



Standard Specification for Push-Fit Crosslinked Polyethylene (PEX) Mechanical Fittings for Crosslinked Polyethylene (PEX) Tubing¹

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1. Scope

1.1 This specification covers crosslinked polyethylene (PEX) push-fit mechanical fittings for use with crosslinked polyethylene (PEX) tubing in $\frac{1}{2}$, $\frac{3}{4}$, 1 and 1 $\frac{1}{4}$ in. nominal diameters that meet the requirements of Specification F876. These fittings are intended for use in residential and commercial, hot and cold, potable water distribution systems as well as hydronic heating, including under-floor heating systems, up to and including 100 psig (6.90 bar) and 180°F (82°C). Included are the requirements for materials, workmanship, dimensions, performance, and markings to be used on the fittings.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 The text of this specification references notes, footnotes, and appendixes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the specification.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

- A269 Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- A276 Specification for Stainless Steel Bars and Shapes

- A312/A312M Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
- A351/A351M Specification for Castings, Austenitic, for Pressure-Containing Parts
- B16/B16M Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
- B140/B140M Specification for Copper-Zinc-Lead (Red Brass or Hardware Bronze) Rod, Bar, and Shapes
- B283 Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed)
- B371/B371M Specification for Copper-Zinc-Silicon Alloy Rod
- B395/B395M Specification for U-Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes
- D618 Practice for Conditioning Plastics for Testing
- D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- D1505 Test Method for Density of Plastics by the Density-Gradient Technique
- D1599 Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings
- D1600 Terminology for Abbreviated Terms Relating to Plastics
- D2000 Classification System for Rubber Products in Automotive Applications
- D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
- D2765 Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics
- D6284 Test Method for Rubber Property—Effect of Aqueous Solutions with Available Chlorine and Chloramine
- D6394 Specification for Sulfone Plastics (SP)
- F412 Terminology Relating to Plastic Piping Systems
- F876 Specification for Crosslinked Polyethylene (PEX) Tubing
- F877 Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems
- F2023 Test Method for Evaluating the Oxidative Resistance of Crosslinked Polyethylene (PEX) Tubing and Systems to Hot Chlorinated Water

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

2.2 PPI Standards:³

PPI TR-3 Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe

2.3 NSF Standard:⁴

NSF Standard No. 14 for Plastic Piping Components and Related Materials

2.4 EN Standards:⁵

EN 12164 Copper and copper alloys - Rod for free machining purposes

EN 12165 Copper and copper alloys - Wrought and unwrought forging stock

EN 12168 Copper and copper alloys - Hollow rod for free machining purposes

2.5 ISO Standard:⁶

ISO 9080 Plastics piping and ducting systems -- Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation

3. Terminology

3.1 Definitions are in accordance with Terminology **F412** and abbreviations are in accordance with Terminology **D1600**, unless otherwise indicated.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *push-fit fitting*—A type of fitting that joins pipes that are not caulked, threaded, soldered, cemented, brazed or welded. These joints consist of elastomeric seals and tube grippers. Such joints must be installed in accordance to the manufacturer's instructions.

4. Classification

4.1 This specification covers PEX bodied push-fit fittings suitable for use with PEX tubing that meets the requirements of Specification **F876**.

5. Materials and Manufacture

5.1 *Fitting Body*—The fitting body shall be made from crosslinked polyethylene compounds suitable for elevated temperature pressure service.

NOTE 1—Since fittings specified by this standard will be used in hot and cold water plumbing systems, a material used to manufacture fittings in accordance with this specification must demonstrate qualities consistent with that application in addition to the fitting performance requirements of this specification. Those qualifying characteristics include, but are not limited to, an established hydrostatic design basis (HDB) or stress design basis (SDB) in accordance with PPI TR-3, or an ISO 9080 compliant minimum required stress (MRS), or similar rating.

³ Available from Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, <http://www.plasticpipe.org>.

⁴ Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140, <http://www.nsf.org>.

