b. Polybutylene water distribution pipe or tubing shall be supported or anchored at the beginning and end of long bends in accordance with the manufacturer's instructions.

**Table 84.30-8**
**PIPE AND TUBING FOR WATER SERVICES AND PRIVATE WATER MAINS**

| Material | Standard |
|---|---|
| Acrylonitrile butadiene styrene (ABS)[a] | ASTM D1527; ASTM D2282 |
| Brass | ASTM B43 |
| Cast iron | ASTM A377; AWWA C115/A21.15 |
| Chlorinated polyvinyl chloride (CPVC)[a] | ASTM D2846; ASTM F441; ASTM F442 |
| Copper[b] | ASTM B42; ASTM B88 |
| Ductile iron | ASTM A377; AWWA C115/A21.15; AWWA C151/A21.51 |
| Galvanized steel | ASTM A53 |
| Polybutylene (PB)[a] | ASTM D2662; ASTM D2666; ASTM D3000; ASTM D3309 |
| Polyethylene (PE)[a] | ASTM D2239; ASTM D2737; ASTM D2104; ASTM D2447; ASTM D3035 |
| Polyvinyl chloride (PVC)[a] | ASTM D1785; ASTM D2241; ASTM D2672; AWWA C900 |
| Stainless steel | ANSI B36.19 |

Note a: Plastic water service systems shall be installed in accordance with ASTM D2774. See Appendix for further explanatory material.

Note b: Copper tubing, type M, may not be installed underground.

**Table 84.30-9**
**WATER DISTRIBUTION PIPE AND TUBING**

| Material | Standard |
|---|---|
| Brass | ASTM B43 |
| Cast iron | ASTM A377; AWWA C115/A21.15 |
| Chlorinated polyvinyl chloride (CPVC)[a] | ASTM D2846 |
| Copper[b] | ASTM B42; ASTM B88 |
| Ductile iron | ASTM A377; AWWA C115/A21.15; AWWA C151/A21.51 |
| Galvanized steel | ASTM A53 |
| Polybutylene (PB)[a] | ASTM D3309 |
| Stainless steel | ANSI B36.19M; ASTM A270; ASTM A450 |

Note a: Plastic pipe and tubing installed underground shall be in accordance with ASTM D2774. See Appendix for further explanatory material.

Note b: Copper tubing, type M, may not be installed underground.

**Table 84.30-9m**
**MINIMUM BENDING RADIUS OF POLYBUTYLENE WATER DISTRIBUTION PIPE AND TUBING**

| Pipe Size (inches) | Bending Radius (inches) | Tubing Size (inches) | Bending Radius (inches) |
|---|---|---|---|
| ¾ | 12¾ | ¼ | 4½ |
| 1 | 15¾ | ⅜ | 6 |
| 1¼ | 20 | ½ | 7½ |
| 1½ | 23 | ¾ | 10½ |
| 2 | 28½ | 1 | 13½ |
| | | 1¼ | 16½ |
| | | 1½ | 19½ |
| | | 2 | 25½ |

Note: See Appendix for further explanatory material.

**Table 84.30-10**
**EXTERIOR TURF SPRINKLER SYSTEM PIPE AND TUBING**

| Material | Standard |
|---|---|
| Acrylonitrile butadiene styrene (ABS)[a] | ASTM D1527; ASTM D2282 |
| Brass | ASTM B43 |
| Cast iron | ASTM A377; AWWA C115/A21.15 |
| Chlorinated polyvinyl chloride (CPVC)[a] | ASTM F441; ASTM F442; ASTM D2846 |
| Copper[b] | ASTM B88 |
| Ductile iron | ASTM A377; AWWA C115/A21.15; AWWA C151/A21.51 |
| Galvanized steel | ASTM A53 |
| Polybutylene (PB)[a] | ASTM D2666; ASTM D3000; ASTM D2662; ASTM D3309 |
| Polyethylene (PE)[a] | ASTM D2104; ASTM D2239; ASTM D2447; ASTM D3035; ASTM D2737 |
| Polyvinyl chloride (PVC)[a] | ASTM D1785; ASTM D2241; ASTM D2672; AWWA C900 |

Note a: Plastic pipe and tubing installed underground shall be in accordance with ASTM D2774. See Appendix for further explanatory material.

Note b: Copper tubing, type M, may not be installed underground.

(g) *Circulating loops.* Polybutylene pipe and tubing may not be used for continuously circulating hot water loops.

(5) PIPE FITTINGS AND VALVES. (a) *Fittings.* Pipe fittings shall conform to the pipe material standards listed in this chapter or one of the standards listed in Table 84.30-11. Threaded drain pipe fittings shall be of the recessed drainage type.

