



# Standard Specification for Push-Fit Crosslinked Polyethylene (PEX) Mechanical Fittings for Crosslinked Polyethylene (PEX) Tubing<sup>1</sup>

This standard is issued under the fixed designation F2854; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.10 on Fittings. Current edition approved May 1, 2021. Published May 2021. Originally approved in 2010. Last previous edition approved in 2020 as F2854–20a. DOI: 10.1520/F2854–21.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

- A269/A269M Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- A276/A276M 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/B283M 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

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

\*A Summary of Changes section appears at the end of this standard

- D2765** Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics
- D2837** Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
- D6284** Test Method for Rubber Property—Effect of Aqueous Solutions with Available Chlorine and Chloramine
- D6394** Classification System for and Basis for 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) Pipe, Tubing and Systems to Hot Chlorinated Water
- F2159** Specification for Plastic Insert Fittings Utilizing a Copper Crimp Ring, or Alternate Stainless Steel Clamps for SDR9 Crosslinked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing
- F2735** Specification for Plastic Insert Fittings For SDR9 Cross-linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing
- F3348** Specification for Plastic Press Insert Fittings with Factory Assembled Stainless Steel Press Sleeve for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing
- 2.2 PPI Standards:**<sup>3</sup>
- 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:**<sup>4</sup>
- NSF Standard No. 14** for Plastic Piping Components and Related Materials
- 2.4 EN Standards:**<sup>5</sup>
- 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 Standards:**<sup>6</sup>
- ISO 9080** Plastics piping and ducting systems -- Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation

**ISO 12162** Thermoplastics materials for pipes and fittings for pressure applications –Classification, designation and design coefficient

### 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.

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. C69850 or UNS No. C69300, Specification **B140/B140M** copper alloy UNS No. C31400, Specification **B283/B283M** 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/A269M** stainless steel alloy 304, 304L, 316, 316L (UNS Nos. S30400, S30403, S31600 or S31603), Specification **A276/A276M** stainless steel alloy 304, 401L, 316, or 316L (UNS Nos. S30400, S30403, S31600 or S31603), or Specification **A351/A351M** stainless steel UNS No. J92800.

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

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

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

<sup>6</sup> 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>.

5.2.3 *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).

NOTE 2—Since fittings specified by this standard will be used in hot-and-cold water plumbing systems (also noted for Specifications F2159, F2735, and F3348), a material used to manufacture fittings in accordance with this specification must demonstrate qualities consistent with that application in addition to the performance requirements of this specification. Those qualifying characteristics include, but are not limited to, an established hydrostatic design basis (HDB) in accordance Test Method D2837 or ISO 9080/ ISO 12162 compliant minimum required stress (MRS) and a demonstration of resistance to the long-term effects of those chemicals normally found in potable water at the maximum temperature stated in this specification.

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/m<sup>3</sup>.

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.

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.

TABLE 1 Compression Set Maximum %

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