Designation: F 1380 – 95a (Reapproved 2002)ε1

An American National Standard

Standard Specification for Metal Insert Fittings for Polybutylene (PB) Tubing[1]

This standard is issued under the fixed designation F 1380; 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.

ε[1] NOTE—Supplementary Requirement section was editorially revised in December 2002.

1. Scope

1.1 This specification covers metal insert fittings for polybutylene (PB) plastic tubing. These fittings are intended for use in 100 psi (6.9 MPa) cold- and hot-water distribution systems operating at temperatures up to and including 180°F (82°C). Included are the requirements for materials, workmanship, burst pressure, sustained pressure, temperature cycling tests, and markings to be used on the fittings.

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

1.3 The following precautionary caveat pertains only to the test method portion, Section 9, 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 Machines[2]

B 62 Specification for Composition Bronze or Ounce Metal Castings[2]

B 75 Specification for Seamless Copper Tube[2]

B 88 Specification for Seamless Copper Water Tube[2]

B 140 Specification for Copper-Zinc-Lead (Leaded Red Brass or Hardware Bronze) Rod, Bar, and Shapes[2]

B 283 Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed)[2]

B 584 Specification for Copper Alloy Sand Castings for General Applications[2]

D 618 Practice for Conditioning Plastics for Testing[3]

D 883 Terminology Relating to Plastics[3]

D 1598 Test Method for Time-To-Failure of Plastic Pipe Under Constant Internal Pressure[4]

D 1599 Test Method for Resistance to Short-Time, Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings[4]

D 1600 Terminology for Abbreviated Terms Relating to Plastics[3]

D 2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings[4]

D 3309 Specification for Polybutylene (PB) Plastic Hot-Water Distribution Systems[4]

F 412 Terminology Relating to Plastic Piping Systems[4]

2.2 *American National Standards Institute Standard:*

B1.20.1 Pipe Threads General Purpose (Inch)[5]

B16.18 Cast Copper Alloy Solder Joint Pressure Fittings[5]

B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings[5]

2.3 *Manufacturers Standardization Society Standard:*

SP-104 Wrought Copper LW Solder Joint Pressure Fittings[6]

2.4 *National Sanitation Foundation Standards:*

Standard No. 14 for Plastic Piping Components and Related Materials[7]

Standard No. 61 for Drinking Water Systems Components—Health Effects[7]

3. Terminology

3.1 Definitions are in accordance with Terminologies D 883 and F 412 and abbreviations are in accordance with Terminology D 1600, unless otherwise indicated.

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[1] This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.61 on Water.

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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.

[5] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

[6] Available from Manufacturers Standardization Society of the Valves and Fittings Industry, 1815 N. Fort Myer Dr., Arlington, VA 22209.

[7] Available from the National Sanitation Foundation, PO Box 1468, Ann Arbor, MI 48106.

4. Classification

4.1 This specification covers one class of fittings suitable for use with PB tubing that meets the requirements of applicable ASTM specifications. At the present time this is Specification D 3309.

5. Materials and Manufacture

5.1 *Fittings*—The fittings shall be made from one of the following metals (Note 1):

5.1.1 *Wrought Copper Fittings*—Wrought copper fittings shall be made from material meeting the requirements of Specification B 75 for one of the following coppers: Copper Alloy UNS C10200, C10300, C10800, C12000, or C12200.

5.1.2 *Cast Copper Alloy Fittings*—Cast copper alloy fittings shall be made from material meeting the requirements of Specification B 584, Copper Alloy UNS C84400. When fittings are assembled with copper insert fittings, the insert fittings shall comply with 5.1.1.

5.1.3 *Cast Copper Alloy Valves*—Cast copper alloy valves shall be made from material meeting the requirements of Specification B 62 Copper Alloy UNS C83600 or Specification B 584 Copper Alloy UNS C83800 or C84400. When valves are assembled with copper insert fittings, the fittings shall comply with 5.1.1.

5.1.4 *Machined Brass Fittings*—Machined brass fittings shall be made from material meeting the requirements of Specification B 140 Copper Alloy UNS C31400 or Specification B 16 Copper AlloyUNS C36000.

5.1.5 *Forged Brass Fittings*—Forged brass fittings shall be made from material meeting the requirements of Specification B 283 Copper Alloy UNS C37700.

5.2 *Crimp Rings*—Crimp rings shall be made from Copper Alloy UNS C10200, C12000, or C12200. The crimp rings shall have a minimum allowable hardness of 35 and a maximum allowable hardness of 45 measured on the Rockwell 15T scale.