(b) *Water supply valves.* 1. Control valves for water services and private water mains shall be designed and constructed to withstand a minimum pressure of 125 psig at 73.4°F.

2. Control valves for water distribution systems shall be designed and constructed to withstand a minimum pressure of 100 psig at 180°F.

3. A control valve for water supply piping 3/4 inches through 4 inches in diameter which serves 2 or more plumbing fixtures shall have a nominal diameter at least equal to the piping and shall have a minimum Cv factor as specified in Table 84.30-10a.

**Table 84.30-10a**
**MINIMUM Cv FACTORS**

| Nominal Valve Diameters | Cv Factors |
|---|---|
| ¾ | 18 |
| 1 | 35.5 |
| 1¼ | 61 |
| 1½ | 107 |
| 2 | 175 |
| 3 | 255 |
| 4 | 340 |

Note: The Cv factor is defined as the flow coefficient for valves, expressing the flow rate in gallons per minute of 60° with a one psi pressure drop across the valve.

(c) *Special fittings and valves.* 1. Water hammer arrestors shall conform to ANSI A112.26.1 or ASSE 1010.

2. Relief valves and automatic gas shutoff devices for hot water supply systems shall conform to ANSI Z21.22.

3. Water pressure reducing valves and strainers for water pressure reducing valves for domestic supply systems shall conform to ASSE 1003.

4. Hose connection vacuum breakers shall conform to ASSE 1011 or ASSE 1019.

5. Backflow preventers with intermediate atmospheric vents shall conform to ASSE 1012.

6. Reduced pressure principle backflow preventers shall conform to ASSE 1013.

7. Backwater valves shall conform to ANSI A112.14.1.

8. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001.

9. Laboratory faucet vacuum breakers shall conform to ASSE 1035.

10. Trap seal primer valves shall conform to ASSE 1018.

(d) *Pipe saddles.* Pipe saddles shall be installed in accordance with the instructions of the saddle manufacturer and the following limitations:

1. Pipe saddles may be installed on private interceptor main sewers, building sewers, underground drain and vent pipe and tubing, and where otherwise approved by the department;

2. A saddle for drain piping shall have a radius in accordance with s. ILHR 82.30 (8) (a);

3. The material of the saddle shall be compatible with the materials of the pipes which are to be connected to the saddle;

4. The hole in the pipe which is to receive the saddle shall be drilled or cored to match the saddle outlet;

5. Straps or clamps which wrap around the pipe and saddle shall be provided by the manufacturer of the saddle;

6. Saddles shall be installed with straps or clamps which wrap around the pipe and saddle; and

7. Proper hangers or bedding shall be provided to maintain alignment between the opening in the pipe and the saddle.

**Table 84.30-11**
**PIPE FITTINGS**

| Material | Standard |
|---|---|
| Acrylonitrile butadiene styrene (ABS) | ASTM D2468; ASTM D3311; ASTM F409 |
| Cast bronze | ANSI B16.15; ANSI B16.24 |
| Cast copper alloy | ANSI B16.18; ANSI B16.23; ANSI B16.26; ANSI B16.32 |
| Cast iron | ANSI B16.4; ANSI B16.12; ANSI B16.1 |
| Chlorinated polyvinyl chloride (CPVC) | ASTM F437; ASTM F438; ASTM F439 |
| Copper | ANSI B16.22; ASNI B16.29; ANSI B16.43 |
| Ductile iron and gray iron | ANSI/AWWA C110/A21.10; ANSI/AWWA C153/A21.53; ANSI B16.42 |
| Malleable iron | ANSI B16.3 |
| Polybutylene (PB)[c] | ASTM D3309; MSS SP-103 |
| Polyethylene (PE) | ASTM D2609; ASTM D2683; ASTM D3261 |
| Polyvinyl chloride (PVC) | ASTM D2464; ASTM D2466; ASTM D2467; ASTM D3311; ASTM F409 |
| Stainless steel | ASTM A403 |
| Steel[a] | ANSI B16.5; ANSI B16.9; ANSI B16.11; ANSI B16.28 |
| Styrene-rubber (SR) | ASTM D2852 |

Note a: Steel fittings and malleable iron fittings to be used in a water supply system shall be galvanized-coated in accordance with ASTM A123.

Note b: See s. ILHR 84.30 (4) (intro.) concerning the maximum lead content for fittings.

Note c: Copper and copper alloy fittings conforming to MSS SP-103, may not be installed underground.

