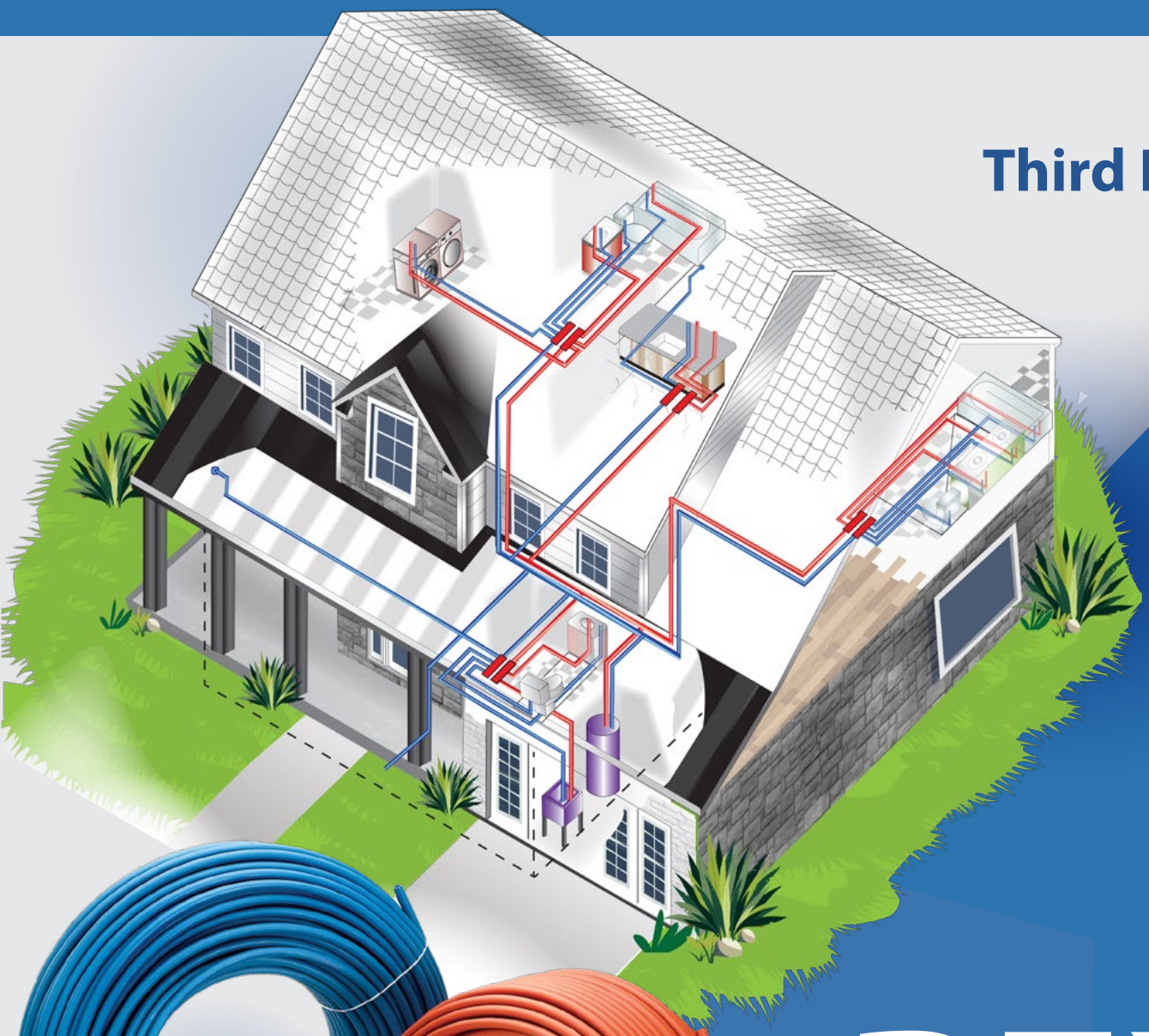
Third Edition



PEX

Plumbing Distribution Systems Design and Installation Guide

Advantages | Material Properties | Codes & Standards

Joining Methods | PEX Plumbing Layouts | Optimizing Design

Installation Guidelines | Water Service Line | Other Applications

IAPMO

PPI Plastics Pipe Institute The Voice of an Industry.