6. Performance Requirements

6.1 *Hydrostatic Burst*—Fittings with the dimensions and tolerances noted in Table 1 (see Fig. 1 and Fig. 2) and tubing manufactured in accordance with Specification D 3309 will be tested as an assembly and shall meet the minimum hydrostatic burst requirements shown in Table 2 when tested in accordance with 9.5.

6.2 *Hydrostatic Sustained Pressure Strength*—Tubing and fittings (tested as assemblies) shall meet the hydrostatic sustained pressure strength requirements shown in Table 3 when tested in accordance with 9.6.

6.3 *Thermocycling*—Fittings and tubing assembled using the manufacturer's recommended procedure shall not leak or separate when thermocycled 10 000 times between the temperatures of 60°F (16°C) and 180°F (82°C) when tested in accordance with 9.7.

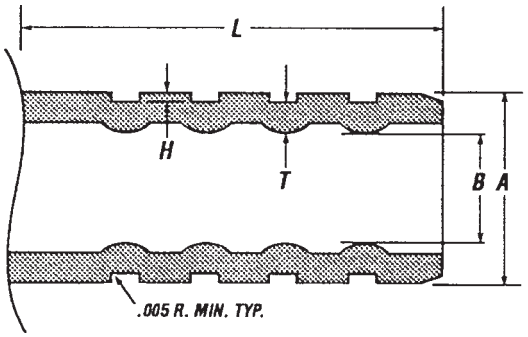
6.4 *Excessive Temperature and Pressure Capability*—In the event of a heating system malfunction, polybutylene tubing and fitting assemblies shall have adequate strength to accommodate short-term conditions, 48 h, of 210°F (99°C) and 150 psi (1.04 MPa) until repairs are made. Tubing and fittings (tested as assemblies) shall meet sustained pressure requirements shown in Table 4 when tested in accordance with 9.8.

7. Dimensions and Permissible Variations

7.1 *Dimensions and Tolerances*—The dimensions and tolerances shall be as shown in Table 1 and Table 5 when measured in accordance with 9.4.

7.1.1 *Alignment*—Alignment of all openings of fittings shall be within 1⁄16 in./ft (5 mm/m).

TABLE 1 Dimensions and Tolerances



Size	A Outside Diameter	Tolerance	B Minimum Inside Diameter Under Barb	T Minimum Wall Thickness[A]	L Minimum Insert Length[B]	Minimum Ribs	H Minimum Ribbed Height	Maximum Flash and Mismatch, Total on Crest Diameter[C,D]
3⁄8	0.375	±0.005	0.232	0.022	0.6	3	0.008	0.005
1⁄2	0.500	±0.005	0.355	0.026	0.6	3	0.008	0.005
3⁄4	0.715	±0.005	0.535	0.029	0.6	3	0.008	0.005
1	0.904	±0.004	0.771	0.032	0.7	4	0.012	0.005

[A] Applies to entire fitting, not just insert area.
[B] Fitting shall be designed with sufficient overall dimensions to allow proper use of a crimp tool without interference with previously completed crimps on the same fitting.
[C] The maximum flash and mismatch at the root diameter between the ribs shall not exceed 30 % of the rib height.
[D] The total flash and mismatch is assumed to be the difference between the dimensions *x* and *y* (see Fig. 1). These dimensions shall be measured with appropriate calipers or micrometers. See Fig. 2 for a graphic definition of flash and mismatch created by imperfection in die half interfaces.

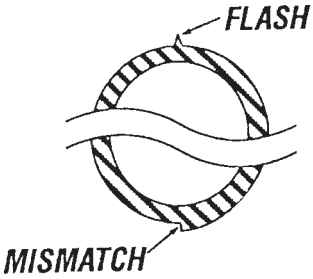


FIG. 1 Total Flash and Mismatch

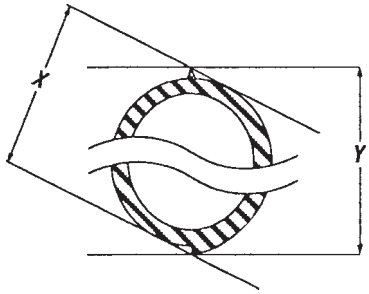


FIG. 2 Flash and Mismatch Created by Imperfection in Die Half Interfaces

TABLE 2 Minimum Hydrostatic Burst Strength Requirements for PB 21 SDR 11 Tubing and Fitting Assemblies

Temperature, °F (°C)	Burst Pressure,[A] psi (MPa)
73 (23)	440 (3.04)

[A]The fiber stress used to derive this test pressure is 2220 psi (15.18 MPa) at 73°F (23°C).

