



Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing¹

This standard is issued under the fixed designation F1960; 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 (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This specification covers cold expansion fittings and cross-linked (PEX) reinforcing rings for use with cross-linked polyethylene (PEX) plastic tubing in nominal tubing sizes of $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, 1, $1\frac{1}{4}$, $1\frac{1}{2}$ in., 2, $2\frac{1}{2}$, and 3 in. nominal diameters that meet the requirements of Specifications **F876** and for use with Polyethylene of Raised Temperature (PE-RT) pipe in nominal tubing sizes of $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, 1, $1\frac{1}{4}$, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, and 3 that meet the requirements of Specification **F877**/**F2769**. These fittings are intended for use in 100 psi (690 kPa) cold- and hot-water distribution systems operating at temperatures up to and including ~~180°F (82°C)~~ 180 °F (82 °C). The system is comprised of a PEX reinforcing ring and a cold expansion fitting. Included are the requirements for materials, workmanship, dimensions, and markings to be used on the fitting components. The components covered by this specification are intended for use in residential and commercial, hot and cold, potable water distribution systems as well as sealed central heating, including under-floor-heating systems.

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

1.4 *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.*

2. Referenced Documents

- 2.1 *ASTM Standards:*²
- [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](#)
 - [B62 Specification for Composition Bronze or Ounce Metal Castings](#)
 - [B75/B75M Specification for Seamless Copper Tube](#)
 - [B283/B283M Specification for Copper and Copper-Alloy Die Forgings \(Hot-Pressed\)](#)
 - [B371/B371M Specification for Copper-Zinc-Silicon Alloy Rod](#)
 - [B453/B453M Specification for Copper-Zinc-Lead Alloy \(Leaded-Brass\) Rod, Bar, and Shapes](#)
 - [B584 Specification for Copper Alloy Sand Castings for General Applications](#)
 - [B927/B927M Specification for Brass Rod, Bar, and Shapes](#)
 - [B967/B967M Specification for Copper-Zinc-Tin-Bismuth Alloy Rod, Bar and Wire](#)
 - [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](#)
 - [D1600 Terminology for Abbreviated Terms Relating to Plastics](#)
 - [D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings](#)

¹ 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 April 1, 2015/Oct. 1, 2018, Published May 2015/October 2018. Originally approved in 1999. Last previous edition approved in 2014/2015 as **F1960 – 14a**/**F1960 – 15**. DOI: 10.1520/F1960-15-10.1520/F1960-18.

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.

*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
- D3035 Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
- 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
- F2769 Specification for Polyethylene of Raised Temperature (PE-RT) Plastic Hot and Cold-Water Tubing and Distribution Systems

2.2 *ANSI Standard:*

- B1.20 Pipe Threads General Purpose³
- B16.18 Cast Copper Alloy Solder Joint Pressure Fittings
- B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

2.3 *NSF Standards:*

- NSF 14 for Plastic Piping Components and Related Materials⁴
- NSF 61 for Drinking Water System Components-Health Effects⁴

2.4 *Manufacturers' Standardization Society Standards:*

- SP-104 Wrought Copper Solder Joint Pressure Fittings⁵

3. Terminology

3.1 *Definitions:*

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

3.1.2 *PEX reinforcing rings*—cross-linked polyethylene rings used to add contraction force around the cold expansion fittings.

4. Classification

4.1 This specification covers one class of cold expansion fittings with PEX reinforcing rings suitable for use with PEX tubing that meets the requirements of Specifications F876 and with PE-RT tubing that meets the requirements of Specification F877F2769.

5. Materials and Manufacture

5.1 Cold expansion fittings shall be made from one of the following materials:

5.1.1 Brass:

5.1.1.1 *Machined Brass*—Machined brass fittings shall be made from material meeting the requirements of one of the following listed below:

Specification	Alloy
ASTM B16/B16M	UNS C36000
ASTM B140/B140M	UNS C31400
ASTM B371/B371M	UNS C69300
Standard EN 12164	CW614N
ASTM B453/B453M	UNS C35300
ASTM B927/B927M	UNS C27450, C27451
ASTM B967/B967M	UNS C49260, C49340

5.1.1.2 *Forged Brass*—Forged brass fittings shall be made from material meeting the requirements of Specification B283/B283M, Copper Alloy UNS Nos. C27450, C27451, C27453, C35330, C36500, C37700, C46400, C48600, C49260, C49340, or C69300.

5.1.1.3 *Cast Copper Alloys*—Cast copper alloy fittings shall be made from material meeting the requirements of Specification B584, Copper Alloy UNS Nos. C84400, C83800, C87850 or C89844 or C89836 or Specification B62, Copper Alloy UNS No. C83600, or Standard EN 1982, copper alloy EN Symbol CuSn4Zn6Pb3–C.

5.1.2 *Sulfone:*

5.1.2.1 *20 % Glass-Filled Polysulfone*—Polysulfone fittings produced using glass reinforcement shall be molded from polysulfone materials as specified in Specification D6394. The polymers shall consist of polysulfone and glass fiber and meet the following line call out for additional properties (SP0113G20A30430).

