

TABLE P2903.6(1)—continued  
CONVERSIONS FROM WATER SUPPLY FIXTURE UNIT TO GALLON PER MINUTE FLOW RATES

SUPPLY SYSTEMS PREDOMINANTLY FOR FLUSH TANKS			SUPPLY SYSTEMS PREDOMINANTLY FOR FLUSHOMETER VALVES		
Load	Demand		Load	Demand	
(Water supply fixture units)	(Gallons per minute)	(Cubic feet per minute)	(Water supply fixture units)	(Gallons per minute)	(Cubic feet per minute)
25	21.5	2.87412	25	38.0	5.07984
30	23.3	3.114744	30	42.0	5.61356
35	24.9	3.328632	35	44.0	5.88192
40	26.3	3.515784	40	46.0	6.14928
45	27.7	3.702936	45	48.0	6.41664
50	29.1	3.890088	50	50.0	6.684

For SI: 1 gallon per minute = 3.785 L/m, 1 cubic foot per minute = 0.4719 L/s.

**P2903.8.2 Minimum size.** Where the *developed length* of the distribution line is 60 feet (18 288 mm) or less, and the available pressure at the meter is not less than 40 pounds per square inch (276 kPa), the size of individual distribution lines shall be not less than  $\frac{3}{8}$  inch (10 mm) diameter. Certain fixtures such as one-piece water closets and whirlpool bathtubs shall require a larger size where specified by the manufacturer. If a water heater is fed from the end of a cold water manifold, the manifold shall be one size larger than the water heater feed.

**P2903.8.3 Orientation.** Manifolds shall be permitted to be installed in a horizontal or vertical position.

**P2903.8.4 Support and protection.** Plastic piping bundles shall be secured in accordance with the manufacturer's instructions and supported in accordance with Section P2605. Bundles that have a change in direction equal to or greater than 45 degrees (0.79 rad) shall be protected from chafing at the point of contact with framing members by sleeving or wrapping.

**P2903.8.5 Valving.** Fixture valves, when installed, shall be located either at the fixture or at the manifold. If valves are installed at the manifold, they shall be labeled indicating the fixture served.

**P2903.8.6 Hose bibb bleed.** A *readily accessible* air bleed shall be installed in hose bibb supplies at the manifold or at the hose bibb exit point.

**P2903.9 Valves.** Valves shall be installed in accordance with Sections P2903.9.1 through P2903.9.5.

**P2903.9.1 Service valve.** Each *dwelling unit* shall be provided with an accessible main shutoff valve near the entrance of the water service. The valve shall be of a full-open type having nominal restriction to flow, with provision for drainage such as a bleed orifice or installation of a separate drain valve. Additionally, the water service shall be valved at the curb or lot line in accordance with local requirements.

**P2903.9.2 Water heater valve.** A *readily accessible* full-open valve shall be installed in the cold-water supply pipe to each water heater at or near the water heater.

**P2903.9.3 Fixture valves and access.** Valves serving individual fixtures, *appliances*, risers and branches shall

be provided with access. An individual shutoff valve shall be required on the fixture supply pipe to each plumbing fixture other than bathtubs and showers.

**P2903.9.4 Valve requirements.** Valves shall be of an *approved* type and compatible with the type of piping material installed in the system. Ball valves, gate valves, globe valves and plug valves intended to supply drinking water shall meet the requirements of NSF 61.

**P2903.9.5 Valves and outlets prohibited below grade.** Potable water outlets and combination stop-and-waste valves shall not be installed underground or below grade. Freezeproof yard hydrants that drain the riser into the ground are considered to be stop-and-waste valves.

**Exception:** Installation of freezeproof yard hydrants that drain the riser into the ground shall be permitted if the potable water supply to such hydrants is protected upstream of the hydrants in accordance with Section P2902 and the hydrants are permanently identified as nonpotable outlets by *approved* signage that reads as follows: "Caution, Nonpotable Water. Do Not Drink."

**P2903.10 Hose bibb.** Hose bibbs subject to freezing, including the "frostproof" type, shall be equipped with an accessible stop-and-waste-type valve inside the building so that they can be controlled and drained during cold periods.

**Exception:** Frostproof hose bibbs installed such that the stem extends through the building insulation into an open heated or *semiconditioned space* need not be separately valved (see Figure P2903.10).

## SECTION P2904 DWELLING UNIT FIRE SPRINKLER SYSTEMS

**P2904.1 General.** The design and installation of residential fire sprinkler systems shall be in accordance with NFPA 13D or Section P2904, which shall be considered equivalent to NFPA 13D. Partial residential sprinkler systems shall be permitted to be installed only in buildings not required to be equipped with a residential sprinkler system. Section P2904 shall apply to stand-alone and multipurpose wet-pipe sprinkler systems that *do not include the use of antifreeze*. A multipurpose fire sprinkler system shall provide domestic water to both fire sprinklers and plumbing fixtures. A stand-alone



sprinkler system shall be separate and independent from the water distribution system. A backflow preventer shall not be required to separate a stand-alone sprinkler system from the water distribution system.

**P2904.1.1 Required sprinkler locations.** Sprinklers shall be installed to protect all areas of a *dwelling unit*.

**Exceptions:**

1. Attics, crawl spaces and normally unoccupied concealed spaces that do not contain fuel-fired appliances do not require sprinklers. In attics, crawl spaces and normally unoccupied concealed spaces that contain fuel-fired equipment, a sprinkler shall be installed above the equipment; however, sprinklers shall not be required in the remainder of the space.
2. Clothes closets, linen closets and pantries not exceeding 24 square feet (2.2 m<sup>2</sup>) in area, with the smallest dimension not greater than 3 feet (915 mm) and having wall and ceiling surfaces of gypsum board.
3. Bathrooms not more than 55 square feet (5.1 m<sup>2</sup>) in area.
4. Garages; carports; exterior porches; unheated entry areas, such as mud rooms, that are adjacent to an exterior door; and similar areas.

**P2904.2 Sprinklers.** Sprinklers shall be new listed residential sprinklers and shall be installed in accordance with the sprinkler manufacturer's installation instructions.

**P2904.2.1 Temperature rating and separation from heat sources.** Except as provided for in Section P2904.2.2, sprinklers shall have a temperature rating of not less than 135°F (57°C) and not more than 170°F (77°C). Sprinklers shall be separated from heat sources as required by the sprinkler manufacturer's installation instructions.