TABLE 3 Minimum Hydrostatic Sustained Pressure Requirements for PB 21 SDR 11 Tubing and Fitting Assemblies at 180°F

Test Duration, h	Hydrostatic Test Pressure Air Bath,[A] psi (MPa)
1000	220 (1.52)

[A]The fiber stress used to derive the test pressure is 1100 psi (7.57 MPa) at 180°F (82°C).

TABLE 4 Excessive Temperature and Pressure Requirement for PB 21 SDR 11 Tubing and Fittings Assemblies

Test Duration, h	Hydrostatic Test Pressure Air Bath,[A] psi (MPa)	Air Bath Temperature, °F (°C)
48	150 (1.04)	210 (99)

[A]The fiber stress used to derive this test pressure is 750 psi (5.18 MPa) at 210°F (99°C).

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

7.1.3 *Threaded Ends*—Fitting threads shall be right-hand conforming to ANSI/ASME B1.20.1. They shall be taper threads (NPT).

7.1.4 *Internal Threads*—All internal threads shall be countersunk a distance not less than one-half the pitch of the thread at an angle of approximately 45° with the axis of the thread, and all external threads shall be chamfered at an angle of 30 to 45° from the axis, for the purpose of easier entrance in making a joint and protection of the thread. Countersinking and chamfering shall be concentric with the threads.

7.1.5 *Length*—The length of threads shall be measured to include the countersink or chamfer.

7.1.6 *Tapered Pipe Threads*—Tapered pipe threads (NPT) shall be checked by use of working plug or ring gages in either standard or limit types. Gages shall be threaded on/in hand tight.

7.1.6.1 The reference point for gaging internal product threads depends upon the chamfer diameter. When the internal chamfer diameter exceeds the major diameter of the internal thread, the reference point is the last thread scratch on the chamfer cone. Otherwise, when the internal chamfer diameter does not exceed the major diameter of the internal thread, the reference point is the end of the fitting. On the external thread it shall be flush with the end of the fitting.

7.1.7 *Tolerance*—Tolerance for an internal threaded end having an internal shoulder shall be from the gage reference point (notch) to one turn small. Tolerance for an internal threaded end without shoulder and for an external threaded end shall be from one turn small to one turn large.

7.1.8 *Crimp Joints*—Insert fittings shall be jointed to the PB tubing by copper crimp rings. The crimp ring dimensions and tolerances shall be in accordance with Table 5. The crimp rings shall be copper with a minimum hardness of 35 and maximum hardness of 45 on the Rockwell 15T scale. The crimp rings shall be free of burrs and sharp edges. Crimping tool and gage, supplied by the tool and gage manufacturer, shall be used in crimping the ring to affix the insert fittings. The tool shall be adjusted according to manufacturer's instructions. (See 7.1.8.1) The tolerances for dimensions and out-of-roundness on the ring after it has been crimped shall be in accordance with Table 6. These tolerances are required to have an adequate seal and pull-out strength and not over-stress the tubing or fitting.

7.1.8.1 In the crimping operation, the fitting or tool manufacturer's instructions shall be followed. The crimping tool shall be adjusted before starting the job, at the start of each day, and when required by the tool manufacturer. The crimping procedure shall be as follows: slide the ring onto tubing, insert the fitting according to the manufacturer's instructions, and position the ring ⅛ to ¼ in. (3.2 to 6.4 mm) from end of tube when tube is placed in accordance with fitting manufacturer's instructions and parallel to the tubing. The crimping tool's jaws shall be centered over the ring. The crimp tool shall be closed completely so as to make a crimp while the tool is at 90° to the tubing. The rings shall not be double crimped. Each crimp shall be checked with the caliper gage provided by the manufacturer.

8. Workmanship, Finish, and Appearance

8.1 The outside surfaces to seal against the tube 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 the wall integrity.