5.1.2.2 *Unreinforced Sulfone Plastic (SP)*—Fittings shall be molded from sulfone plastic (SP) as specified in Specification D6394. The material shall be unreinforced polysulfone (group 01, class 1, grade 2), or polyphenylsulfone (group 3, class 1, grade 2.) Material may also be an unreinforced blend of these two materials with the polyphenylsulfone continuous phase comprising 55 to 80% of the blend.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.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 Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 127 Park St., NE, Vienna, VA 22180-4602, <http://www.mss-hq.com>.

5.1.2.3 Clean rework material of the same commercial designation, generated for the manufacturer's own production may be used by the same manufacturer, provided the fittings meet all of the requirements of this specification. Rework material shall not be introduced at a ratio exceeding 25%.

5.2 Reinforcing rings shall be made from PEX material meeting the performance requirements of 6.1.

5.3 *Stainless Steel*—fittings shall be made from material meeting the requirements of Specification **A351/A351M**, stainless steel UNS No. J92800.

5.4 *Wrought Copper*—Wrought copper fittings shall be made from material meeting the requirements of Specification **B75/B75M** for one of the following coppers: copper UNS C10200, C10300, C10800, or C12200.

6. General Requirements

6.1 The following sections of Specification **F877** constitute a part of this specification:

- 6.1.1 Requirements,
- 6.1.2 Test Methods, and
- 6.1.3 Retest and Rejection.

6.2 In addition, when a section with a title identical to that referenced in 6.1, above, appears in this specification, it contains additional requirements that supplement those appearing in **F877**.

6.1 ~~System Performance Requirements—General~~—All performance tests shall be performed on assemblies of fittings, PEX reinforcing rings and PEX or PE-RT tubing. Fittings and reinforcing rings shall meet the material and dimensional requirements of this specification. PEX tubing shall meet the requirements of Specifications **F876**. PE-RT tubing shall meet the requirements of Specification **F2769**. Assembly of test specimens shall be in accordance with 10.1. Each assembly shall contain at least two joints. Use separate sets of assemblies for each performance test requirement.

6.1.1 ~~General~~—All performance tests shall be performed on assemblies of fittings, PEX reinforcing rings and PEX tubing. Fittings and reinforcing rings shall meet the material and dimensional requirements of this specification. PEX tubing shall meet the requirements of Specifications Fitting manufactured according to this specification and intended for use with PEX tubing meeting requirements of Specification **F876** and, shall comply with the following performance requirements of Specification **F877**. Assembly of test specimens shall be in accordance with 10.1. Each assembly shall contain at least two joints. Use separate sets of assemblies for each performance test requirement. When a section with an identical title appears in this specification, it contains additional requirements that supplement those found in Specification **F877**.

- 6.1.1.1 Requirements,
- 6.1.1.2 Test Methods, and
- 6.1.1.3 Retest and Rejection.

6.1.2 ~~Dimensions~~—Any randomly selected fitting or fittings and PEX reinforcing rings shall be used to determine dimensions. Measurements shall be made in accordance with Test Method Fittings, manufactured according to this specification and intended for use with PE-RT tubing meeting the requirements of Specification **D2122****F2769**, except determine diameter by making measurements at four locations spaced at approximately 45° apart around the circumference. Inspection and gauging of solder shall comply with the following performance requirements of Specification **F2769**. Joint ends shall be accordance with ANSI B16.18, ANSI B16.22, or Manufacturers' Standardization Society SP-104. When a section with an identical title appears in this Specification, it contains additional requirements that supplement those found in Specification **F2769**.

- 6.1.2.1 Requirements,
- 6.1.2.2 Test Methods, and
- 6.1.2.3 Retest and Rejection.

6.2 ~~Dimensions~~—Any randomly selected fitting or fittings and PEX reinforcing rings shall be used to determine dimensions. Measurements shall be made in accordance with Test Method **D2122**, except determine diameter by making measurements at four locations spaced at approximately 45° apart around the circumference. Inspection and gauging of solder joint ends shall be accordance with ANSI B16.18, ANSI B16.22, or Manufacturers' Standardization Society SP-104.

7. Performance Requirements

7.1 *PEX Reinforcing Rings*:

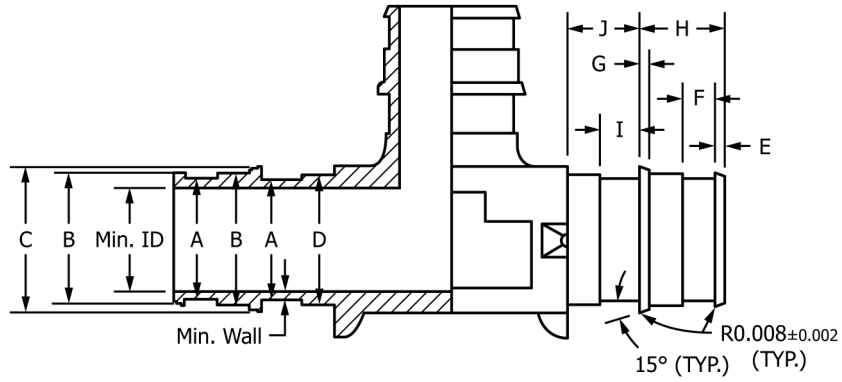
7.1.1 *Density*—When determined in accordance with 11.1, the PEX reinforcing rings shall have a density in the range from 926 to 940 kg/m³.