(6) SPECIAL MATERIALS. (a) *Sheet lead.* Sheet lead for the following uses may not weigh less than indicated in subds. 1. to 3.

1. Safe pans, 4 pounds per square foot;

2. Site-fabricated flashings for vent pipes, 3 pounds per square foot; and

3. Prefabricated flashings for vent pipes, 2½ pounds per square foot.

(b) *Traps and fixture drain connection fittings.* Copper or tubular brass traps and fixture drain connections fittings shall be at least of 20 gage material.

(c) *Sheet copper.* Sheet copper for the following uses may not weigh less than indicated in subds. 1. and 2. and shall conform to ASTM B152.

1. Safe pans, 12 ounces per square foot;

2. Flashing for vent pipes, 8 ounces per square foot; and

3. Flush tank linings, 10 ounces per square foot.

(d) *Cleanout plugs.* Cleanout plugs shall be of brass or plastic. Brass cleanout plugs shall be used with metallic piping only and shall conform

to ASTM A74. Plastic cleanout plugs shall conform to the requirements of sub. (5) (a).

(e) *Flush pipes and fittings.* Flush pipes and fittings shall be of nonferrous material and shall conform to ANSI A112.19.5.

(f) *Safing materials.* Safing materials made from chlorinated polyethylene shall conform to ASTM D4068.

History: Cr. Register, May, 1988, No. 389, eff. 6-1-88; am. (4) (intro.), Register, August, 1988, No. 392, eff. 9-1-88; renum. (2) (e) to (g) to (f) to (h), cr. (2) (e), am. Table 84.30-4, r. and recr. Table 84.30-5, Register, August, 1991, No. 428, eff. 9-1-91; am. (2) (c), (d) 1. and (e), r. (2) (d) 3., renum. (2) (d) 4. to be (2) (d) 3., cr. (2) (i), Register, April, 1992, No. 436, eff. 5-1-92; am. (3) (a), Tables 1, 3 to 9, 10 and 11, Register, September, 1992, No. 441, eff. 10-1-92; am. Table 84.30-9, cr. (4) (g), Register, September, 1993, No. 453, eff. 10-1-93.

**ILHR 84.40 Joints and connections.** (1) GENERAL. (a) *Tightness.* Joints and connections in the plumbing system shall be watertight and gastight for the pressure required by test or the system design, whichever is greater, with the exception of perforated or open joint piping.

Note: The testing requirements for tightness are in s. ILHR 82.21.

(b) *Preparation of pipe ends.* Pipe ends shall be prepared in accordance with the applicable pipe standard or the pipe or fitting manufacturer's instructions.

(c) *Prohibited joints and connections.* Unless otherwise permitted in this chapter or ch. ILHR 82 or 83, the following types of joints and connections shall be prohibited:

1. Cement or concrete joints;

2. Mastic or hot poured bituminous joints;

3. Elastomeric rolling o-rings between different diameter pipes;

4. Solvent cement joints between different types of plastic pipe; and

5. Roll grooving of galvanized steel pipe.

(2) ABS PLASTIC PIPE. Joints between acrylonitrile butadiene styrene plastic pipe or fittings shall be installed in accordance with pars. (a) to (c).

(a) *Mechanical joints.* Mechanical joints shall be installed in accordance with the manufacturer's instructions.

1. Drain and vent systems. Mechanical push-on joints for drain and vent systems shall conform to ASTM D3212.

2. Water supply systems. Mechanical push-on joints and mechanical compression-type joints for water supply systems which use a flexible elastomeric seal shall conform to ASTM D3139.

(b) *Solvent cemented joints.* Solvent cemented joints shall be made in accordance with ASTM D2235 and its appendix, ASTM D2661 or ASTM F628.

1. Joint surfaces shall be clean and free of moisture.

2. Solvent cement conforming to ASTM D2235 shall be applied to all joint surfaces and the joint shall be made while the cement is wet.

3. Solvent cement shall be handled in accordance with ASTM F402.

4. Solvent cement used on pipes and fittings of a water supply system shall conform to NSF 14 and shall be certified by a nationally recognized testing agency as to conforming to NSF 14. The container for the solvent cement shall bear the certification mark of the testing agency.

Note: See Appendix for further explanatory material.

(c) *Threaded joints.* Threaded joints shall only be used on pipes of schedule 80 or heavier. Threaded joints shall conform to ANSI B1.20.1. The pipe shall be threaded with dies specifically designed for plastic pipe. Thread lubricant or tape approved for such use shall be applied to the male threads only.

(3) BLACK STEEL PIPE. Joints between black steel pipe or fittings shall be in accordance with pars. (a) to (d).