TABLE 5 Crimp Ring Dimensions Before Installation[A,B,C,D]

Nominal Tube Size	Average Outside Diameter,[B] in. (mm)		Average Wall Thickness,[B] in. (mm)		Width, in. (mm)
	+0.0025	+0.0635	+0.0035	+0.0889	
⅜	0.625	(15.88)	0.049	(1.24)	0.350–0.385 (8.89–9.78)
	−0.0025	−0.0635	−0.0035	−0.0889	
	+0.0025	+0.0635	+0.0035	+0.0889	
½	0.750	(19.05)	0.049	(1.24)	0.350–0.385 (8.89–9.78)
	−0.0025	−0.0635	−0.0035	−0.0889	
	+0.0025	+0.0635	+0.0035	+0.0889	
¾	1.000	(25.4)	0.049	(1.24)	0.350–0.385 (8.89–9.78)
	−0.0025	−0.0635	−0.0035	−0.0889	
	+0.003	+0.0762	+0.0035	+0.0889	
1	1.250	(31.75)	0.049	(1.24)	0.350–0.385 (8.89–9.78)
	−0.003	−0.0762	−0.0035	−0.0889	

[A]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 shall be used to measure outside diameters and width of rings.
[B]The average measurement is obtained from measurements taken in at least two different circumferential positions which are equally spaced around the circumference.
[C]Dimensional changes and deformations caused by stamping and cutting shall not exceed the limits of Table 5.
[D]The maximum out-of-roundness of the crimp ring shall not inhibit assembly with the fitting and tubing. The crimp ring dimensions after crimping shall comply with Table 6.

TABLE 6 Crimp Ring Dimensions After Crimping on Tube/Fitting Assembly

Nominal Tube Size Insert End	Final Crimped Outside Diameter[A,B]	
	Minimum, in. (mm)	Maximum, in. (mm)
⅜	0.580 (14.7)	0.595 (15.1)
½	0.700 (17.8)	0.715 (18.2)
¾	0.945 (24.0)	0.960 (24.4)
1	1.175 (29.8)	1.190 (30.2)

[A]For all diameters except for the area of scoring caused by the crimping tool.
[B]The maximum out-of-roundness as measured by the difference between the minimum crimped outside diameter and the maximum crimped outside diameter shall not exceed 0.006 in. (0.150 mm).

9. Test Methods

9.1 *Conditioning*—Condition specimens at 73 ± 4°F (23 ± 2°C) and 50 ± 5 % relative humidity for not less than 4 h prior to test. Method D 618 shall be used to the extent possible for conditioning before other temperatures.

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

9.3 *Sampling*—A sample of the fittings, sufficient to determine conformance with this specification, shall be taken at random.

9.4 *Dimensions*—Randomly selected fitting or fittings shall be used to determine dimensions. Measurements shall be made in accordance with 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 B16.18, ANSI B16.22, or MSS SP-104.

9.5 *Burst Pressure*—Determine the minimum burst pressure in accordance with Test Method D 1599 with at least six specimens of PB 21 tubing and insert fittings. Leakage or separation at any of the joints tested at less than the minimum burst requirements for the temperature specified in Table 2, shall constitute a failure in this test.

9.6 *Hydrostatic Sustained Pressure*—Perform the test in accordance with Test Method D 1598, using fitting and tubing assemblies using the following conditions:

9.6.1 Test temperature shall be at 180 ± 4°F (82 ± 2°C).

9.6.2 The external test environment shall be air.

9.6.3 Fill the specimens with water at a temperature of at least 120°F (50°C).

9.6.4 At least six specimens of PB 21 tubing and insert fittings shall be tested and leakage or separation at any joint tested at less than 1 000 h at the sustained pressure of 220 psi (1.52 MPa) and temperature of 180°F (82°C) as given in Table 3, shall constitute failure in this test.

9.7 *Thermocycling*:

9.7.1 *Summary of Test Method*—This test method describes a pass-fail test for thermally cycling PB tubing and insert fittings over a critical temperature range for a selected number of cycles while subjected to a nominal internal pressure. The test provides a measure of resistance to failure due to the combined effects of differential thermal expansion and creep of PB tubing and insert fittings intended for use up to and including 180°F (82°C).

9.7.2 *Apparatus*—A water source capable of maintaining a nominal internal pressure of 200 ± 10 psi on the specimens is required. The immersion system shall consist of two water reservoirs controlled at 60 ± 4°F (16 ± 2°C) and 180 ± 4°F (82 ± 2°C) into which the pressurized specimens are cycled manually using flexible connectors or from which the hot and cold water is alternately cycled over the test specimens automatically and returned to the proper reservoir (Note 1).

NOTE 1—Automatic recycling may be accomplished by pumping from each reservoir through a delivery system having timer-actuated valves to specimen trough having synchronized, timer-actuated return drains. Any automatic apparatus shall provide for complete immersion of the test specimen in the trough.