Home Innovation RESEARCH LABS™

PPFA Plastic Pipe and Fittings Association

ES ICC EVALUATION SERVICE®

PEX

Plumbing Distribution Systems Design and Installation Guide

Third Edition

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Code Acceptance

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PEX plumbing systems are recognized in all major plumbing and building model codes and are commonly used for hot- and cold-water distribution applications, water service lines, fire protection and radiant heating/cooling systems. The following is a summary of relevant model code requirements which specifically pertain to PEX plumbing systems for hot- and cold-water distribution systems.

The following sections are direct extracts from the latest model codes from USA and Canada, as applicable to PEX plumbing systems, with permission of the publishers. The code edition of each extract is stated.

Note: PEX has been accepted for hot- and cold-water distribution piping in North American model codes since 1993 and codes are constantly reviewed and updated. The user must determine which code/s are applicable to each specific project and must ensure compliance with all local, state, and federal codes, regulations, and standards.

International Plumbing Code (IPC 2024)

PIPING SUPPORT

308.1 General. Plumbing piping shall be supported in accordance with this section.

308.2 Piping seismic supports. Where earthquake loads are applicable in accordance with the *International Building Code*, plumbing piping supports, anchorage, and bracing shall be designed and installed for seismic forces in accordance with Chapter 16 of the *International Building Code*.

308.3 Materials. Hangers, anchors and supports shall support the piping and the contents of the piping. Hangers and strapping material shall be of *approved* material that will not promote galvanic action.

308.4 Structural attachment. Hangers and anchors shall be attached to the building construction in an *approved* manner.

308.5 Interval of support. Pipe shall be supported in accordance with Table 308.5.
Exception: The interval of support for piping systems designed to provide for expansion/contraction shall conform to the engineered design in accordance with Section 316.1.

308.9 Parallel water distribution systems. Piping bundles for manifold systems shall be supported in accordance with Table 308.5. Support at changes in direction shall be in accordance with the manufacturer's instructions. Where hot water piping is bundled with cold water piping, hot water piping shall be insulated in accordance with Section 607.5.

601.3 Existing piping used for grounding. Existing metallic water service piping used for electrical grounding shall not be replaced with nonmetallic pipe or tubing until other *approved* means of grounding is provided.

603.1 Size of water service pipe. The water service pipe shall be sized to supply water to the structure in the quantities and at the pressures required in this code. The water service pipe shall be not less than 3/4 inch (19.1 mm) in diameter.

604.3 Water distribution system design criteria. The water distribution system shall be designed, and pipe sizes shall be selected such that under conditions of peak demand, the capacities at the fixture supply pipe outlets shall be not less than shown in Table 604.3. The minimum flow rate and flow pressure provided to fixtures and appliances not listed in Table 604.3 shall be in accordance with the manufacturer's installation instructions.

604.10 Gridded and parallel water distribution system manifolds. Hot water and cold water manifolds installed with gridded or parallel connected individual distribution lines to each fixture or fixture fitting shall be designed in accordance with Sections 604.10.1 through 604.10.3.

604.10.1 Manifold sizing. Hot water and cold water manifolds shall be sized in accordance with Table 604.10.1. The total gallons per minute is the demand of all outlets supplied.

605.3 Water service pipe. Water service pipe shall conform to NSF 61 and shall conform to one of the standards listed in Table 605.3 (ASTM F876, AWWA C904, CSA B137.5). Water service pipe or tubing, installed underground and outside of the structure, shall have a working pressure rating of not less than 160 psi (1100 kPa) at 73.4°F (23°C). Where the water pressure exceeds 160 psi (1100 kPa), piping materials shall have a working pressure rating not less than the highest available pressure

605.4 Water distribution pipe. Water distribution pipe and tubing shall conform to NSF 61 and shall conform to one of the standards listed in Table 605.4 (ASTM F876, CSA B137.5). Hot water distribution pipe and tubing shall have a pressure rating of not less than 100 psi (690 kPa) at 180°F (82°C). Where the water pressure exceeds 160 psi (1100 kPa), piping materials shall have a working pressure rating not less than the highest available pressure.