**P2904.2.2 Intermediate temperature sprinklers.** Sprinklers shall have an intermediate temperature rating not less than 175°F (79°C) and not more than 225°F (107°C) where installed in the following locations:

1. Directly under skylights, where the sprinkler is exposed to direct sunlight.
2. In attics.
3. In concealed spaces located directly beneath a roof.
4. Within the distance to a heat source as specified in Table P2904.2.2

**P2904.2.3 Freezing areas.** Piping shall be protected from freezing as required by Section P2603.6. Where sprinklers are required in areas that are subject to freezing, dry-side-wall or dry-pendent sprinklers extending from a nonfreezing area into a freezing area shall be installed.

**P2904.2.4 Sprinkler coverage.** Sprinkler coverage requirements and sprinkler obstruction requirements shall be in accordance with Sections P2904.2.4.1 and P2904.2.4.2.

**P2904.2.4.1 Coverage area limit.** The area of coverage of a single sprinkler shall not exceed 400 square feet (37 m<sup>2</sup>) and shall be based on the sprinkler listing and the sprinkler manufacturer's installation instructions.

**P2904.2.4.2 Obstructions to coverage.** Sprinkler discharge shall not be blocked by obstructions unless additional sprinklers are installed to protect the obstructed area. Additional sprinklers shall not be required where the sprinkler separation from obstructions complies with either the minimum distance indicated in Figure P2904.2.4.2 or the minimum distances specified in the sprinkler manufacturer's instructions where the manufacturer's instructions permit a lesser distance.

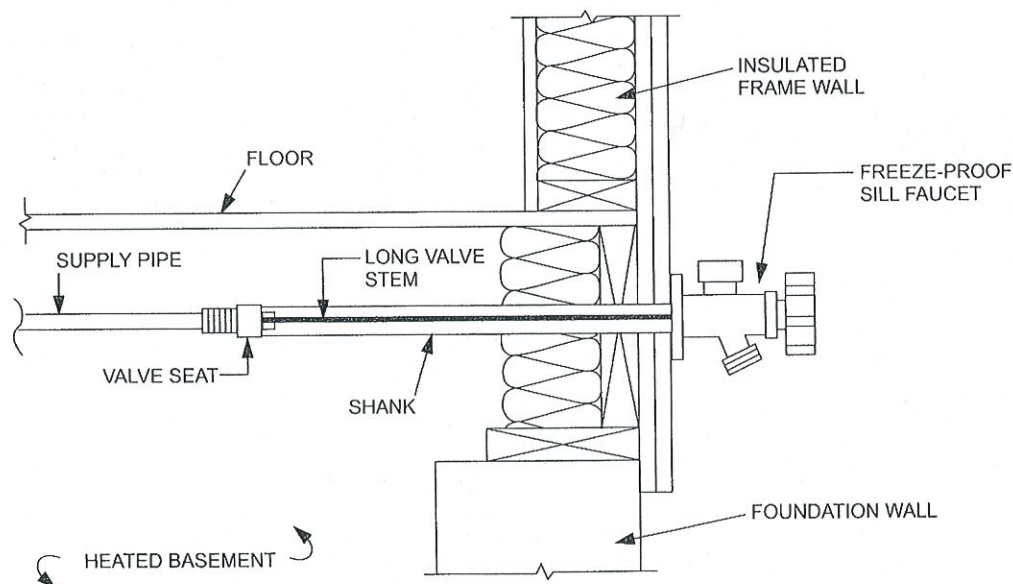
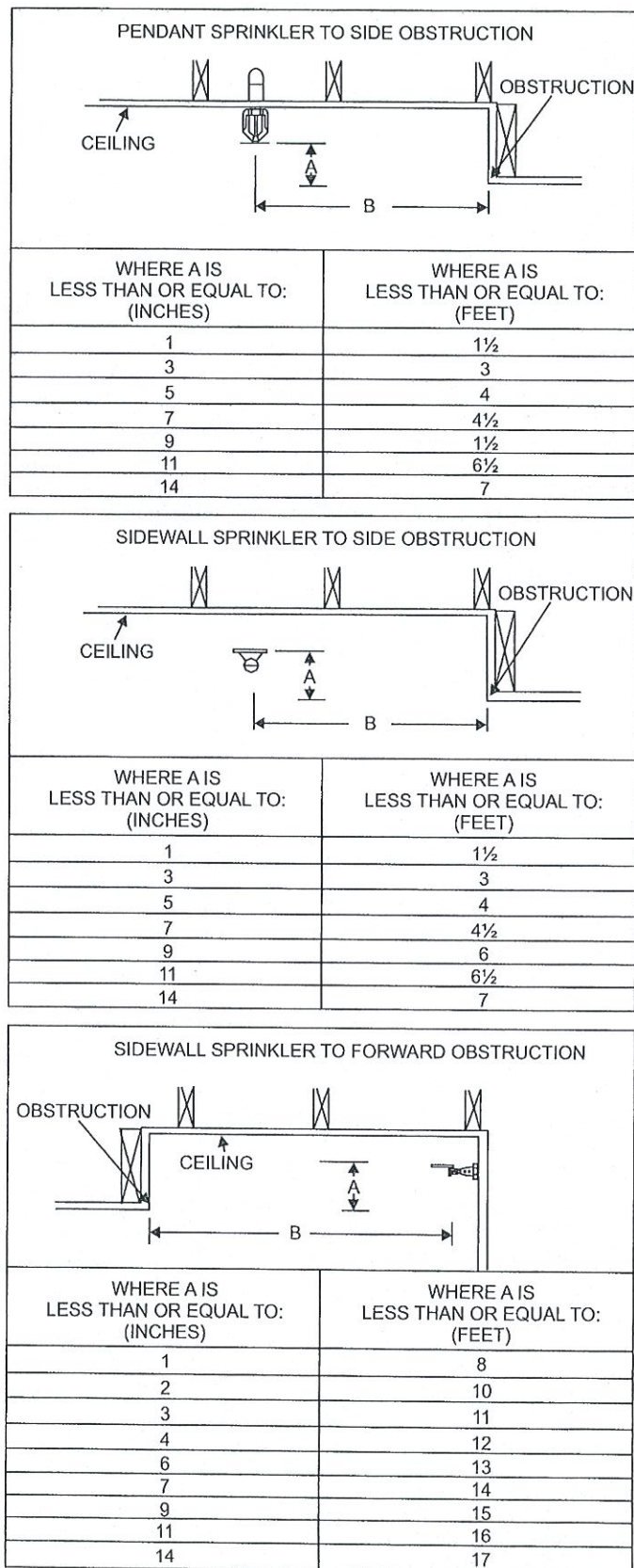


