



Standard Specification for Cold-Expansion Fittings with Metal Compression-Sleeves for Crosslinked Polyethylene (PEX) Pipe and SDR9 Polyethylene of Raised Temperature (PE-RT) Pipe¹

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1. Scope*

1.1 This specification covers cold-expansion fittings using metal compression-sleeves for use with crosslinked polyethylene (PEX) plastic pipe in $\frac{3}{8}$ -in., $\frac{1}{2}$ -in., $\frac{5}{8}$ -in., $\frac{3}{4}$ -in., 1-in., 1 $\frac{1}{4}$ -in., 1 $\frac{1}{2}$ -in., and 2 in. nominal diameters, meeting the requirements of Specification F876 and for use with Polyethylene of Raised Temperature (PE-RT) pipe in $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, 1, 1 $\frac{1}{4}$, nominal diameters meeting the requirements of Specification F2769, whereby the pipe is cold-expanded before fitting assembly. The components covered by this specification are intended for use in residential and commercial, hot and cold, potable water distribution systems or other applications such as municipal water service lines, radiant panel heating systems, hydronic baseboard heating systems, snow and ice melting systems, geothermal underground pipe systems and building services pipe with continuous operation at pressures up to and including 100 psi (690 kPa), and at temperatures up to and including 180°F (82°C).

1.2 Included in this specification are the requirements for materials, workmanship, dimensions, and markings to be used on the fittings and compression-sleeves. Performance requirements are as referenced in Specification F877 for systems containing PEX pipe and Specification F2769 for systems containing PE-RT pipe.

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

1.4 The following precautionary caveat pertains only to the test method portion, Section 10, of this specification. *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.*

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.

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2. Referenced Documents

2.1 ASTM Standards:²

- A108 Specification for Steel Bar, Carbon and Alloy, Cold-Finished
- 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
- A519 Specification for Seamless Carbon and Alloy Steel Mechanical Tubing
- B16/B16M Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
- B62 Specification for Composition Bronze or Ounce Metal Castings
- 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
- B584 Specification for Copper Alloy Sand Castings for General Applications
- B689 Specification for Electroplated Engineering Nickel Coatings
- B851 Specification for Automated Controlled Shot Peening of Metallic Articles Prior to Nickel, Autocatalytic Nickel, or Chromium Plating, or as Final Finish
- D1600 Terminology for Abbreviated Terms Relating to Plastics
- D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
- F412 Terminology Relating to Plastic Piping Systems
- F876 Specification for Crosslinked Polyethylene (PEX) Tubing

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

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 *ASME Standards:*

B1.20.1 Pipe Threads General Purpose (Inch)³

B16.18 Cast Copper Alloy Solder Joint Pressure Fittings (Inch)³

B16.22 Wrought Copper Alloy Solder Joint Pressure Fittings (Inch)³

2.3 *NSF Standards:*

Standard No. 14 for Plastic Piping Components and Related Materials⁴

Standard No. 61 for Drinking Water System Components—Health Effects⁴

2.4 *MSS Standard:*

SP-104 Wrought Copper Solder Joint Pressure Fittings⁵

2.5 *EN Standards:*

EN 12164 Copper and Copper Alloys—Rod for Free Machining Purposes⁶

EN 12165 Copper and Copper Alloys—Wrought and Unwrought Forging Stock⁶

5.1.1 *Machined Brass*—Machined brass cold-expansion fittings shall be made from material meeting the requirements of Specification **B16/B16M**, Copper Alloy UNS C36000, or Specification **B140/B140M**, Copper Alloy UNS C31400, or Specification **B371/B371M**, Copper Alloy UNS C69300, or Specification **B283/B283M**, Copper Alloy UNS C89844, Copper Alloy UNS No. C27450 or Standard EN 12164, Copper Alloy CW614N.

5.1.2 *Machined Stainless Steel*—Machined stainless steel cold-expansion fittings shall be made from material meeting the requirements of Specification **A312/A312M**, stainless steel alloy 304L or 316L, or Specification **A269/A269M**, stainless steel alloy 304L or 316L, or Specification **A276/A276M**, stainless steel alloy 304L or 316L.

5.1.3 *Machined Carbon Steel*—Machined carbon steel cold-expansion fittings shall be made from material meeting the requirements of Specification **A108**, Carbon Steel Alloy 1020 or 1025, or Specification **A519**, Carbon Steel Alloy 1020, or 1025 or 1026.

