



Standard Specification for Mechanical Cold Expansion Insert Fitting With Compression Sleeve for Cross-linked Polyethylene (PEX) Tubing¹

This standard is issued under the fixed designation F 1865; 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 mechanical cold expansion insert fittings with compression sleeve suitable for use with PEX tubing that meets the requirements of Specification F 876 or F 877. These fittings are intended for use in 100 psi (689.5 kPa) cold and hot water distributions systems operating at temperatures up to and including 180° F (82°C). Included are the requirements for materials, workmanship, dimensions, burst pressure, sustained pressure, excessive temperature and pressure, temperature cycling tests, and markings to be used on the fittings and compression sleeves

1.2 The values stated in inch-pounds units are to be regarded as the standard. The values given in parentheses are provided for information purposes only.

1.3 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.*

2. Referenced Documents

2.1 ASTM Standards:

- B 16 Specification for Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines²
- B 140/B 140M Specification for Copper-Zinc-Lead (Leaded Red Brass or Hardware Bronze) Rod, Bar and Shapes²
- B 283 Specification for Copper and Copper-Alloy Die Forgings (Hot Pressed)²
- D 618 Practice for Conditioning Plastics for Testing³
- D 1598 Test Method for Time-To-Failure of Plastic Pipe Under Constant Internal Pressure⁴
- D 1599 Test Method for Short-Time, Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings⁴

¹ This standard is under the jurisdiction of Committee F-17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.26 on Olefin Based Pipe.

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² Annual Book of ASTM Standards, Vol 02.01.

³ Annual Book of ASTM Standards, Vol 08.01.

⁴ Annual Book of ASTM Standards, Vol 08.04.

D 1600 Terminology for Abbreviated Terms Relating to Plastics³

D 1898 Practice for Sampling of Plastics³

D 2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings⁴

E 18 Test Method for Rockwell Hardness and Superficial Hardness of Metallic Materials⁵

F 412 Terminology Relating to Plastic Piping Systems⁴

F 876 Specification for Crosslinked Polyethylene (PEX) Tubing⁴

F 877 Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems⁴

2.2 ASME Standards:⁶

B 1.20.1 Pipe Threads General Purpose (inch)

B 16.18 Cast Copper Alloy Solder Joint Pressure Fittings

B 16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

2.3 NSF International Standards:⁷

NSF 14 Plastic Piping Components and Related Materials

NSF 61 Drinking Water System Components-Health Effects

2.4 MSS Standard:⁸

SP-104 Wrought Copper Solder Joint Pressure Fittings

3. Terminology

3.1 *Definitions:* Definitions are in accordance with Terminology F 412 and abbreviations are in accordance with Terminology D 1600 unless otherwise indicated.

4. Classification

4.1 This specification covers one class of mechanical cold expansion insert fittings with compression sleeve suitable for use with PEX tubing that meets the requirements of Specification F 876 and F 877.

5. Materials and Manufacture

5.1 *Fittings*—The fittings shall be made from one of the following metals:

⁵ Annual Book of ASTM Standards, Vol 03.01.

⁶ Available from American Society of Mechanical Engineers, United Engineering Center, 345 E. 47th St., New York, NY 10017.

⁷ Available from the National Sanitation Foundation, P.O. Box 1468, Ann Arbor, MI 48106.

⁸ Available from Manufacturer's Standardization Society of the Valve and Fittings Industry, 5203 Leesburg Pike, Suite 502, Falls Church, VA 22041.

5.1.1 *Machined Brass Fittings*—Machined brass fittings shall be made from material meeting the requirements of Specification B 140 copper alloy UNS C31400, Specification B 16 Copper alloy UNS C38500, or DIN 17660 – CuZn39Pb3.

5.1.2 *Forged Brass Fittings*—Forged brass fittings shall be made from material meeting the requirements of Specification B 283 Copper alloy UNS C37700, or DIN 17660-CuZn40Pb2.

5.1.3 *Compression Sleeves*—Compression sleeves shall be made from material meeting the requirements of Specification B 140 copper alloy UNS C37700, Specification B 16 Copper alloy UNS C38500, or DIN 17660-CuZn39PB3.