FIGURE P2903.10  
TYPICAL FROSTPROOF HOSE BIBB INSTALLATION NOT REQUIRING SEPARATE VALVE



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

**FIGURE P2904.2.4.2**  
**MINIMUM ALLOWABLE DISTANCE BETWEEN SPRINKLER AND OBSTRUCTION**



**TABLE P2904.2.2**  
**LOCATIONS WHERE INTERMEDIATE TEMPERATURE SPRINKLERS ARE REQUIRED**

HEAT SOURCE	RANGE OF DISTANCE FROM HEAT SOURCE WITHIN WHICH INTERMEDIATE TEMPERATURE SPRINKLERS ARE REQUIRED <sup>a, b</sup> (inches)
Fireplace, side of open or recessed fireplace	12 to 36
Fireplace, front of recessed fireplace	36 to 60
Coal and wood burning stove	12 to 42
Kitchen range top	9 to 18
Oven	9 to 18
Vent connector or chimney connector	9 to 18
Heating duct, not insulated	9 to 18
Hot water pipe, not insulated	6 to 12
Side of ceiling or wall warm air register	12 to 24
Front of wall mounted warm air register	18 to 36
Water heater, furnace or boiler	3 to 6
Luminaire up to 250 watts	3 to 6
Luminaire 250 watts up to 499 watts	6 to 12

For SI: 1 inch = 25.4 mm.

a. Sprinklers shall not be located at distances less than the minimum table distance unless the sprinkler listing allows a lesser distance.

b. Distances shall be measured in a straight line from the nearest edge of the heat source to the nearest edge of the sprinkler.

**P2904.2.4.2.1 Additional requirements for pendent sprinklers.** Pendent sprinklers within 3 feet (915 mm) of the center of a ceiling fan, surface-mounted ceiling luminaire or similar object shall be considered to be obstructed, and additional sprinklers shall be installed.

**P2904.2.4.2.2 Additional requirements for sidewall sprinklers.** Sidewall sprinklers within 5 feet (1524 mm) of the center of a ceiling fan, surface-mounted ceiling luminaire or similar object shall be considered to be obstructed, and additional sprinklers shall be installed.

**P2904.2.5 Sprinkler installation on systems assembled with solvent cement.** The solvent cementing of threaded adapter fittings shall be completed and threaded adapters for sprinklers shall be verified as being clear of excess cement prior to the installation of sprinklers on systems assembled with solvent cement.

**P2904.2.6 Sprinkler modifications prohibited.** Painting, caulking or modifying of sprinklers shall be prohibited. Sprinklers that have been painted, caulked, modified or damaged shall be replaced with new sprinklers.

**P2904.3 Sprinkler piping system.** Sprinkler piping shall be supported in accordance with the requirements for cold water distribution piping. Sprinkler piping shall comply with all requirements for cold water distribution piping. For multipurpose piping systems, the sprinkler piping shall connect to and be a part of the cold water distribution piping system.

**P2904.3.1 Nonmetallic pipe and tubing.** Nonmetallic pipe and tubing, such as CPVC, PEX, and PE-RT shall be listed for use in residential fire sprinkler systems.

**P2904.3.1.1 Nonmetallic pipe protection.** Nonmetallic pipe and tubing systems shall be protected from

exposure to the living space by a layer of not less than  $\frac{3}{8}$ -inch-thick (9.5 mm) gypsum wallboard,  $\frac{1}{2}$ -inch-thick (13 mm) plywood, or other material having a 15-minute fire rating.

#### Exceptions:

1. Pipe protection shall not be required in areas that do not require protection with sprinklers as specified in Section P2904.1.1.
2. Pipe protection shall not be required where exposed piping is permitted by the pipe listing.

**P2904.3.2 Shutoff valves prohibited.** With the exception of shutoff valves for the entire water distribution system, valves shall not be installed in any location where the valve would isolate piping serving one or more sprinklers.

**P2904.3.3 Single dwelling limit.** Piping beyond the service valve located at the beginning of the water distribution system shall not serve more than one dwelling.

**P2904.3.4 Drain.** A means to drain the sprinkler system shall be provided on the system side of the water distribution shutoff valve.

**P2904.4 Determining system design flow.** The flow for sizing the sprinkler piping system shall be based on the flow rating of each sprinkler in accordance with Section P2904.4.1 and the calculation in accordance with Section P2904.4.2.

**P2904.4.1 Determining required flow rate for each sprinkler.** The minimum required flow for each sprinkler shall be determined using the sprinkler manufacturer's published data for the specific sprinkler model based on all of the following:

1. The area of coverage.
2. The ceiling configuration.



3. The temperature rating.
4. Any additional conditions specified by the sprinkler manufacturer.

**P2904.4.2 System design flow rate.** The design flow rate for the system shall be based on the following:

1. The design flow rate for a room having only one sprinkler shall be the flow rate required for that sprinkler, as determined by Section P2904.4.1.
2. The design flow rate for a room having two or more sprinklers shall be determined by identifying the sprinkler in that room with the highest required flow rate, based on Section P2904.4.1, and multiplying that flow rate by 2.
3. Where the sprinkler manufacturer specifies different criteria for ceiling configurations that are not smooth, flat and horizontal, the required flow rate for that room shall comply with the sprinkler manufacturer's instructions.
4. The design flow rate for the sprinkler system shall be the flow required by the room with the largest flow rate, based on Items 1, 2 and 3.
5. For the purpose of this section, it shall be permissible to reduce the design flow rate for a room by subdividing the space into two or more rooms, where each room is evaluated separately with respect to the required design flow rate. Each room shall be bounded by walls and a ceiling. Openings in walls shall have a lintel not less than 8 inches (203 mm) in depth and each lintel shall form a solid barrier between the ceiling and the top of the opening.

**P2904.5 Water supply.** The water supply shall provide not less than the required design flow rate for sprinklers in accordance with Section P2904.4.2 at a pressure not less than that used to comply with Section P2904.6.

**P2904.5.1 Water supply from individual sources.** Where a dwelling unit water supply is from a tank system, a private well system or a combination of these, the available water supply shall be based on the minimum pressure control setting for the pump.