5.1.4 *Forged Brass*—Forged brass cold-expansion fittings shall be made from material meeting the requirements of Specification **B283/B283M**, Copper Alloy UNS C37700 or UNS C89844, or Copper Alloy UNS No. C27450, or Copper Alloy UNS C69300 or Standard EN 12165, Copper Alloy CW617N.

5.1.5 *Cast Copper Alloys*—Cast copper alloy cold-expansion fittings shall be made from material meeting the requirements of Specification **B62** copper alloy UNS C83600, or Specification **B584**, copper-alloy UNS C83800, C84400 or C89844.

5.2 *Compression-Sleeves*—Metal compression-sleeves shall be made from one of the following materials:

5.2.1 *Machined Brass*—Machined brass compression-sleeves shall be made from material meeting the requirements of Specification **B16/B16M** copper-alloy UNS C36000, or Standard EN 12168, Copper Alloy CW614N, or Copper Alloy UNS No. C27450, or Standard EN 12165, Copper Alloy CW617N, or Specification **B371/B371M**, Copper Alloy UNS C69300.

5.2.2 *Machined Stainless Steel*—Machined stainless steel compression-sleeves shall be made from material meeting the requirements of Specification **A312/A312M**, stainless steel alloy 304L or 316L, or Specification **A269/A269M**, stainless steel alloy 304L or 316L, or Specification **A276/A276M**, stainless steel alloy 304L or 316L.

5.3 *Plating*—Plating of either fitting component with nickel or chrome, or other metal is optional and must fall within the dimensional tolerances of this specification. Plating can not negatively affect the quality of markings or the ability to meet S1.2.

5.3.1 *Nickel Plating*—Application of electroplated nickel coating shall meet the requirements of Specifications **B689** and **B851**.

5.3.2 *Chrome Plating*—Application of electroplated chrome coating shall meet the requirements of Specification **B851**.

3. Terminology

3.1 *Definitions*—Definitions of terms used in this specification 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 *crosslinked polyethylene, n*—a polyethylene material which has undergone a change in molecular structure using a chemical or a physical process whereby the polymer chains are chemically linked

3.2.2 *fitting assembly, n*—comprised of a cold-expansion fitting and a metal compression-sleeve, whereby the pipe is cold-expanded before fitting insertion, and the compression-sleeve is pulled in an axial direction over the pipe.

4. Classification

4.1 This specification covers one class of metal and plastic cold-expansion fittings with metal compression-sleeves suitable for use with PEX pipe that meets the requirements of Specification **F876** or PE-RT pipe that meets the requirements of Specification **F2769**.

5. Materials and Manufacture

5.1 *Fittings*—Cold-expansion fittings shall be made from one of the following materials:

³ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5900, <http://www.asme.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.org>.

⁶ Available from European Committee for Standardization (CEN), 36 rue de Stassart, B-1050, Brussels, Belgium, <http://www.cenorm.be>.

6. Performance Requirements

6.1 *General*—All performance tests shall be conducted on assemblies of fittings (cold-expansion fittings and compression-sleeves) and pipe meeting the requirements of Specification **F876** in the case of PEX pipe, or Specification **F2769** in the case of PE-RT pipe. Fittings shall meet the material and dimensional requirements of this specification. Assembly of test specimens shall be in accordance with **9.3**. Each assembly shall contain at least two joints. Use separate sets of assemblies for each performance test requirement.

6.2 Fittings manufactured according to this specification and intended for use with PEX pipe meeting the requirements of Specification **F876**, shall comply with the following performance requirements of Specification **F877**. When a section with an identical title appears in this Specification, it contains additional requirements that supplement those found in Specification **F877**.

- 6.2.1 Requirements,
- 6.2.2 Test Methods, and
- 6.2.3 Retest and Rejection.

6.3 Fittings, manufactured according to this specification and intended for use with PE-RT pipe meeting the requirements of Specification **F2769**, shall comply with the following performance requirements of Specification **F2769**. When a section with an identical title appears in this Specification, it contains additional requirements that supplement those found in Specification **F2769**.

- 6.3.1 Requirements,
- 6.3.2 Test Methods, and
- 6.3.3 Retest and Rejection.

7. Dimensions

7.1 *Dimensions and Tolerances*—The dimensions and tolerances of the cold-expansion fittings and compression-sleeves, when measured in accordance with **10.1**, shall be as shown in **Figs. 1 and 2**.

7.1.1 *Alignment*—The maximum angular variation of any opening shall not exceed 1° off the true centerline axis.

7.1.2 *Fittings with Solder-Joint Ends*—Solder-joint end dimensions shall be in accordance with ASME B16.18, ASME B16.22, or MSS SP-104.