6. Performance Requirements

6.1 *General*—All performance tests shall be performed on assemblies of fittings, compression sleeves, and PEX tubing. Fittings and compression sleeves shall meet the material and dimensional requirements of this specification. PEX tubing shall meet the requirements of Specification F 876 or F 877. Assembly of test specimens shall be in accordance with 9.2. Use separate sets of assemblies for each performance test requirement.

6.2 *Hydrostatic Burst*—Assemblies shall meet the minimum hydrostatic burst requirements shown in Table 1 when tested in accordance with 10.5.

6.3 *Hydrostatic Sustained Pressure Strength*—Assemblies shall meet the hydrostatic sustained pressure strength requirements shown in Table 2 when tested in accordance with 10.6.

6.4 *Thermocycling*—Assemblies shall not leak or separate when thermocycled 1000 times between the temperatures of 60°F (16°C) and 180°F (82°C) when tested in accordance with 10.7.

6.5 *Excessive Temperature and Pressure Capability:*

6.5.1 *General*—In the event of a water heating system malfunction, PEX tubing and assemblies shall have adequate strength to accommodate short-term conditions, 48 hours, of 210°F (99°C) and 150 psi (1034 KPa) until repairs can be made.

6.5.2 *Excessive Temperature Hydrostatic Sustained Pressure*—Tubing and fittings, when tested as assemblies, shall not fail as defined in Test Method D 1598 in less than 30 days (720 h) when tested in accordance with 10.8 and the requirements shown in Table 3.

7. Dimensions

7.1 *Dimensions and Tolerances*—The dimensions and tolerances of fittings and compression sleeves shall be as shown in Fig. 1 and Fig. 2 when measured in accordance with 10.4.

7.1.1 *Alignment*—The maximum angular variation of any

TABLE 1 Minimum Hydrostatic Burst Strength Requirements for Fitting, Compression Sleeve, and PEX Tubing Assemblies

Nominal Tubing Size			Minimum Burst Pressures at Different Temperatures		
in.	mm.	psi ^A at 73.4°F	(Kpa) at (23°C)	psi ^A at 180°F	(Kpa) at (82.2°C)
3/8	(10)	620	(4275)	275	(1896)
1/2	(13)	480	(3309)	215	(1482)
5/8 and larger	(16) and larger	475	(3275)	210	(1448)

^A The fiber stress to derive this test pressure is: at 73.4°F (23.0°C) 1900 psi (13.10 Mpa); at 180°F (82.2°C) 850 psi (5.86 Mpa).

TABLE 2 Minimum Hydrostatic Sustained Pressure Requirements for Fitting, Compression Sleeve, and PEX Tubing Assemblies^{A,B}

Nominal Tubing Size		Pressure Required for Test, psi (Kpa) ^A	
in.	mm	210 ± 4°F	(99 ± 2°C)
3/8	10	250	(1724)
1/2	13	195	(1344)
5/8 and larger	16 and larger	190	(1310)

^A The fiber stress to derive this test pressure is : 770 psi (5.31 Mpa) at 180°F (82.2°C).

^B Test duration is 1000 h.

TABLE 3 Excessive Temperature and Pressure Requirements for Fitting, Compression Sleeve, and PEX Tubing Assemblies

Test Duration	Hydrostatic Test Pressure Air Bath, ^A psi (Kpa)	Air Bath Temperature, °F (°C)
30 days (720 h)	150 (1034)	210 (99)

^A The fiber stress used to derive this test pressure is 435 psi (2.99 Mpa) at 230°F (110°C).

opening shall not exceed 1/2° off the true centerline axis.

7.1.2 *Fittings with Solder Joint Ends*—Solder joint ends shall be in accordance with ASME B 16.22, ASME B 16.18 or MSS SP-104

7.1.3 *Tapered Threaded Ends*—Fitting threads shall be right-hand conforming to ASME B 1.20.1. They shall be taper threads (NPT).