605.5 Fittings. Pipe fittings shall be *approved* for installation with the piping material installed and shall comply with the applicable standards listed in Table 605.5. Pipe fittings utilized in water supply systems shall also comply with NSF 61.

605.16 PEX plastic. Joints between cross-linked polyethylene plastic tubing and fittings shall comply with Sections 605.16.1 through 605.16.3.

605.16.1 Flared joints. Flared pipe ends shall be made by a tool designed for that operation.

605.16.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions. Fittings for crosslinked polyethylene (PEX) plastic tubing shall comply with the applicable standards listed in Table 605.5 and shall be installed in accordance with the manufacturer's instructions. PEX tubing shall be factory marked with the appropriate standards for the fittings that the PEX manufacturer specifies for use with the tubing.

605.16.3 Push-fit joints. Push-fit joints shall conform to ASSE 1061 and shall be installed in accordance with the manufacturer's instructions.

International Residential Code (IRC 2024)

P2605.1 General. Piping shall be supported in accordance with the following:

1-4. *Not applicable to PEX hanger support spacing*
5. Piping shall be supported at distances not to exceed those indicated in Table P2605.1.

PIPING MATERIAL	MAXIMUM HORIZONTAL SPACING (feet)	MAXIMUM VERTICAL SPACING (feet)
Crosslinked polyethylene (PEX), 1 inch and smaller	2.67 [32 inches]	10[b]
Crosslinked polyethylene (PEX), 1 1/4 inches and larger	4 [48 inches]	10[b]

[b] For sizes 2 inches and smaller, a guide shall be installed midway between vertical supports

P2609.3 Plastic pipe, fittings, and components. Plastic pipe, fittings, and components shall be third-party certified as conforming to NSF/ANSI 14.

P2609.5 Water supply systems. Water service pipes, water distribution pipes and the necessary connecting pipes, fittings, control valves, faucets and appurtenances used to dispense water intended for human ingestion shall be evaluated and *listed* as conforming to the requirements of NSF/ANSI/CAN 61.

P2903.9 Gridded and parallel water distribution systems. Hot water and cold water manifolds installed with parallel-connected individual distribution lines and cold water manifolds installed with gridded distribution lines to each fixture or fixture fitting shall be designed in accordance with Sections P2903.8.1 through P2903.8.5.

P2903.9.1 Sizing of manifolds. Manifolds shall be sized in accordance with Table P2903.8.1. Total gallons per minute is the demand for all outlets.

P2903.9.2 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 psi (276 kPa) for the size of individual distribution lines shall be not less than 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 manufacturer. Where 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.

P2903.9.3 Support and protection. Plastic piping bundles shall be secured in accordance with manufacturer's installation 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.

P2903.9.4 Valving. Fixture valves, when installed, shall be located at either the fixture or at the manifold. Valves installed at manifold shall be *labeled* indicating the fixture served.

P2904 Dwelling Unit Automatic Sprinkler Systems

P2904.1 General. The design and installation of automatic sprinkler systems shall be in accordance with NFPA 13D or Section P2904, which shall be considered to be equivalent to NFPA 13D. Partial automatic sprinkler systems shall be permitted to be installed only in buildings not required to be equipped with an automatic 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 automatic sprinkler system shall provide domestic water to both fire sprinklers and plumbing fixtures. A stand-alone automatic sprinkler system shall be separate and independent from the water distribution system. A backflow preventer shall not be required to separate an automatic sprinkler system from the water distribution system, provided that the sprinkler system complies with all of the following:

1. The system complies with NFPA 13D or Section 2904.
2. The piping material complies with Section P2906.
3. The system does not contain antifreeze.
4. The system does not have a fire department connection.