**P2904.5.2 Required capacity.** The water supply shall have the capacity to provide the required design flow rate for sprinklers for a period of time as follows:

1. Seven minutes for dwelling units one story in height and less than 2,000 square feet (186 m<sup>2</sup>) in area.
2. Ten minutes for dwelling units two or more stories in height or equal to or greater than 2,000 square feet (186 m<sup>2</sup>) in area.

Where a well system, a water supply tank system or a combination thereof is used, any combination of well capacity and tank storage shall be permitted to meet the capacity requirement.

**P2904.6 Pipe sizing.** The piping to sprinklers shall be sized for the flow required by Section P2904.4.2. The flow required to supply the plumbing fixtures shall not be required to be added to the sprinkler design flow.

**P2904.6.1 Method of sizing pipe.** Piping supplying sprinklers shall be sized using the prescriptive method in Section P2904.6.2 or by hydraulic calculation in accordance with NFPA 13D. The minimum pipe size from the water supply source to any sprinkler shall be  $\frac{3}{4}$  inch (19 mm) nominal. Threaded adapter fittings at the point where sprinklers are attached to the piping shall be a minimum of  $\frac{1}{2}$  inch (13 mm) nominal.

**P2904.6.2 Prescriptive pipe sizing method.** Pipe shall be sized by determining the available pressure to offset friction loss in piping and identifying a piping material, diameter and length using the equation in Section P2904.6.2.1 and the procedure in Section P2904.6.2.2.

**P2904.6.2.1 Available pressure equation.** The pressure available to offset friction loss in the interior piping system ( $P_t$ ) shall be determined in accordance with the Equation 29-1.

$$P_t = P_{sup} - PL_{svc} - PL_m - PL_d - PL_e - P_{sp} \quad (\text{Equation 29-1})$$

where:

$P_t$  = Pressure used in applying Tables P2904.6.2(4) through P2904.6.2(9).

$P_{sup}$  = Pressure available from the water supply source.

$PL_{svc}$  = Pressure loss in the water-service pipe.

$PL_m$  = Pressure loss in the water meter.

$PL_d$  = Pressure loss from devices other than the water meter.

$PL_e$  = Pressure loss associated with changes in elevation.

$P_{sp}$  = Maximum pressure required by a sprinkler.

**P2904.6.2.2 Calculation procedure.** Determination of the required size for water distribution piping shall be in accordance with the following procedure:

**Step 1—Determine  $P_{sup}$**

Obtain the static supply pressure that will be available from the water main from the water purveyor, or for an individual source, the available supply pressure shall be in accordance with Section P2904.5.1.

**Step 2—Determine  $PL_{svc}$**

Use Table P2904.6.2(1) to determine the pressure loss in the water service pipe based on the selected size of the water service.

**Step 3—Determine  $PL_m$**

Use Table P2904.6.2(2) to determine the pressure loss from the water meter, based on the selected water meter size.

**Step 4—Determine  $PL_d$**

Determine the pressure loss from devices other than the water meter installed in the piping system supplying sprinklers, such as pressure-reducing valves, backflow preventers, water softeners or water filters. Device pressure losses shall be based on the device manufacturer's specifications. The flow rate used to determine pressure loss shall



be the rate from Section P2904.4.2, except that 5 gpm (0.3 L/s) shall be added where the device is installed in a water-service pipe that supplies more than one dwelling. As alternative to deducting pressure loss for a device, an automatic bypass valve shall be installed to divert flow around the device when a sprinkler activates.

#### Step 5—Determine $PL_e$

Use Table P2904.6.2(3) to determine the pressure loss associated with changes in elevation. The elevation used in applying the table shall be the difference between the elevation where the water source pressure was measured and the elevation of the highest sprinkler.

#### Step 6—Determine $P_{sp}$

Determine the maximum pressure required by any individual sprinkler based on the flow rate from Section P2904.4.1. The required pressure is provided in the sprinkler manufacturer's published data for the specific sprinkler model based on the selected flow rate.

#### Step 7—Calculate $P_r$

Using Equation 29-1, calculate the pressure available to offset friction loss in water-distribution piping between the service valve and the sprinklers.

#### Step 8—Determine the maximum allowable pipe length

Use Tables P2904.6.2(4) through P2904.6.2(9) to select a material and size for water distribution piping. The piping material and size shall be acceptable if the *developed length* of pipe between the service valve and the most remote sprinkler does not exceed the maximum allowable length specified by the applicable table. Interpolation of  $P_r$  between the tabular values shall be permitted.

The maximum allowable length of piping in Tables P2904.6.2(4) through P2904.6.2(9) incorporates an adjustment for pipe fittings, and no additional consideration of friction losses associated with pipe fittings shall be required.

**P2904.7 Instructions and signs.** An owner's manual for the fire sprinkler system shall be provided to the owner. A sign or valve tag shall be installed at the main shutoff valve to the water distribution system stating the following: "Warning, the water system for this home supplies fire sprinklers that require certain flows and pressures to fight a fire. Devices that restrict the flow or decrease the pressure or automatically shut off the water to the fire sprinkler system, such as water softeners, filtration systems and automatic shutoff valves, shall not be added to this system without a review of the fire sprinkler system by a fire protection specialist. Do not remove this sign."

