof.
- <sup>6</sup> Assembly [Public Use (See Table 4-1)].
- <sup>7</sup> When sizing flushometer systems, see Section 610.10.
- <sup>8</sup> Reduced fixture unit loading for additional hose bibbs is to be used only when sizing total building demand and for pipe sizing when more than one hose bibb is supplied by a segment of water-distributing pipe. The fixture branch to each hose bibb shall be sized on the basis of 2.5 fixture units.

**TABLE 6-6  
Fixture Unit Table for Determining Water Pipe and Meter Sizes**

Inch	mm
1/2	15
3/4	20
1	25
1-1/4	32
1-1/2	40
2	50
2-1/2	65

**Pressure Range – 30 to 45 psi (207 to 310 kPa)\*\***

Meter and Street Service, Inches	Building Supply and Branches, Inches	Maximum Allowable Length in Feet (meters)														
		40 (12)	60 (18)	80 (24)	100 (30)	150 (46)	200 (61)	250 (76)	300 (91)	400 (122)	500 (152)	600 (183)	700 (213)	800 (244)	900 (274)	1000 (305)
3/4	1/2***	6	5	4	3	2	1	1	1	0	0	0	0	0	0	0
3/4	3/4	16	16	14	12	9	6	5	5	4	4	3	2	2	2	1
3/4	1	29	25	23	21	17	15	13	12	10	8	6	6	6	6	6
1	1	36	31	27	25	20	17	15	13	12	10	8	6	6	6	6
3/4	1-1/4	36	33	31	28	24	23	21	19	17	16	13	12	12	11	11
1	1-1/4	54	47	42	38	32	28	25	23	19	17	14	12	12	11	11
1-1/2	1-1/4	78	68	57	48	38	32	28	25	21	18	15	12	12	11	11
1	1-1/2	85	84	79	65	56	48	43	38	32	28	26	22	21	20	20
1-1/2	1-1/2	150	124	105	91	70	57	49	45	36	31	26	23	21	20	20
2	1-1/2	151	129	129	110	80	64	53	46	38	32	27	23	21	20	20
1	2	85	85	85	85	85	85	82	80	66	61	57	52	49	46	43
1-1/2	2	220	205	190	176	155	138	127	120	104	85	70	61	57	54	51
2	2	370	327	292	265	217	185	164	147	124	96	70	61	57	54	51
2	2-1/2	445	418	390	370	330	300	280	265	240	220	198	175	158	143	133

**Pressure Range – 46 to 60 psi (317 to 414 kPa)\*\***

3/4	1/2***	7	7	6	5	4	3	2	2	1	1	1	0	0	0	0
3/4	3/4	20	20	19	17	14	11	9	8	6	5	4	4	3	3	3
3/4	1	39	39	36	33	28	23	21	19	17	14	12	10	9	8	8
1	1	39	39	39	36	30	25	23	20	18	15	12	10	9	8	8
3/4	1-1/4	39	39	39	39	39	39	34	32	27	25	22	19	19	17	16
1	1-1/4	78	78	76	67	52	44	39	36	30	27	24	20	19	17	16
1-1/2	1-1/4	78	78	78	78	66	52	44	39	33	29	24	20	19	17	16
1	1-1/2	85	85	85	85	85	85	80	67	55	49	41	37	34	32	30
1-1/2	1-1/2	151	151	151	151	128	105	90	78	62	52	42	38	35	32	30
2	1-1/2	151	151	151	151	150	117	98	84	67	55	42	38	35	32	30
1	2	85	85	85	85	85	85	85	85	85	85	85	85	85	83	80
1-1/2	2	370	370	340	318	272	240	220	198	170	150	135	123	110	102	94
2	2	370	370	370	370	368	318	280	250	205	165	142	123	110	102	94
2	2-1/2	654	640	610	580	535	500	470	440	400	365	335	315	285	267	250

**Pressure Range – Over 60 psi (414 kPa)\*\***

3/4	1/2***	7	7	7	6	5	4	3	3	2	1	1	1	1	1	0
3/4	3/4	20	20	20	20	17	13	11	10	8	7	6	6	5	4	4
3/4	1	39	39	39	39	35	30	27	24	21	17	14	13	12	12	11
1	1	39	39	39	39	38	32	29	26	22	18	14	13	12	12	11
3/4	1-1/4	39	39	39	39	39	39	39	39	34	28	26	25	23	22	21
1	1-1/4	78	78	78	78	74	62	53	47	39	31	26	25	23	22	21
1-1/2	1-1/4	78	78	78	78	78	74	65	54	43	34	26	25	23	22	21
1	1-1/2	85	85	85	85	85	85	85	85	81	64	51	48	46	43	40
1-1/2	1-1/2	151	151	151	151	151	151	130	113	88	73	51	51	46	43	40
2	1-1/2	151	151	151	151	151	151	142	122	98	82	64	51	46	43	40
1	2	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
1-1/2	2	370	370	370	370	360	335	305	282	244	212	187	172	153	141	129
2	2	370	370	370	370	370	370	370	340	288	245	204	172	153	141	129
2	2-1/2	654	654	654	654	654	650	610	570	510	460	430	404	380	356	329

\*\*Available static pressure after head loss.

\*\*\*Building supply, three-quarter (3/4) inch (20 mm) nominal size minimum.

**Table 6-7  
Flushometer Fixture Units for Water Sizing Using  
Table 6-5**

**Fixture Category: Water Closet w/ Flushometer Valves**

Number of Flushometer Valves	Individual Fixture Units Assigned in Decreasing Value	Fixture Units Assigned for Water Closets and Similar 10-Unit Fixtures in Accumulative Values
1	40	40
2	30	70
3	20	90
4	15	105
5 or more	10 each	115 plus 10 for each additional fixture in excess of 5

**Fixture Category: Urinals w/ Flushometer Valves**

Number of Flushometer Valves	Individual Fixture Units Assigned in Decreasing Value	Fixture Units Assigned for Urinals and Similar 5-Unit Fixtures in Accumulative Values
1	20	20
2	15	35
3	10	45
4	8	53
5 or more	5 each	58 plus 5 for each additional fixture in excess of 5

**TABLE 6-8  
Sizing of Residential Water Softeners**

Required Size of Softener Connection	Number of Bathroom Groups Served <sup>1</sup>
3/4 in.	up to 2 <sup>2</sup>
1 in.	up to 4 <sup>3</sup>

<sup>1</sup> Installation of a kitchen sink and dishwasher, laundry tray, and automatic clothes washer permitted without additional size increase.

<sup>2</sup> An additional water closet and lavatory permitted.

<sup>3</sup> Over four bathroom groups, the softener size shall be engineered for the specific installation.

*See also Appendix A, Recommended Rules for Sizing the Water Supply System, and Appendix L, Alternate Plumbing Systems, for alternate methods of sizing water supply systems.*