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

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

Exception: For plastic piping, it shall be permissible to follow the manufacturer's installation instructions.

P2904.3.1 Non-metallic 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 Non-metallic pipe protection. Nonmetallic pipe and tubing systems shall be protected from exposure to the living space by a layer of not less than 3/8 inch thick (9.5 mm) gypsum wallboard, 1/2 inch thick (13 mm) plywood, or other material having a 15-minute fire rating.

P2904.4 Determining system design flow. The flow for sizing the sprinkler piping system shall be based on Sections P2904.4.1 and P2904.4.2.

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

P2904.6 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.

P2906.4 Water service pipe. Water service pipe shall conform to NSF/ANSI/CAN 61 and shall conform to one of the standards indicated in Table P2906.4. 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).

P2906.5 Water distribution pipe. Water distribution piping within dwelling units shall conform to NSF/ANSI/CAN 61 and shall conform to one of the standards indicated in Table P2906.5. Water distribution pipe and tubing shall have a pressure rating of not less than 100 psi at 180°F (689 kPa at 82°C).

P2906.9 Plastic pipe joints. Joints in plastic piping shall be made with approved fittings by solvent cementing, heat fusion, corrosion-resistant metal clamps with insert fittings or compression connections.

P2906.10 Cross-linked polyethylene plastic (PEX). Joints between crosslinked polyethylene plastic tubing or fittings shall comply with Section P2906.9.10.1 or Section P2906.9.10.2.

P2906.10.2 Mechanical joints. Mechanical joints shall be installed in accordance with the manufacturer's instructions. Fittings for cross-linked polyethylene (PEX) plastic tubing shall comply with the applicable standards indicated in Table P2906.6 and shall be installed in accordance with manufacturer's instructions. PEX tubing shall be factory marked with applicable fitting standards for the fittings that the PEX manufacturer specifies for use with the tubing.

P2906.18 Joints between different materials. Joints between different piping materials shall be made in accordance with Section P2906.18.1, P2906.18.2, P2906.18.3 or P2906.18.4, or with a mechanical joint of the compression or mechanical sealing type having an elastomeric seal conforming to ASTM D1869 or ASTM F477. Joints shall be installed in accordance with the manufacturer's instructions.

P2906.18.3 Plastic pipe or tubing to other piping material. Joints between different types of plastic pipe or between plastic pipe and other piping material shall be made with an *approved* adapter fitting.

Uniform Plumbing Code (UPC 2024)

301.2.3 Plastic Pipe, Plastic Pipe Fittings, and Components. Plastic pipe, plastic pipe fittings, and components other than those for gas shall comply with NSF/ANSI 14.

312.0 Protection of Piping, Tubing, Materials, and Structures.

312.9 Steel Nail Plates. Plastic piping or tubing, and copper or copper alloy piping or tubing penetrating framing members to within 1 inch (25.4 mm) of the exposed framing shall be protected by steel nail plates not less than No. 18 gauge (0.0478 inches) (1.2 mm) in thickness. The steel nail plate shall extend along the framing member not less than 1 1/2 inches (38 mm) beyond the outside diameter of the pipe or the tubing.

313.0 Hangers, Supports and Anchors.

313.3 Suspended Piping. Suspended piping shall be supported at intervals not to exceed those shown in Table 313.3.

313.4 Alignment. Piping shall be supported in such a manner as to maintain its alignment and prevent sagging.

604. Materials.

604.1 Pipe, Tube, and Fittings. Pipe, tube, fittings, solvent cement, thread sealants, solders, and flux used in potable water systems intended to supply drinking water shall comply with NSF/ANSI/CAN 61. Where pipe fittings and valves are made from copper alloys containing more than 15 percent zinc by weight and are used in plastic piping systems, they shall be resistant to dezincification and stress corrosion cracking in compliance with NSF/ANSI 14.