TABLE P2904.6.2(1)  
WATER SERVICE PRESSURE LOSS ( $PL_{svc}$ )<sup>a, b</sup>

FLOW RATE <sup>c</sup> (gpm)	3/4-INCH WATER SERVICE PRESSURE LOSS (psi)				1-INCH WATER SERVICE PRESSURE LOSS (psi)				1 1/4-INCH WATER SERVICE PRESSURE LOSS (psi)			
	Length of water service pipe (feet)				Length of water service pipe (feet)				Length of water service pipe (feet)			
	40 or less	41 to 75	76 to 100	101 to 150	40 or less	41 to 75	76 to 100	101 to 150	40 or less	41 to 75	76 to 100	101 to 150
8	5.1	8.7	11.8	17.4	1.5	2.5	3.4	5.1	0.6	1.0	1.3	1.9
10	7.7	13.1	17.8	26.3	2.3	3.8	5.2	7.7	0.8	1.4	2.0	2.9
12	10.8	18.4	24.9	NP	3.2	5.4	7.3	10.7	1.2	2.0	2.7	4.0
14	14.4	24.5	NP	NP	4.2	7.1	9.6	14.3	1.6	2.7	3.6	5.4
16	18.4	NP	NP	NP	5.4	9.1	12.4	18.3	2.0	3.4	4.7	6.9
18	22.9	NP	NP	NP	6.7	11.4	15.4	22.7	2.5	4.3	5.8	8.6
20	27.8	NP	NP	NP	8.1	13.8	18.7	27.6	3.1	5.2	7.0	10.4
22	NP	NP	NP	NP	9.7	16.5	22.3	NP	3.7	6.2	8.4	12.4
24	NP	NP	NP	NP	11.4	19.3	26.2	NP	4.3	7.3	9.9	14.6
26	NP	NP	NP	NP	13.2	22.4	NP	NP	5.0	8.5	11.4	16.9
28	NP	NP	NP	NP	15.1	25.7	NP	NP	5.7	9.7	13.1	19.4
30	NP	NP	NP	NP	17.2	NP	NP	NP	6.5	11.0	14.9	22.0
32	NP	NP	NP	NP	19.4	NP	NP	NP	7.3	12.4	16.8	24.8
34	NP	NP	NP	NP	21.7	NP	NP	NP	8.2	13.9	18.8	NP
36	NP	NP	NP	NP	24.1	NP	NP	NP	9.1	15.4	20.9	NP

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 gallon per minute = 0.063 L/s, 1 pound per square inch = 6.895 kPa.

NP = Not permitted. Pressure loss exceeds reasonable limits.

a. Values are applicable for underground piping materials listed in Table P2905.4 and are based on an SDR of 11 and a Hazen Williams C Factor of 150.

b. Values include the following length allowances for fittings: 25% length increase for actual lengths up to 100 feet and 15% length increase for actual lengths over 100 feet.

c. Flow rate from Section P2904.4.2. Add 5 gpm to the flow rate required by Section P2904.4.2 where the water-service pipe supplies more than one dwelling.

**TABLE P2904.6.2(2)**  
**MINIMUM WATER METER PRESSURE LOSS ( $PL_m$ )<sup>a</sup>**

FLOW RATE (gallons per minute, gpm) <sup>b</sup>	$\frac{5}{8}$ -INCH METER PRESSURE LOSS (pounds per square inch, psi)	$\frac{3}{4}$ -INCH METER PRESSURE LOSS (pounds per square inch, psi)	1-INCH METER PRESSURE LOSS (pounds per square inch, psi)
8	2	1	1
10	3	1	1
12	4	1	1
14	5	2	1
16	7	3	1
18	9	4	1
20	11	4	2
22	NP	5	2
24	NP	5	2
26	NP	6	2
28	NP	6	2
30	NP	7	2
32	NP	7	3
34	NP	8	3
36	NP	8	3

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa, 1 gallon per minute = 0.063 L/s.

NP—Not permitted unless the actual water meter pressure loss is known.

- a. Table P2904.6.2(2) establishes conservative values for water meter pressure loss or installations where the water meter loss is unknown. Where the actual water meter pressure loss is known,  $P_m$  shall be the actual loss.
- b. Flow rate from Section P2904.4.2. Add 5 gpm to the flow rate required by Section P2904.4.2 where the water-service pipe supplies more than one dwelling.

**TABLE P2904.6.2(3)**  
**ELEVATION LOSS ( $PL_e$ )**

ELEVATION (feet)	PRESSURE LOSS (psi)
5	2.2
10	4.4
15	6.5
20	8.7
25	10.9
30	13
35	15.2
40	17.4

For SI: 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa.



TABLE P2904.6.2(4)  
ALLOWABLE PIPE LENGTH FOR  $\frac{3}{4}$ -INCH TYPE M COPPER WATER TUBING

SPRINKLER FLOW RATE <sup>a</sup> (gpm)	WATER DISTRIBUTION SIZE (inch)	AVAILABLE PRESSURE— $P_t$ (psi)									
		15	20	25	30	35	40	45	50	55	60
		Allowable length of pipe from service valve to farthest sprinkler (feet)									
8	$\frac{3}{4}$	217	289	361	434	506	578	650	723	795	867
9	$\frac{3}{4}$	174	232	291	349	407	465	523	581	639	697
10	$\frac{3}{4}$	143	191	239	287	335	383	430	478	526	574
11	$\frac{3}{4}$	120	160	200	241	281	321	361	401	441	481
12	$\frac{3}{4}$	102	137	171	205	239	273	307	341	375	410
13	$\frac{3}{4}$	88	118	147	177	206	235	265	294	324	353
14	$\frac{3}{4}$	77	103	128	154	180	205	231	257	282	308
15	$\frac{3}{4}$	68	90	113	136	158	181	203	226	248	271
16	$\frac{3}{4}$	60	80	100	120	140	160	180	200	220	241
17	$\frac{3}{4}$	54	72	90	108	125	143	161	179	197	215
18	$\frac{3}{4}$	48	64	81	97	113	129	145	161	177	193
19	$\frac{3}{4}$	44	58	73	88	102	117	131	146	160	175
20	$\frac{3}{4}$	40	53	66	80	93	106	119	133	146	159
21	$\frac{3}{4}$	36	48	61	73	85	97	109	121	133	145
22	$\frac{3}{4}$	33	44	56	67	78	89	100	111	122	133
23	$\frac{3}{4}$	31	41	51	61	72	82	92	102	113	123
24	$\frac{3}{4}$	28	38	47	57	66	76	85	95	104	114
25	$\frac{3}{4}$	26	35	44	53	61	70	79	88	97	105
26	$\frac{3}{4}$	24	33	41	49	57	65	73	82	90	98
27	$\frac{3}{4}$	23	30	38	46	53	61	69	76	84	91
28	$\frac{3}{4}$	21	28	36	43	50	57	64	71	78	85
29	$\frac{3}{4}$	20	27	33	40	47	53	60	67	73	80
30	$\frac{3}{4}$	19	25	31	38	44	50	56	63	69	75
31	$\frac{3}{4}$	18	24	29	35	41	47	53	59	65	71
32	$\frac{3}{4}$	17	22	28	33	39	44	50	56	61	67
33	$\frac{3}{4}$	16	21	26	32	37	42	47	53	58	63
34	$\frac{3}{4}$	NP	20	25	30	35	40	45	50	55	60
35	$\frac{3}{4}$	NP	19	24	28	33	38	42	47	52	57
36	$\frac{3}{4}$	NP	18	22	27	31	36	40	45	49	54
37	$\frac{3}{4}$	NP	17	21	26	30	34	38	43	47	51
38	$\frac{3}{4}$	NP	16	20	24	28	32	36	40	45	49
39	$\frac{3}{4}$	NP	15	19	23	27	31	35	39	42	46
40	$\frac{3}{4}$	NP	NP	18	22	26	29	33	37	40	44

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa, 1 gallon per minute = 0.963 L/s.