7.1.3 *Tapered Threaded-Ends*—Fitting threads shall be right-hand, conforming to ASME B1.20.1, and shall be tapered threads (NPT).

7.1.4 *Straight Threaded-Ends*—Fitting threads shall be right-hand, conforming to ASME B1.20.1, and shall be straight mechanical threads (NPSM).

7.1.5 *Inside Diameter*—The minimum inside diameter, listed as Dimension F in **Fig. 1**, applies to the entire fitting not just the insert area. When fitting has ends that are of different sizes or configurations (for example, threaded, solder), or both, the minimum ID applies to entire insert area.

8. Workmanship, Finish, and Appearance

8.1 The fittings shall be made from materials that are homogeneous throughout. All sealing surfaces shall be smooth and free of foreign material. The walls of cold-expansion fittings and compression-sleeves shall be free of cracks, holes,

blisters, voids, foreign inclusions, or other defects that are visible to the unaided eye and that affect wall integrity.

8.2 *Splay*—Molded polymer fittings shall be free of visible splay excepting some light blushing at the gate location.

9. Assembly

9.1 Joints:

9.1.1 *Cold-Expansion Joints*—Fittings shall be joined to pipe by first expanding the end of the pipe with the expander tool, inserting the cold-expansion fitting into expanded pipe, then pulling the compression-sleeve over the pipe and the fitting, compressing the pipe between the compression-sleeve and the fitting. Cold-expansion fittings and compression-sleeves shall meet the dimensional and material requirements of this specification. Pipe shall meet the requirements of Specification **F876** in the case of PEX pipe or Specification **F2769** in the case of PE-RT pipe.

9.2 Expander Tool:

9.2.1 The expander tool shall have a six-section radial expanding cylindrical-shaped head with unexpanded and maximum expanded diameters as shown in **Table 1**.

9.2.2 The expander tool shall be inspected according to manufacturer's instructions.

9.3 Procedure:

9.3.1 Slide the compression-sleeve onto the pipe so that the inside-beveled end is facing toward the end of the pipe. Slide the compression-sleeve far enough down the pipe so that it will not prevent expansion of the pipe. Insert the head of the expander-tool into the pipe. The expander-tool segments shall be centered inside the pipe. Expand the pipe for approximately 3 s, and remove the tool. Rotate the tool approximately 30°, insert the expander-tool into the pipe and repeat the expansion process. The cold-expansion fitting shall be inserted within 30 s of the second expansion. The fitting is properly inserted when the pipe is pushed up against the last rib (dimensioned as Rib I in **Fig. 1**) of the cold-expansion fitting. If full insertion is not possible, remove the cold-expansion fitting immediately and expand the pipe again for 3 s.

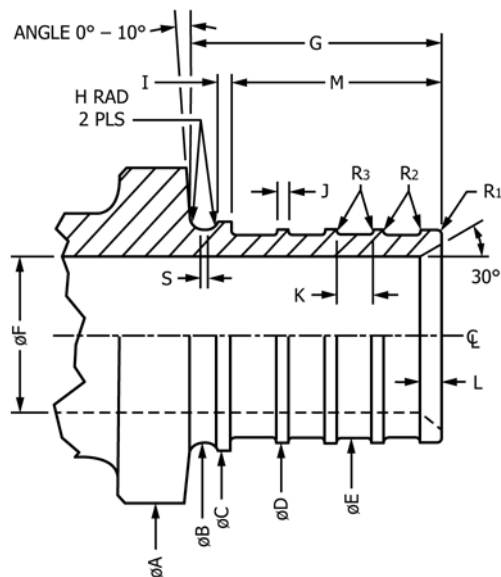
9.3.2 When the expansion is complete, and the cold-expansion fitting is inserted properly into the pipe, the metal compression-sleeve shall be pulled over the fitting with an axial compression tool provided for the purpose.

9.3.3 The compression procedure shall be as follows: Pull the compression-sleeve over the cold-expansion fitting and the pipe end using a suitable axial compression tool provided for the purpose. The maximum allowable gap between the edge of the compression-sleeve and the collar of the cold-expansion fitting (surface A on **Fig. 1**) shall be 0.040 in. (1.0 mm)

9.3.4 Each fitting assembly shall be checked per the manufacturer's instructions.

10. Test Methods

10.1 *Dimensions*—Use any randomly selected cold-expansion fittings and compression-sleeves to determine dimensions. Measurements shall be made in accordance with Test Method **D2122**, except to determine the diameters, by making measurements at four locations spaced at approximately 45° apart around the circumference. Inspection and



Note 1—All dimensions shall be measured with appropriate micrometers, such as pin or ball micrometers for wall thickness, and outside-diameter micrometers with flat anvils, or vernier calipers, to measure outside diameter and width of cold-expansion fittings and compression-sleeves.