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 comply with the applicable standards referenced in Table 604.1.

604.10 Plastic Materials. Approved plastic materials shall be permitted to be used in building supply piping, provided that where metal building supply 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, the metallic pipe shall be permitted to be replaced with nonmetallic pipe.

604.10.1 Tracer Wire. Plastic materials for building supply piping outside underground shall have an electrically continuous corrosion-resistant blue insulated copper tracer wire, or other approved conductor, installed adjacent to the piping. Access shall be provided to the tracer wire, or the tracer wire shall terminate above-ground at each end of the nonmetallic piping. The tracer wire size shall be not less than 14 AWG and the insulation type shall be suitable for direct burial.

604.13 Water Heater Connectors. PEX, PEX-AL-PEX, PE-AL-PE, or PE-RT tubing shall not be installed within the first 18 inches (457 mm) of piping connected to a water heater.

605.9 PEX Plastic Tubing and Joints. PEX plastic tubing and fitting joining methods shall be installed in accordance with the manufacturer's instructions and shall comply with Section 605.9.1 through Section 605.9.3.

605.9.1 Fittings. Fittings for PEX tubing shall comply with the applicable standards referenced in Table 604.1. PEX tubing that complies with ASTM F876 shall be marked with the applicable standard designation for the fittings, specified by the tubing manufacturer for use with the tubing.

605.9.2 Mechanical Joints. Mechanical joints shall be installed in accordance with manufacturer's installation instructions.

605.9.3 Push Fit Fittings. Removable and nonremovable push fit fittings that employ a quick assembly push fit connector shall comply with ASSE 1061

605.16.2 Plastic Pipe to Other Materials. Where connecting plastic pipe to other types of piping, approved types of adapter or transition fittings designed for the specific transition intended shall be used.

National Standard Plumbing Code (NSPC 2024)

3.1.3 Standards Applicable to Plumbing Materials. A material shall be considered approved if it is listed or certified by a recognized certification body as complying with one or more of the standards cited in Table 3.1.3, and in the case of plastic pipe, fittings and solvent cement also NSF 14.

3.4.1.1 Plastic Piping. Plastic piping materials used for the conveyance of potable water shall comply with NSF 14 and be marked accordingly.

3.4.2 Water Service Piping. Water service piping to the building water supply control valve shall be of materials listed in Table 3.4, and shall be water pressure rated not less than 160 psi at 73°F. *See Table 3.4.2*. Water service pipe and pipe fittings shall comply with NSF 61.

NOTE: The working pressure rating of plastic pipe varies depending on the water temperature, plastic composition, dimension ratio or pipe schedule and size, and method of joining. Refer to Table 3.4.2 for plastic piping suitable for water service.

3.4.3 Water Distribution Piping. Water piping for the distribution of hot and cold water within buildings shall be of materials listed in Table 3.4 and shall be water pressure rated for not less than 100 psi at 180°F and 160 psi at 73°F. Plastic piping used for hot water distribution shall be installed in accordance with the requirements of Section 10.15.8. Water distribution pipe and pipe fittings shall comply with NSF 61.

NOTE: The working pressure rating of plastic pipe varies depending on the water temperature, plastic composition, dimension ratio or pipe schedule and size, and method of joining. Refer to Table 3.4.3.

3.4.4 Fittings.

a. Fittings for water supply piping shall be compatible with the pipe material used.

b. Insert fittings for plastic tubing shall be the metallic or plastic type that comply with the standards listed in Table 3.1.3.

8.7 Support of Plastic Pipe.

a. Plastic drain, waste, vent, and pressure pipe shall be installed and supported as recommended by the manufacturer's instructions.

b. Maximum horizontal support spacing shall be based on the pipe schedule or wall thickness, the pipe size, the system operating temperature, the ambient temperature, and any concentrated loads.

c. Vertical pipe shall be maintained in straight alignment with supports at each story height. Intermediate supports shall be provided where required for stability.

d. Pipe shall also be supported at changes of direction or elevation.

e. Supports shall not compress, distort, cut, or abrade the piping and shall allow free movement.

f. Provisions shall be made for expansion and contraction of the piping.