NP—Not permitted

a. Flow rate from Section P2904.4.2.



TABLE P2904.6.2(5)  
ALLOWABLE PIPE LENGTH FOR 1-INCH TYPE M COPPER WATER TUBING

SPRINKLER FLOW RATE <sup>a</sup> (gpm)	WATER DISTRIBUTION SIZE (inch)	AVAILABLE PRESSURE— $P_t$ (psi)									
		15	20	25	30	35	40	45	50	55	60
		Allowable length of pipe from service valve to farthest sprinkler (feet)									
8	1	806	1075	1343	1612	1881	2149	2418	2687	2955	3224
9	1	648	864	1080	1296	1512	1728	1945	2161	2377	2593
10	1	533	711	889	1067	1245	1422	1600	1778	1956	2134
11	1	447	586	745	894	1043	1192	1341	1491	1640	1789
12	1	381	508	634	761	888	1015	1142	1269	1396	1523
13	1	328	438	547	657	766	875	985	1094	1204	1313
14	1	286	382	477	572	668	763	859	954	1049	1145
15	1	252	336	420	504	588	672	756	840	924	1008
16	1	224	298	373	447	522	596	671	745	820	894
17	1	200	266	333	400	466	533	600	666	733	799
18	1	180	240	300	360	420	479	539	599	659	719
19	1	163	217	271	325	380	434	488	542	597	651
20	1	148	197	247	296	345	395	444	493	543	592
21	1	135	180	225	270	315	360	406	451	496	541
22	1	124	165	207	248	289	331	372	413	455	496
23	1	114	152	190	228	267	305	343	381	419	457
24	1	106	141	176	211	246	282	317	352	387	422
25	1	98	131	163	196	228	261	294	326	359	392
26	1	91	121	152	182	212	243	273	304	334	364
27	1	85	113	142	170	198	226	255	283	311	340
28	1	79	106	132	159	185	212	238	265	291	318
29	1	74	99	124	149	174	198	223	248	273	298
30	1	70	93	116	140	163	186	210	233	256	280
31	1	66	88	110	132	153	175	197	219	241	263
32	1	62	83	103	124	145	165	186	207	227	248
33	1	59	78	98	117	137	156	176	195	215	234
34	1	55	74	92	111	129	148	166	185	203	222
35	1	53	70	88	105	123	140	158	175	193	210
36	1	50	66	83	100	116	133	150	166	183	199
37	1	47	63	79	95	111	126	142	158	174	190
38	1	45	60	75	90	105	120	135	150	165	181
39	1	43	57	72	86	100	115	129	143	158	172
40	1	41	55	68	82	96	109	123	137	150	164

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa, 1 gallon per minute = 0.963 L/s.

a. Flow rate from Section P2904.4.2.



**TABLE P2904.6.2(6)**  
**ALLOWABLE PIPE LENGTH FOR 3/4-INCH CPVC PIPE**

SPRINKLER FLOW RATE <sup>a</sup> (gpm)	WATER DISTRIBUTION SIZE (inch)	AVAILABLE PRESSURE— $P_i$ (psi)									
		15	20	25	30	35	40	45	50	55	60
		Allowable length of pipe from service valve to farthest sprinkler (feet)									
8	3/4	348	465	581	697	813	929	1045	1161	1278	1394
9	3/4	280	374	467	560	654	747	841	934	1027	1121
10	3/4	231	307	384	461	538	615	692	769	845	922
11	3/4	193	258	322	387	451	515	580	644	709	773
12	3/4	165	219	274	329	384	439	494	549	603	658
13	3/4	142	189	237	284	331	378	426	473	520	568
14	3/4	124	165	206	247	289	330	371	412	454	495
15	3/4	109	145	182	218	254	290	327	363	399	436
16	3/4	97	129	161	193	226	258	290	322	354	387
17	3/4	86	115	144	173	202	230	259	288	317	346
18	3/4	78	104	130	155	181	207	233	259	285	311
19	3/4	70	94	117	141	164	188	211	234	258	281
20	3/4	64	85	107	128	149	171	192	213	235	256
21	3/4	58	78	97	117	136	156	175	195	214	234
22	3/4	54	71	89	107	125	143	161	179	197	214
23	3/4	49	66	82	99	115	132	148	165	181	198
24	3/4	46	61	76	91	107	122	137	152	167	183
25	3/4	42	56	71	85	99	113	127	141	155	169
26	3/4	39	52	66	79	92	105	118	131	144	157
27	3/4	37	49	61	73	86	98	110	122	135	147
28	3/4	34	46	57	69	80	92	103	114	126	137
29	3/4	32	43	54	64	75	86	96	107	118	129
30	3/4	30	40	50	60	70	81	91	101	111	121
31	3/4	28	38	47	57	66	76	85	95	104	114
32	3/4	27	36	45	54	63	71	80	89	98	107
33	3/4	25	34	42	51	59	68	76	84	93	101
34	3/4	24	32	40	48	56	64	72	80	88	96
35	3/4	23	30	38	45	53	61	68	76	83	91
36	3/4	22	29	36	43	50	57	65	72	79	86
37	3/4	20	27	34	41	48	55	61	68	75	82
38	3/4	20	26	33	39	46	52	59	65	72	78
39	3/4	19	25	31	37	43	50	56	62	68	74
40	3/4	18	24	30	35	41	47	53	59	65	71

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa, 1 gallon per minute = 0.963 L/s.

a. Flow rate from Section P2904.4.2.