⁵ Available from European Committee for Standardization (CEN), 36 rue de Stassart, B-1050, Brussels, Belgium, <http://www.cenorm.be>.

⁶ Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, <http://www.iso.ch>.

5.2 *Tubular Stiffener*—If required by the manufacturer, a tubular stiffener shall be used. It shall support the PEX tubing at least in the areas of sealing and gripping. Split stiffeners shall not be used. The stiffener shall be made from one of the following:

5.2.1 *Machined Brass*—Machined brass stiffeners shall be made from material meeting the requirements of Specification **B371/B371M** copper alloy UNS No. C69300, Specification **B140/B140M** copper alloy UNS No. C31400, Specification **B283** copper alloy UNS No. C37700, Specification **B16/B16M** copper-alloy UNS C36000 or copper alloy UNS C38500 or DIN 17660 – CuZn39Pb3, Standard EN 12168 copper Alloy CW614N, Standard EN 12164 copper Alloy CW614N or copper alloy UNS No. C35330, or Standard EN 12165 copper Alloy CW617N.

5.2.2 *Machined Stainless Steel*—Machined stainless steel stiffeners shall be made from material meeting the requirements of Specification **A312/A312M** stainless steel alloy 304, 304L, 316 or 316L, (UNS Nos. S30400, S30403, S31600 or S31603), Specification **A269** stainless steel alloy 304, 304L, 316, 316L (UNS Nos. S30400, S30403, S31600 or S31603), Specification **A276** stainless steel alloy 304, 401L, 316, or 316L (UNS Nos. S30400, S30403, S31600 or S31603), or Specification **A351/A351M** stainless steel UNS No. J92800.

5.2.3 *Polysulfone*—Polysulfone stiffeners shall be molded from sulfone plastic (SP) as specified in Specification **D6394**. The material shall be unreinforced polysulfone (group 01, class 1, grade 0).

5.3 *O-rings*—O-rings shall be made from an elastomeric material with a minimum tensile strength of 1450 psi (10.0 MPa) as classified in Classification **D2000** and shall meet the performance requirements of **6.10**.

5.4 *Tube grippers*—Metallic components in the tube grippers shall be made of Series 300 stainless steel.

5.5 *Potable Water Requirements*—Products intended for contact with potable water shall be evaluated, tested, and certified for conformance with the health effects portion of NSF Standard No. 14 by an acceptable certifying organization when required by the regulatory authority having jurisdiction.

6. Performance Requirements

6.1 *General*—Unless otherwise stated, all performance tests shall be performed on the number of fittings required to obtain six mechanical ends assembled with PEX tubing. PEX tubing used for testing purposes shall meet the requirements of Specification **F876**. All assemblies used for test specimens shall be assembled in accordance with the fitting manufacturer's written installation instructions. Use separate sets of assemblies for each performance test requirement with the exception of **6.4**.

6.2 All applicable fitting requirements of Specification **F877**, Section 6 *Requirements*, shall be met.

6.3 *Dimensions*—Any randomly selected fitting or fittings shall be used to determine dimensions. Measurements shall be made in accordance with Test Method **D2122**.

6.4 *Oxidative Stability in Potable Chlorinated Water Applications*—Fittings component(s) being tested for chlorine resistance shall not fail when tested in accordance with 8.4.

6.5 *Density*—When determined in accordance with 8.5, the PEX fitting body shall have a minimum density of 926 kg/m³.

6.6 *Degree of Crosslinking*—When tested in accordance with 8.6, the degree of crosslinking for the PEX body shall be within the range from 60 to 89% inclusive.

6.7 *Water-hammer*—Fitting assemblies shall not pull-out or leak when tested in accordance with 8.7.

6.8 *Pull-out*—Fitting assemblies shall not pull-out or leak when tested in accordance with 8.8.