8. Workmanship, Finish and Appearance

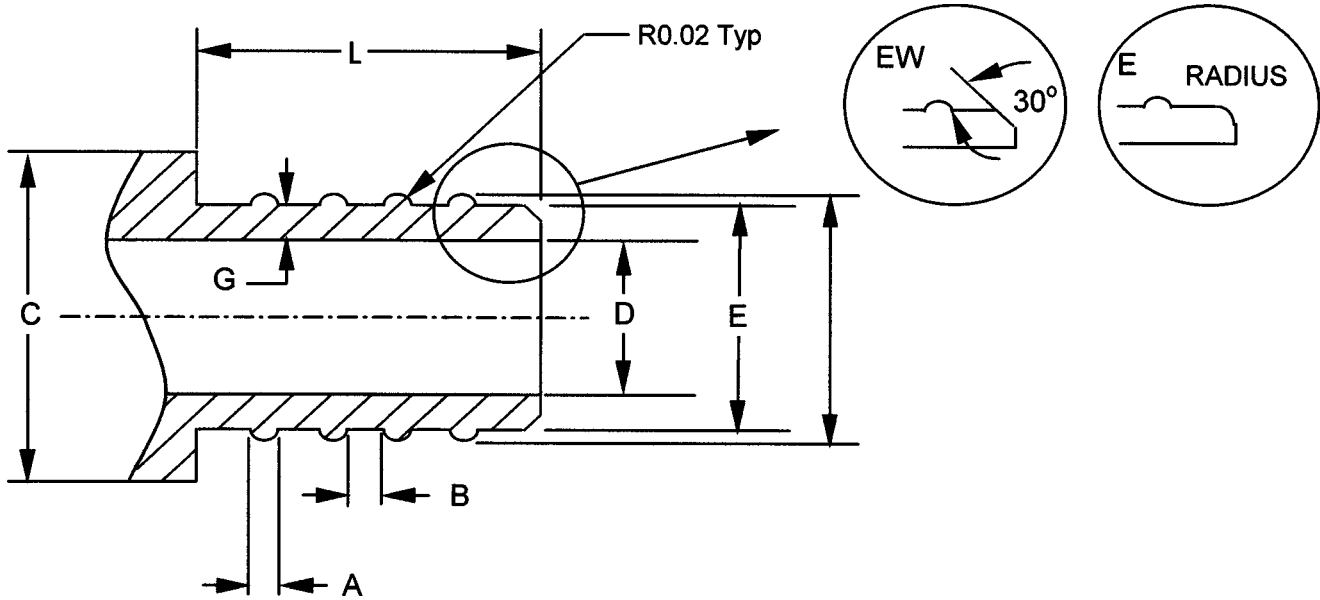
8.1 The sealing, mating and threaded surfaces of the fitting(s) shall be smooth and free of foreign material. The fitting walls shall be free of cracks, holes, blisters, voids, foreign inclusions, or other defects that are visible to the unmagnified eye and that may affect the wall integrity.

9. Assembly

9.1 *Joints*—Mechanical Cold Expansion Insert Fittings with Compression Sleeve shall be joined to the PEX tubing by drawing a compression sleeve over the PEX tubing that has been cold expanded and into which the fitting has been inserted. This action forces the tubing into annular spaces formed by ribs on the fitting. Fittings and compression sleeves shall meet the dimensional tolerances of this Specification. PEX tubing shall meet the requirements of Specification F 876 or F 877.

9.1.1 *Solder Joints*— Soldering of fittings joints shall be completed prior to installation of the PEX tubing. Excessive heat from the soldering operation will damage the PEX tubing.

9.2 *Assembly Procedure*—To affix the mechanical cold expansion insert fitting with compression sleeve to the PEX tubing, the procedure shall be as follows: Cut the tubing square using a cutter designed for plastic tubing. Inspect the end for burrs or foreign debris. Slide the compression sleeve onto the tubing at least 1 in. (25 mm) beyond the end of the tube. Insert the properly sized expansion tool (see Note 1) fully into the tubing until the end of the tube meets the stop on the tool. Expand the tubing to the fullest reach of the tool. The fullest reach of the tool shall not expand the inside diameter of the tubing more than 0.20 in. (5.0 mm) for sizes up to 5/8 in. nominal and 0.24 in. (6.0 mm) for larger sizes up to 1 in. Insert