**TABLE P2904.6.2(7)**  
**ALLOWABLE PIPE LENGTH FOR 1-INCH CPVC PIPE**

SPRINKLER FLOW RATE <sup>a</sup> (gpm)	WATER DISTRIBUTION SIZE (inch)	AVAILABLE PRESSURE— $P_t$ (psi)									
		15	20	25	30	35	40	45	50	55	60
		Allowable length of pipe from service valve to farthest sprinkler (feet)									
8	1	1049	1398	1748	2098	2447	2797	3146	3496	3845	4195
9	1	843	1125	1406	1687	1968	2249	2530	2811	3093	3374
10	1	694	925	1157	1388	1619	1851	2082	2314	2545	2776
11	1	582	776	970	1164	1358	1552	1746	1940	2133	2327
12	1	495	660	826	991	1156	1321	1486	1651	1816	1981
13	1	427	570	712	854	997	1139	1281	1424	1566	1709
14	1	372	497	621	745	869	993	1117	1241	1366	1490
15	1	328	437	546	656	765	874	983	1093	1202	1311
16	1	291	388	485	582	679	776	873	970	1067	1164
17	1	260	347	433	520	607	693	780	867	954	1040
18	1	234	312	390	468	546	624	702	780	858	936
19	1	212	282	353	423	494	565	635	706	776	847
20	1	193	257	321	385	449	513	578	642	706	770
21	1	176	235	293	352	410	469	528	586	645	704
22	1	161	215	269	323	377	430	484	538	592	646
23	1	149	198	248	297	347	396	446	496	545	595
24	1	137	183	229	275	321	366	412	458	504	550
25	1	127	170	212	255	297	340	382	425	467	510
26	1	118	158	197	237	276	316	355	395	434	474
27	1	111	147	184	221	258	295	332	368	405	442
28	1	103	138	172	207	241	275	310	344	379	413
29	1	97	129	161	194	226	258	290	323	355	387
30	1	91	121	152	182	212	242	273	303	333	364
31	1	86	114	143	171	200	228	257	285	314	342
32	1	81	108	134	161	188	215	242	269	296	323
33	1	76	102	127	152	178	203	229	254	280	305
34	1	72	96	120	144	168	192	216	240	265	289
35	1	68	91	114	137	160	182	205	228	251	273
36	1	65	87	108	130	151	173	195	216	238	260
37	1	62	82	103	123	144	165	185	206	226	247
38	1	59	78	98	117	137	157	176	196	215	235
39	1	56	75	93	112	131	149	168	187	205	224
40	1	53	71	89	107	125	142	160	178	196	214

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa, 1 gallon per minute = 0.963 L/s.

a. Flow rate from Section P2904.4.2.



TABLE P2904.6.2(8)  
ALLOWABLE PIPE LENGTH FOR  $\frac{3}{4}$ -INCH PEX AND PE-RT TUBING

SPRINKLER FLOW RATE <sup>a</sup> (gpm)	WATER DISTRIBUTION SIZE (inch)	AVAILABLE PRESSURE— $P_i$ (psi)									
		15	20	25	30	35	40	45	50	55	60
		Allowable length of pipe from service valve to farthest sprinkler (feet)									
8	$\frac{3}{4}$	93	123	154	185	216	247	278	309	339	370
9	$\frac{3}{4}$	74	99	124	149	174	199	223	248	273	298
10	$\frac{3}{4}$	61	82	102	123	143	163	184	204	225	245
11	$\frac{3}{4}$	51	68	86	103	120	137	154	171	188	205
12	$\frac{3}{4}$	44	58	73	87	102	117	131	146	160	175
13	$\frac{3}{4}$	38	50	63	75	88	101	113	126	138	151
14	$\frac{3}{4}$	33	44	55	66	77	88	99	110	121	132
15	$\frac{3}{4}$	29	39	48	58	68	77	87	96	106	116
16	$\frac{3}{4}$	26	34	43	51	60	68	77	86	94	103
17	$\frac{3}{4}$	23	31	38	46	54	61	69	77	84	92
18	$\frac{3}{4}$	21	28	34	41	48	55	62	69	76	83
19	$\frac{3}{4}$	19	25	31	37	44	50	56	62	69	75
20	$\frac{3}{4}$	17	23	28	34	40	45	51	57	62	68
21	$\frac{3}{4}$	16	21	26	31	36	41	47	52	57	62
22	$\frac{3}{4}$	NP	19	24	28	33	38	43	47	52	57
23	$\frac{3}{4}$	NP	17	22	26	31	35	39	44	48	52
24	$\frac{3}{4}$	NP	16	20	24	28	32	36	40	44	49
25	$\frac{3}{4}$	NP	NP	19	22	26	30	34	37	41	45
26	$\frac{3}{4}$	NP	NP	17	21	24	28	31	35	38	42
27	$\frac{3}{4}$	NP	NP	16	20	23	26	29	33	36	39
28	$\frac{3}{4}$	NP	NP	15	18	21	24	27	30	33	36
29	$\frac{3}{4}$	NP	NP	NP	17	20	23	26	28	31	34
30	$\frac{3}{4}$	NP	NP	NP	16	19	21	24	27	29	32
31	$\frac{3}{4}$	NP	NP	NP	15	18	20	23	25	28	30
32	$\frac{3}{4}$	NP	NP	NP	NP	17	19	21	24	26	28
33	$\frac{3}{4}$	NP	NP	NP	NP	16	18	20	22	25	27
34	$\frac{3}{4}$	NP	NP	NP	NP	NP	17	19	21	23	25
35	$\frac{3}{4}$	NP	NP	NP	NP	NP	16	18	20	22	24
36	$\frac{3}{4}$	NP	NP	NP	NP	NP	15	17	19	21	23
37	$\frac{3}{4}$	NP	NP	NP	NP	NP	NP	16	18	20	22
38	$\frac{3}{4}$	NP	NP	NP	NP	NP	NP	16	17	19	21
39	$\frac{3}{4}$	NP	NP	NP	NP	NP	NP	NP	16	18	20
40	$\frac{3}{4}$	NP	NP	NP	NP	NP	NP	NP	16	17	19

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa, 1 gallon per minute = 0.963 L/s.

NP— Not permitted.

a. Flow rate from Section P2904.4.2.