(a) *Threaded joints.* Threaded joints shall conform to ANSI B1.20.1. Pipe joint compound or tape shall be used on the male threads only.

(b) *Mechanical joints.* Mechanical joints shall be installed in accordance with the manufacturer's instructions.

(c) *Caulked joints.* Caulked joints shall only be used for drain or vent piping. Caulked joints for hub and spigot piping and fittings shall be firmly packed with oakum or hemp. Molten lead shall be poured in one operation not less than one inch deep and not to extend more than 1/8 inch below the rim of the pipe, and caulked tight. Paint, varnish or other coatings may not be used on the joining material until after the joint has been tested and approved.

1. Caulked joints for drain piping shall be used only in a vertical position.

2. Caulked joints for vent piping may be used for piping in a vertical or horizontal position.

(d) *Welded joints.* Joints between black steel pipe or fittings may be welded.

(4) BRASS PIPE. Joints between brass pipe or fittings shall be in accordance with the provisions of pars. (a) to (d).

(a) *Brazed joints.* All joint surfaces to be brazed shall be cleaned bright by other than chemical means. Brazing filler metal conforming to AWS A5.8 or other approved material shall be used. The joining of water supply piping shall be made with lead-free materials. "Lead-free " shall mean a chemical composition equal to or less than 0.2% of lead.

(b) *Mechanical joints.* Mechanical joints shall be installed in accordance with the manufacturer's instructions. Mechanical push-on joints and mechanical compression type joints for water supply systems which use flexible elastomeric seals shall conform to ASTM D3139.

(c) *Soldered joints.* All joint surfaces to be soldered shall be cleaned bright by other than chemical means. A nontoxic flux shall be applied to all joint surfaces. Solder conforming to ASTM B32 or other approved material shall be used. The joining of water supply piping shall be made with lead-free materials. "Lead-free" shall mean a chemical composition equal to or less than 0.2% of lead.

(d) *Threaded joints.* Threaded joints shall conform to ANSI B1.20.1. Pipe joint compound or tape shall be used on the male threads only.

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**Table 84.60-8m**

| | |
|---|---|
| **FMRC** | Factory Mutual Research Corp.<br>1151 Boston-Providence Turnpike<br>Norwood, Massachusetts 02062 |
| Standard Reference Number | Title |
| 1680 | Couplings used in Hubless Cast Iron Systems for Drain, Waste or Vent, Sewer, Rainwater or Storm Drain Systems Above and Below Ground, Industrial/ Commercial and Residential, January 1989 |

**Table 84.60-9**

| | |
|---|---|
| | Federal Specifications*<br>National Bureau of Standards<br>Office of Engineering Standards<br>U.S. Department of Commerce<br>Washington, D.C. 20234 |
| **FS** | *Standards are available from the Superintendent of Documents U.S. Government Printing Office, Washington, D.C. 20402 |
| Standard Reference Number | Title |
| WW-P-325B | Pipe, Bends, Traps, Caps and Plugs; Lead (For Industrial Pressure, and Soil and Waste Applications), June 9, 1976 |

**Table 84.60-10**

| | |
|---|---|
| **MSS** | Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.<br>127 Park Street, N.E.<br>Vienna, Virginia 22180 |
| Standard Reference Number | Title |
| SP - 103 | Wrought Copper and Copper Alloy Insert Fittings for Polybutylene Systems, April 1990 |

**Table 84.60-11**

| | |
|---|---|
| NSF | National Sanitation Foundation<br>3475 Plymouth Road<br>P.O. Box 1468<br>Ann Arbor, Michigan 48106 |

| Standard Reference Number | Title |
|---|---|
| Standard 14-90 | Plastic Piping Compounds and Related Materials |

**Table 84.60-12**

| Standard Reference Number | Title |
|---|---|
| WQA | Water Quality Association<br>4151 Naperville Road<br>Lisle, Illinois 60532 |

| Standard Reference Number | Title |
|---|---|
| S-100-85 | Household, Commercial and Portable Exchange Water Softeners |

History: Cr. Register, May, 1988, No. 389, eff. 6-1-88; am. Table 84.60-5, r. and recr. Table 84.60-9, Register, August, 1991, No. 428, eff. 9-1-91; am. Table 84.60-2, Register, April, 1992, No. 436, eff. 5-1-92; am. Tables 2 to 10, cr. Table 8m, Register, September, 1992, No. 441, eff. 10-1-92; rn. Tables 84.60-10 and 84-60-11 to be Tables 84.60-11 and 12, Cr. Table 84.60-10, Register, September, 1993, No. 453, eff. 10-1-93.