7.1.2 *Degree of Cross-linking*—When tested in accordance with 11.2, the degree of cross-linking for PEX reinforcing rings shall be within the range from 70 to 89% inclusive.

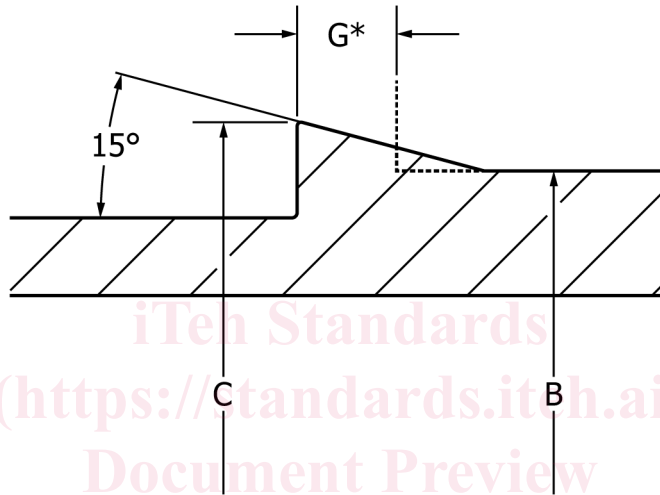
7.1.3 *Stabilizer Migration Resistance*—When tested in accordance with 11.3, the time t^2 , shall be at least 50% of the time, t^1 .

8. Dimensions

8.1 *Dimensions and Tolerances*—The dimensions and tolerances of fittings and PEX reinforcing rings shall be as shown in Figs. 1 and 2, and Fig. 4 when measured in accordance with 6.3.26.2.



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*Maximum width of dimension "G" allowed to transition to surface of dimension "B"

Brass, Stainless Steel and Wrought Copper Dimensions

SizeNominal Tubing Sizes	Min. Wall	Min. ID	A max min	B max min	C max min	D max min	E max min	F max min	G min	H max min	I max min	J max min
3/8 in. 3/8	0.047	0.260	0.395	0.441	0.480	0.427	0.067	0.128		0.325	0.127	0.286
	0.047	0.260	0.395	0.441	0.480	0.427	0.067	0.128		0.325	0.127	0.286
			0.375	0.433	0.472	0.407	0.051	0.108	0.051	0.305	0.107	0.266
1/2 in. 1/2	0.057	0.378	0.533	0.579	0.618	0.565	0.067	0.128		0.404	0.167	0.325
	0.057	0.378	0.533	0.579	0.618	0.565	0.067	0.128		0.404	0.167	0.325
			0.513	0.571	0.610	0.545	0.051	0.108	0.051	0.384	0.147	0.305
5/8 in. 5/8	0.057	0.500	0.655	0.697	0.748	0.683	0.067	0.167		0.482	0.207	0.404
	0.057	0.500	0.655	0.697	0.748	0.683	0.067	0.167		0.482	0.207	0.404
			0.635	0.689	0.740	0.663	0.051	0.147	0.051	0.462	0.187	0.384
3/4 in. 3/4	0.057	0.595	0.748	0.795	0.874	0.782	0.067	0.207		0.522	0.246	0.443
	0.057	0.595	0.748	0.795	0.874	0.782	0.067	0.207		0.522	0.246	0.443
			0.728	0.787	0.866	0.762	0.051	0.187	0.051	0.502	0.226	0.423
1 in. 1	0.072	0.795	0.985	1.032	1.110	0.998	0.067	0.246		0.640	0.285	0.561
	0.072	0.795	0.985	1.032	1.110	0.998	0.067	0.246		0.640	0.285	0.561
			0.965	1.024	1.102	0.978	0.051	0.226	0.051	0.620	0.265	0.541
1 1/4 in. 1 1/4	0.075	0.960	1.159	1.276	1.362	1.237	0.080	0.299		0.781	0.348	0.684
	0.075	0.960	1.159	1.276	1.362	1.237	0.080	0.299		0.781	0.348	0.684
			1.139	1.266	1.352	1.217	0.064	0.279	0.064	0.761	0.328	0.664
1 1/2 in. 1 1/2	0.095	1.084	1.324	1.382	1.494	1.349	0.093	0.351		0.919	0.408	0.805
	0.095	1.084	1.324	1.382	1.494	1.349	0.093	0.351		0.919	0.408	0.805
			1.304	1.374	1.486	1.329	0.077	0.331	0.077	0.899	0.388	0.785
2 in. 2	0.095	1.550	1.800	1.958	2.079	1.891	0.093	0.467		1.137	0.521	1.030
	0.095	1.550	1.800	1.958	2.079	1.891	0.093	0.467		1.137	0.521	1.030