Standard Size	Inches									
	A	Number	B	C	D	E	F	G	EW	L
	Rib	of Ribs	Gap	Stop	Inside	Insert	Rib	Minimum	EX	
	Width Typ		Width Typ	Dia. min	Dia. min	Diameter	Diameter	Wall	Depth	
3/8 in.	0.04 + 0.01	4	0.071 ± 0.010	0.620	0.30	0.370 + 0.008	0.410 + 0.008	0.025	0.020	0.59
1/2 in.	0.04 + 0.01	4	0.071 ± 0.010	0.78	0.40	0.510 + 0.008	0.540 + 0.008	0.040	0.030	0.59
5/8 in.	0.04 + 0.01	4	0.071 ± 0.010	0.86	0.51	0.630 + 0.008	0.670 + 0.008	0.045	0.030	0.59
3/4 in.	0.04 + 0.01	5	0.102 ± 0.010	1.00	0.59	0.730 + 0.008	0.780 + 0.008	0.050	0.035	0.83
1 in.	0.04 + 0.01	5	0.126 ± 0.010	1.40	0.77	0.900 + 0.008	0.950 + 0.008	0.055	0.035	0.94
Metric Size	millimeters									
STD (nom)	A	Number	B	C	D	E	F	G	EW	L
	Rib	of Ribs	Gap	Stop	Inside	Insert	Rib	Minimum	EX	
	Width Typ		Width Typ	Dia. min	Dia. min	Diameter	Diameter	Wall	Depth	
3/8 in. (10 mm)	(1 ± 0.25)	4	(1.8 ± 0.25)	(16)	(7.70)	(9.5 + 0.2)	(10.3 + 0.2)	(0.63)	(0.50)	(15)
1/2 in. (13 mm)	(1 ± 0.25)	4	(1.8 ± 0.25)	(20)	(10.3)	(13.0 + 0.2)	(13.8 + 0.2)	(1.0)	(0.80)	(15)
5/8 in. (16 mm)	(1 ± 0.25)	4	(1.8 ± 0.25)	(22)	(12.9)	(16.0 + 0.2)	(17.0 + 0.2)	(1.14)	(0.80)	(15)
3/4 in. (19 mm)	(1 ± 0.25)	5	(2.6 ± 0.25)	(27)	(15.0)	(18.6 + 0.2)	(19.8 + 0.2)	(1.27)	(0.89)	(21)
1 in. (25 mm)	(1 ± 0.25)	5	(3.2 ± 0.25)	(34)	(19.5)	(22.9 + 0.2)	(24.0 + 0.2)	(1.40)	(0.89)	(24)

FIG. 1 Mechanical Insert Dimensions and Tolerances

the fitting into the expanded tube. Place the joining tool onto the fitting assembly in accordance with the tool manufacturers instructions (see Note 1). Operate the joining tool to slide the compression sleeve over the tubing and until it reaches the stop on the fitting. Remove the joining tool. Compression sleeves that are damaged in any way shall not be re-used.

NOTE 1—Tool manufacturers provide a variety of expansion tools and joining tools with adapters for use on the various fittings configurations and sizes. These tools may utilize mechanical, electrical, hydraulic, or pneumatic devices to actuate their mechanisms. One inch sizes may not require expansion.

10. Test Methods

10.1 Conditioning— Condition specimens at 73 ± 4°F (23 ± 2°C) and 50 ± 5 % relative humidity for not less than 4 h prior to testing. Practice D 618 shall be used to the extent possible as a guide to other conditions.

10.2 Test Conditions— Conduct the tests in the standard laboratory atmosphere of 73 ± 4°F to (23 ± 2°C) and 50 ± 5 % relative humidity, unless otherwise specified in the test methods or in this specification.

10.3 Sampling—A sufficient quantity of fittings, as agreed upon by the purchaser and the seller, shall be selected and tested to determine conformance with this specification (see Practice D 1898). In the case of no prior agreement, random samples selected by the testing laboratory shall be deemed adequate.

10.4 Dimensions—Randomly selected fitting or fittings shall be used to determine dimensions. Measurements shall be made in accordance with Test Method D 2122. Determine the diameters by making measurements at four points spaced at approximately 45° apart around the circumference. Inspection and gaging of solder joint ends shall be in accordance with ANSI B 16.18, ANSI B 16.22, or MSS SP-104. Inspection and gaging of taper pipe threads shall be in accordance with ANSI/ASME G 1.20.1. All fittings that will be subjected to secondary processes of mechanical marking that affect their dimensional tolerances shall be tested in their final marked configuration.

10.5 Burst Pressure— Determine the minimum burst pressure in accordance with Test Method D 1599 with at least six