TABLE P2904.6.2(9)  
ALLOWABLE PIPE LENGTH FOR 1-INCH PEX AND PE-RT TUBING

SPRINKLER FLOW RATE <sup>a</sup> (gpm)	WATER DISTRIBUTION SIZE (inch)	AVAILABLE PRESSURE— $P_a$ (psi)									
		15	20	25	30	35	40	45	50	55	60
		Allowable length of pipe from service valve to farthest sprinkler (feet)									
8	1	314	418	523	628	732	837	941	1046	1151	1255
9	1	252	336	421	505	589	673	757	841	925	1009
10	1	208	277	346	415	485	554	623	692	761	831
11	1	174	232	290	348	406	464	522	580	638	696
12	1	148	198	247	296	346	395	445	494	543	593
13	1	128	170	213	256	298	341	383	426	469	511
14	1	111	149	186	223	260	297	334	371	409	446
15	1	98	131	163	196	229	262	294	327	360	392
16	1	87	116	145	174	203	232	261	290	319	348
17	1	78	104	130	156	182	208	233	259	285	311
18	1	70	93	117	140	163	187	210	233	257	280
19	1	63	84	106	127	148	169	190	211	232	253
20	1	58	77	96	115	134	154	173	192	211	230
21	1	53	70	88	105	123	140	158	175	193	211
22	1	48	64	80	97	113	129	145	161	177	193
23	1	44	59	74	89	104	119	133	148	163	178
24	1	41	55	69	82	96	110	123	137	151	164
25	1	38	51	64	76	89	102	114	127	140	152
26	1	35	47	59	71	83	95	106	118	130	142
27	1	33	44	55	66	77	88	99	110	121	132
28	1	31	41	52	62	72	82	93	103	113	124
29	1	29	39	48	58	68	77	87	97	106	116
30	1	27	36	45	54	63	73	82	91	100	109
31	1	26	34	43	51	60	68	77	85	94	102
32	1	24	32	40	48	56	64	72	80	89	97
33	1	23	30	38	46	53	61	68	76	84	91
34	1	22	29	36	43	50	58	65	72	79	86
35	1	20	27	34	41	48	55	61	68	75	82
36	1	19	26	32	39	45	52	58	65	71	78
37	1	18	25	31	37	43	49	55	62	68	74
38	1	18	23	29	35	41	47	53	59	64	70
39	1	17	22	28	33	39	45	50	56	61	67
40	1	16	21	27	32	37	43	48	53	59	64

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa, 1 gallon per minute = 0.963 L/s.

a. Flow rate from Section P2904.4.2.



**P2904.8 Inspections.** The water distribution system shall be inspected in accordance with Sections P2904.8.1 and P2904.8.2.

**P2904.8.1 Preconcealment inspection.** The following items shall be verified prior to the concealment of any sprinkler system piping:

1. Sprinklers are installed in all areas as required by Section P2904.1.1.
2. Where sprinkler water spray patterns are obstructed by construction features, luminaires or ceiling fans, additional sprinklers are installed as required by Section P2904.2.4.2.
3. Sprinklers are the correct temperature rating and are installed at or beyond the required separation distances from heat sources as required by Sections P2904.2.1 and P2904.2.2.
4. The pipe size equals or exceeds the size used in applying Tables P2904.6.2(4) through P2904.6.2(9) or, if the piping system was hydraulically calculated in accordance with Section P2904.6.1, the size used in the hydraulic calculation.
5. The pipe length does not exceed the length permitted by Tables P2904.6.2(4) through P2904.6.2(9) or, if the piping system was hydraulically calculated in accordance with Section P2904.6.1, pipe lengths and fittings do not exceed those used in the hydraulic calculation.
6. Nonmetallic piping that conveys water to sprinklers is listed for use with fire sprinklers.
7. Piping is supported in accordance with the pipe manufacturer's and sprinkler manufacturer's installation instructions.
8. The piping system is tested in accordance with Section P2503.7.

**P2904.8.2 Final inspection.** The following items shall be verified upon completion of the system:

1. Sprinkler are not painted, damaged or otherwise hindered from operation.
2. Where a pump is required to provide water to the system, the pump starts automatically upon system water demand.
3. Pressure-reducing valves, water softeners, water filters or other impairments to water flow that were not part of the original design have not been installed.
4. The sign or valve tag required by Section P2904.7 is installed and the owner's manual for the system is present.

## SECTION P2905

### MATERIALS, JOINTS AND CONNECTIONS

**P2905.1 Soil and groundwater.** The installation of water service pipe, water distribution pipe, fittings, valves, appurtenances and gaskets shall be prohibited in soil and groundwater that is contaminated with solvents, fuels, organic

compounds or other detrimental materials that cause permeation, corrosion, degradation or structural failure of the water service or water distribution piping material.

**P2905.1.1 Investigation required.** Where detrimental conditions are suspected by or brought to the attention of the *building official*, a chemical analysis of the soil and groundwater conditions shall be required to ascertain the acceptability of the water service material for the specific installation.

**P2905.1.2 Detrimental condition.** When a detrimental condition exists, *approved* alternate materials or alternate routing shall be required.

**P2905.2 Lead content.** Pipe and fittings used in the water-supply system shall have lead content of not greater than 8 percent lead.

**P2905.3 Polyethylene plastic piping installation.** Polyethylene pipe shall be cut square using a cutter designed for plastic pipe. Except where joined by heat fusion, pipe ends shall be chamfered to remove sharp edges. Pipe that has been kinked shall not be installed. For bends, the installed radius of pipe curvature shall be greater than 30 pipe diameters or the coil radius when bending with the coil. Coiled pipe shall not be bent beyond straight. Bends shall not be permitted within 10 pipe diameters of any fitting or valve. Joints between polyethylene plastic pipe and fittings shall comply with Sections P2905.3.1 and P2905.3.2.

**P2905.3.1 Heat-fusion joints.** Joint surfaces shall be clean and free from moisture. Joint surfaces shall be heated to melting temperature and joined. The joint shall be undisturbed until cool. Joints shall be made in accordance with ASTM D 2657.

**P2905.3.2 Mechanical joints.** Mechanical joints shall be installed in accordance with the manufacturer's instructions.

**P2905.4 Water service pipe.** Water service pipe shall conform to NSF 61 and shall conform to one of the standards listed in Table P2905.4. Water service pipe or tubing, installed underground and outside of the structure, shall have a working pressure rating of not less than 160 pounds per square inch at 73°F (1103 kPa at 23°C). Where the water pressure exceeds 160 pounds per square inch (1103 kPa), piping material shall have a rated working pressure equal to or greater than the highest available pressure. Water service piping materials not third-party certified for water distribution shall terminate at or before the full open valve located at the entrance to the structure. Ductile iron water service piping shall be cement mortar lined in accordance with AWWA C104.

**P2905.4.1 Dual check-valve-type backflow preventer.** Where a dual check-valve backflow preventer is installed on the water supply system, it shall comply with ASSE 1024 or CSA B64.6.

**P2905.4.2 Water service installation.** Trenching, pipe installation and backfilling shall be in accordance with Section P2604. Water-service pipe is permitted to be located in the same trench with a *building sewer* provided such sewer is constructed of materials listed for under-