6.9 *Bending*—Fitting assemblies shall not leak when tested in accordance with 8.9

6.10 O-rings:

6.10.1 *Effect of Aqueous Solution of Chloramine*—When tested in accordance with 8.10, the o-rings shall have a maximum change in volume of 30% and a maximum change in hardness of 6.

6.10.2 *Compression Set*—When tested in accordance with 8.11, the compression set shall not exceed the values in Table 1.

7. Dimensions

7.1 *Dimensions and Tolerances*—The minimum dimensions of the fitting shall be as shown in Table 2. All other dimensions and tolerances shall be determined by the manufacturer. The dimensions and tolerances of the fittings and stiffeners covered by this specification must be such that mechanical joining is possible to outside diameter (OD) controlled Specification F876 PEX tubing such that the joints will satisfy the performance requirements in Section 6.

8. Test Methods

8.1 *General*—Unless otherwise stated, test each size of fitting. If the fitting end design is the same for elbows, tees, caps and transition fittings, one such design need only be evaluated, with preference to straight connectors.

8.2 *Conditioning*—Condition test specimens at 73.4 ± 3.6°F (23 ± 2°C) for not less than 40 h for specimens 7 mm or under in thickness and not less than 88 h for specimens over 7 mm prior to test in accordance with Practice D618, for those tests where conditioning is required.

8.3 *Test Conditions*—Conduct the tests in the standard laboratory atmosphere of 73.4 ± 3.6°F (23 ± 2°C), unless otherwise specified in the test methods or in this specification.

TABLE 1 Compression Set Maximum %

O-ring Cross-Section mm	Maximum Compression Set %
3.0 to < 4.0	40
≥ 4.0	35

TABLE 2 Fitting Dimensions

Size, in.	Minimum Wall thickness (A), in. ^A	Minimum Inner Diameter (B), in. ^A
½	0.140	0.490
¾	0.195	0.685
1	0.250	0.880
1¼	0.305	1.075

^A Of the wetted surface between pipe ends.

8.4 *Oxidative Stability in Potable Chlorinated Water Applications*—The test shall be conducted in accordance with the test conditions in Sections 6 through 12 of Test Method F2023.

8.4.1 *Procedure*—Select at least six fittings from randomly selected specimens and assemble each fitting per the fitting manufacturer's written installation instructions with a minimum of 6 in. length of PEX tubing between fittings. Testing shall be performed with ½ in. straight connectors.

8.4.1.1 Test each assembly at 239°F (115°C) and 60 psig (4.14 bar).

8.4.1.2 Test the assemblies for 3000 h. If the PEX tubing fails outside the area of the tube gripper prior to 3000 h, replace the PEX tubing specimen and continue testing of the assembly. Any loss of fluid from the wetted component(s) or failure of the PEX tubing at the tube gripper constitutes a failure. Failure of non-wetted components of the fitting does not constitute a failure of the test. The failed component shall be replaced and the test continued.

8.4.1.3 Once each assembly has reached 3000 h, test the fitting at 73°F and 180°F in accordance with Test Method D1599, Procedure B and the Hydrostatic Burst Requirements of Specification F877. Three fittings shall be tested at each temperature. Testing shall be performed with untested PEX tubing. The tested assemblies shall meet the minimum hydrostatic burst requirements of Specification F877.

8.5 *Density*—Determine the density of the fitting PEX compound in accordance with Test Method D1505 or Test Method D792. Sample from the fitting wall without remolding. Perform the test in triplicate from a single fitting.

8.6 *Degree of Crosslinking*—Place a fitting sample in a lathe with automatic feeding. Shave a strip that consists of the full wall thickness. The strip thickness shall be approximately 0.004 in. (0.1 mm) which is obtained by setting the lathe feeding accordingly. Test the specimens in accordance with Test Methods D2765 Method B, with the only deviation: test specimen preparation. For the purpose of this specification, degree of crosslinking (V) is defined as 100 % minus extract percent equals V. Perform the test in duplicate from a single fitting.