10.5.9 Protection from Fire Systems.

Exceptions:

(2) Backflow preventers shall not be required in NFPA 13D multipurpose or network residential fire sprinkler systems that supply both plumbing fixtures and residential fire sprinklers. The piping in such systems shall be approved for potable water. Such systems shall not have a fire department connection.

10.15.8 Plastic Piping.

a. Plastic piping used for hot water distribution shall conform to the requirements of Section 3.4.3 and Table 3.4.3. Piping shall be water pressure rated for not less than 160 psi at 73°F and 100 psi at 180°F.

NOTE: The working pressure rating for plastic piping varies depending on material composition, dimension ratio or pipe schedule and size, and method of joining. *See Table 3.4.3*.

b. Plastic piping shall not be used downstream from instantaneous water heaters, immersion water heaters, and other heaters not having approved temperature safety devices.

c. Plastic piping shall not be installed within six inches of the exhaust flues for gravity-vented gas-fired equipment and similar high temperatures.

d. The operating pressure in water distribution piping systems utilizing approved plastic piping shall not be more than 80 psi. When necessary, one or more pressure reducing valves shall be provided to regulate the hot and cold water supply pressure to not more than 80 psi. Ref to Section 10.14.6.

National Plumbing Code of Canada (NPCC 2025)

2.2.5.6. Crosslinked Polyethylene Pipe and Fittings

1) Crosslinked polyethylene pipe and manufacturer-approved fittings used in hot and cold *potable water systems* shall conform to CSA 137.5, "Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications" (See Note A-2.2.5.6(1))

2.3.4.4 Support for Vertical Piping.

1) Except as provided in Sentence (2), vertical piping shall be supported at its base and at the floor level of alternate storeys by rests, each of which can bear the weight of pipe that is between it and the rest above.

2) The maximum spacing of supports shall be 7.5 m.

2.3.4.5 Support for Horizontal Piping.

1) Nominally horizontal piping that is inside a building shall be braced to prevent swaying and buckling and to control the effects of thrust.

2) Nominally horizontal piping shall be supported as stated in Table 2.3.4.5 (PEX = 0.8 m)

4) Where PEX , PE-RT, PP-R, PE/AL/PEX or PEX/AL/PEX plastic pipe or tube is installed, hangers shall not compress, cut or abrade the pipe.

A-2.2.5.6(1) Crosslinked Polyethylene Pipe and Fittings. There are some special installation requirements for the use of crosslinked polyethylene pipe and its associated fittings. Reference should, therefore, be made to the installation information in CSA B137.5, "Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications."

2.3.4.6 Support for Underground Horizontal Piping

1) Except as provided in Sentence (2), nominally horizontal piping that is underground shall be supported on a base that is firm and continuous under the whole run of pipe. (See Note: A-2.3.4.6(1).)

2) Nominally horizontal piping installed underground that is not supported as described in Sentence (1) may be installed using hangers fixed to a foundation or structural slab provided that the hangers are capable of

a) keeping the pipe in alignment, and

b) supporting the weight of

i. the pipe,
ii. its contents, and
iii. the fill over the pipe.

2.6.3.1 Design, Fabrication & Installation

(See Note A-2.6.3)

1) *Water distribution systems* shall be designed to provide peak demand flow when the flow pressures at the supply openings conform to the plumbing supply fitting manufacturer's specifications.

2) *Potable water systems* shall be designed, fabricated and installed in accordance with good engineering practice, such as that described in the ASHRAE Handbooks and ASPE Plumbing Engineering Design Handbooks (See Note A-2.6.3.1(2).)

3) In one- and two-family dwelling units and manufactured homes, multi-purpose systems that combine *potable water systems* and residential fire sprinkler systems shall be designed, fabricated and installed in accordance with NFPA 13D, "Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes."

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