Note 2—The average measurement is obtained from measurements taken in at least four locations spaced at approximately 45° around the circumference, in accordance with 10.1.

Size	A ^A	B	C	D	E	F	G	H	I	J ^B	K ^C	L	M	R ₁	R ₂	R ₃	S
3/8 in.	0.745 ⁺	0.408	0.451	0.408	0.385	0.280	0.515	0.034	0.034	0.023	0.059	0.055	0.405	0.008	0.005	0.005	0.000
1/2 in.	0.840 ⁺	0.420	0.461	0.418	0.395	0.292	0.540	0.044	0.044	0.033	0.069	0.065	0.420	0.020	0.010	0.015	0.010
		0.550	0.590	0.552	0.525	0.402	0.725	0.044	0.044	0.036	0.110	0.065	0.600	0.020	0.010	0.015	0.010
5/8 in.	1.100 ⁺	0.596	0.671	0.634	0.605	0.480	0.815	0.034	0.034	0.026	0.133	0.055	0.700	0.008	0.005	0.005	0.000
		0.608	0.683	0.646	0.615	0.492	0.840	0.044	0.044	0.036	0.145	0.065	0.720	0.020	0.010	0.015	0.010
3/4 in.	1.100 ⁺	0.703	0.778	0.742	0.715	0.590	0.815	0.034	0.034	0.026	0.134	0.055	0.700	0.008	0.005	0.005	0.000
		0.715	0.790	0.754	0.725	0.602	0.840	0.044	0.044	0.036	0.146	0.065	0.720	0.020	0.010	0.015	0.010
1 in.	1.375 ⁺	0.900	0.988	0.944	0.908	0.768	1.070	0.054	0.034	0.034	0.180	0.062	0.915	0.008	0.005	0.005	0.000
		0.918	1.000	0.956	0.918	0.780	1.095	0.064	0.044	0.044	0.192	0.072	0.935	0.020	0.010	0.017	0.010
1 1/4 in.	1.600 ⁺	1.110	1.159	1.157	1.110	0.923	1.315	0.005	0.034	0.034	0.189	0.113	1.015	0.018	0.005	0.005	0.253
		1.128	1.171	1.169	1.122	0.938	1.340	0.017	0.044	0.044	0.207	0.123	1.035	0.030	0.010	0.017	0.268
1 1/2 in.	1.910 ⁺	1.327	1.377	1.375	1.327	1.133	1.320	0.005	0.046	0.046	0.177	0.125	1.015	0.034	0.005	0.005	0.253
		1.345	1.389	1.387	1.339	1.148	1.345	0.017	0.056	0.056	0.195	0.135	1.035	0.048	0.010	0.017	0.268
2 in.	2.300 ⁺	1.727	1.797	1.795	1.727	1.493	1.595	0.005	0.058	0.058	0.212	0.156	1.235	0.034	0.005	0.005	0.288
		1.745	1.809	1.807	1.739	1.508	1.620	0.017	0.068	0.068	0.238	0.166	1.255	0.048	0.010	0.017	0.306

^A "A" dimensions (OD) are minimums. No maximum OD is specified, as this is a function of assembly tool geometry.

^B J dimensions 3 PLS.

^C K dimensions 3 PLS.

FIG. 1 Cold-Expansion Fittings Dimensions and Tolerances, in.

gauging of solder joint ends shall be in accordance with ASME B16.18, ASME B16.22, or MSS SP-104.

11. Retests

11.1 If any failure occurs, a retest shall be conducted only if agreed upon between the purchaser and the seller. Failure in the retest is cause for rejection of the shipment.

12. Product Marking

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

12.2 Markings or symbols may be rolled, molded, hot-stamped, etched or applied by printing methods.

12.3 Where recessed marking is used, the marking shall not cause cracks, or reduce the wall thickness below the minimum specified.

12.4 *Content of Marking for Cold-Expansion Fitting and Compression-Sleeve:*

12.4.1 Manufacturer's name or trademark, or both.

12.4.2 Certification mark or seal of the laboratory making the evaluation for this purpose.

12.4.3 This designation, F2080.

12.4.4 Nominal size.

13. Quality Assurance

13.1 When the product is marked with this designation (ASTM F2080), the manufacturer affirms that the product was