NOTE 2—This method provides a test method for measuring the average degree of crosslinking over the fitting wall thickness. That, however, does not mean that the degree of crosslinking is allowed to vary outside the limits for the grade in question at any part of the fitting. In case of disagreement, strips of the same thickness, 0.004 in. (0.1 mm), can be taken in tangential, axial, or radial direction at any angle section or wall thickness depth, or both, etc. to measure the degree of crosslinking.

8.7 *Water-hammer*—Select one randomly selected fitting and assemble per the fitting manufacturer's written installation instructions with lengths of PEX tubing a minimum of 12 in. long.

8.7.1 Hydrostatically pressurize the fitting assembly to 15 ± 5 psig (1.03 ± 0.34 bar).

8.7.2 Increase the pressure in the system within 0.01 ± 0.005 seconds from 15 ± 5 psig (1.03 ± 0.34 bar) to 375 ± 30 psig (25.86 ± 2.07 bar). Return to 15 ± 5 psig (1.03 ± 0.34 bar). The pressure shall be increased to 375 ± 30 psig (25.86 ± 2.07 bar) every 2 seconds.

8.7.3 Test the assembly for 10,000 cycles.

8.8 *Pull-out:*

8.8.1 Fitting assemblies shall be assembled per the fitting manufacturer's written installation instructions with a minimum PEX tubing length of 12 in.

8.8.2 Fitting assemblies shall be subjected to a dead-weight load for a period of 1 h, followed by an air leak test performed at 100 psig (6.90 bar). The loads shall be as follows: $\frac{1}{2}$ Nominal Tube Size (NTS) – 150 lbf, $\frac{3}{4}$ NTS – 275 lbf, 1 NTS – 475 lbf, 1 $\frac{1}{4}$ NTS – 700 lbf.

8.9 *Bending:*

8.9.1 Fitting assemblies shall be assembled per the fitting manufacturer's written installation instructions with a minimum PEX tubing length of 15 in.

8.9.2 Hydrostatically pressurize the assembly to 375 ± 5 psig (25.86 ± 0.34 bar).

8.9.3 Clamp or retain the body of the fitting and bend the tubing to a radius of 10-times the outside diameter of the tubing to an angle of 15° (from the un-bent configuration), ensuring that the tubing does not kink, and hold for 15 minutes.

8.10 *Effect of Aqueous Solution of Chloramine*—Determine the change in volume and the change in hardness in accordance with Test Method **D6284**. Perform the test for 502 hours with a 50 ppm chloramine solution.

8.11 *Compression Set*—Determine the compression set percentage in accordance with Test Method **B395/B395M**. Perform the test for 70 hours at 302°F (150°C).

9. Workmanship, Finish, and Appearance

9.1 The fittings shall be made from compounds that are homogeneous throughout. All sealing surfaces shall be smooth and free of foreign material. The fitting walls shall be free of cracks, holes, blisters, voids, foreign inclusions, or other defects that are visible to the naked eye and that affect wall integrity.

10. Product Marking

10.1 *Quality of Marking*—The marking shall be applied to the fittings in such a manner that it remains legible after installation and inspection.

10.2 *Content of Marking:*

10.2.1 Marking on packaging shall include manufacturer's name or trademark, nominal fitting size, and ASTM F2854.

10.2.2 Marking on fittings shall include manufacturer's name or trademark, nominal fitting size and when space permits, ASTM F2854.

10.2.2.1 Where indent marking is used on fittings, care shall be taken to see that the marking shall not cause cracks or reduce the wall thickness below the minimum specified by the manufacturer.

11. Quality Assurance

11.1 When the product or product packaging is marked with the ASTM designation F2854, the manufacturer affirms that the product was manufactured, inspected, sampled, and tested in accordance with this specification and has been found to meet the requirements of this specification.

12. Keywords

12.1 crosslinked polyethylene; hot- and cold- water distribution; mechanical fitting; PEX; PEX fitting; push-fit

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