9.7.3 *Sampling and Specimen Preparation*—Select at random six specimens of the type and size of PB-21 tubing and fittings to be tested. Assemble the fittings with suitable lengths of tubing, meeting the requirements of Specification D 3309, and attach them to a common manifold in such a way to allow free-end movement of the tubing. Close the specimen assembly with any suitable end closure that will allow free-end mounting and will not leak under the thermocycle conditions, and connect the specimen assembly to the pressure source.

9.7.4 *Procedure*—Pressurize the specimen assembly with water to 200 ± 10 psi and check for leaks. Eliminate any leaks before the thermocycle test is started. Thermally cycle the specimen assembly either manually or automatically and under an internal pressure of 200 ± 10 psi, alternately between 60 ± 4°F (16 ± 2°C) and 180 ± 4°F (82 ± 2°C) by means of immersion in water using the following test cycle (Note 2):

Water immersion at 180°F	2 min minimum
Air immersion at ambient	2 min maximum
Water immersion at 60°F	2 min minimum
Air immersion at ambient	2 min maximum

NOTE 2—If the test must be interrupted before completion, samples are to be kept at room temperature until the test is restarted.

9.7.4.1 Upon completion of 10 000 cycles, visually inspect for leaks while under test pressure. Any evidence of leakage at the fittings or separation of the fittings from the tubing constitutes failure.

9.7.4.2 If no failures are evident, the specimen assembly shall immediately be tested for joint integrity (hydrostatic burst) at 73°F (23°C) in accordance with Test Method D 1599. Leakage or separation during the quick-burst test of any of the joints in the assembly at less than 440 psi shall constitute failure of this test.

9.7.5 *Interpretation of Results*—Failure of any one of six specimens in the assembly shall constitute failure of these tests.

9.8 *Excessive Temperature and Pressure Capability of Tubing and Fitting Assemblies*—Determine in accordance with Test Method D 1598, using six fitting and tubing assemblies using the following conditions and as required in Table 3.

9.8.1 Test temperature shall be 210 ± 4°F (99 ± 2°C).

9.8.2 The external test environment shall be air.

9.8.3 Fill specimens with water at a temperature of at least 120°F (50°C).

9.8.4 Leakage or separation of any joint tested at less than the conditions specified in Table 3 shall constitute failure of this test.

10. Retest

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

11. Product Marking

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

11.2 *Content of Marking*:

11.2.1 Marking on fittings shall include manufacturer's name or trademark, or some other identifying mark.

11.2.2 Marking on packaging shall include manufacturer's name, fitting size, and ASTM F 1380.

11.3 Markings or symbols shall be cast, stamped, or applied by printing methods.

11.4 Where recessed marking is used on fittings, care shall be taken to see that in no case shall the marking cause cracks or reduce the wall thickness below the minimum specified.

12. Quality Assurance

12.1 When the product is marked with this designation, F 1380, 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.

13. Keywords

13.1 cold and hot water distribution; copper crimp rings; metal insert fittings; polybutylene

SUPPLEMENTARY REQUIREMENTS

GOVERNMENT/MILITARY PROCUREMENT

The following supplementary requirements apply *only* to federal and military procurement, not to domestic sales or transfers.

S1. *Responsibility for Inspection*—Unless otherwise specified in the contract or purchase order, the producer is responsible for all inspection and test requirements specified herein. The producer may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless the purchaser disapproves. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification where such inspections are deemed necessary to ensure that material conforms to prescribed requirements.

NOTE S1.1—In U.S. federal contracts, the contractor is responsible for inspection.

S2. *Packaging and Marking for U.S. Government Procurement:*

S2.1 *Packaging*—Unless otherwise specified in the contract, the materials shall be packaged in accordance with the supplier's standard practice in a manner ensuring arrival at destination in satisfactory condition and which will be acceptable to the carrier at lowest rates. Containers and packing shall

comply with Uniform Freight Classification rules or National Motor Freight Classification rules.

S2.2 *Marking*—Marking for shipment shall be in accordance with Fed. Std. No. 123 for civil agencies and MIL-STD-129 for military agencies.

NOTE S2.1—The inclusion of the U.S. Government procurement requirements should not be construed as an indication that the U.S. Government uses or endorses the products described in this specification.

POTABLE WATER REQUIREMENT

This requirement applies whenever a Regulatory Authority or User calls for product to be used to convey or to be in contact with potable water.

S4. Potable Water Requirement—Products intended for contact with potable water shall be evaluated, tested and certified for conformance with ANSI/NSF Standard No. 61 or the health effects portion of NSF Standard No. 14 by an acceptable certifying organization when required by the regulatory authority having jurisdiction.