



Standard Specification for Stainless Steel Clamps for Securing SDR9 Cross-linked Polyethylene (PEX) Tubing to Metal Insert Fittings¹²

This standard is issued under the fixed designation F 2098; 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 stainless steel clamps for use with four sizes of insert fittings that comply with F 1807, and cross-linked polyethylene (PEX) plastic tubing that complies with F 876 or F 877. These clamps are intended as an alternative to the copper-alloy crimp-rings of F 1807, for use in 100 psi (689.5 kPa) cold- and hot-water distribution systems operating at temperatures up to and including 180°F (82°C). Included are requirements for materials, workmanship, dimensions and marking of the stainless steel clamps; requirements for deforming the clamps; and requirements for burst pressure, sustained pressure, excessive temperature and pressure, and temperature cycling, which apply to assemblies of PEX tubing and F 1807 insert fittings secured with deformed clamps per this specification.

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 methods 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:

A 240 Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels³

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing⁴

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 10, 2001. Published July 2001.

² The stainless steel clamp described in this standard is covered by a patent. Interested parties are invited to submit information regarding the identification of an alternative to this patented item to ASTM Headquarters. Your comments will receive careful consideration at a meeting of F17, which you may attend.

³ Annual Book of ASTM Standards, Vol 01.03.

⁴ Annual Book of ASTM Standards, Vol 08.01.

D 1598 Test Method for Time-To-Failure of Plastic Pipe Under Constant Internal Pressure⁵

D 1599 Test Method for Short-Time, Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings⁶

D 1600 Terminology for Abbreviated Terms Relating to Plastics⁵

D 2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings⁶

E 18 Test Methods for Rockwell Hardness and Superficial Hardness of Metallic Materials⁶

F 412 Terminology Relating to Plastic Piping Systems⁶

F 876 Specification for Cross-linked Polyethylene (PEX) Tubing⁶

F 877 Specification for Cross-linked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems⁶

3. Terminology

3.1 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 stainless steel clamps in four sizes suitable for securing PEX tubing that meets the requirements of Specifications F 876 or F 877 to insert fittings that meet the requirements of F 1807.

5. Materials and Manufacture

5.1 *Clamps*—Clamps shall be made from material meeting the requirements of Specification A 240 stainless steel UNS S304000.

6. Performance Requirements

6.1 *General*—All performance tests shall be performed on assemblies of fittings, clamps and PEX tubing. Clamps shall meet the material and dimensional requirements of this specification. Fittings shall meet the material and dimensional requirements of F 1807. PEX tubing shall meet the requirements of Specification F 876 or F 877. Assembly of test

⁵ Annual Book of ASTM Standards, Vol 08.04.

⁶ Annual Book of ASTM Standards, Vol 03.01.

specimens shall be in accordance with 9.1.1. Each assembly shall contain at least two (2) joints. 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 requirements shown in Table 2 when tested in accordance with 10.6.

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

6.5 *Excessive Temperature-Pressure Capability*:

6.5.1 *General*—Assemblies shall have adequate strength to accommodate short-term conditions, 30 days (720 h) of 210°F (99°C) and 150 psi (1034 kPa).

6.5.2 *Excessive Temperature Hydrostatic Sustained Pressure*—Assemblies shall meet sustained pressure requirements shown in Table 3 when tested in accordance with 10.8.

7. Dimensions

7.1 *Dimensions and Tolerances*—The dimensions and tolerances of clamps shall be as shown in Figs. 1-4 when measured in accordance with 10.4.

8. Workmanship, Finish and Appearance

8.1 The surfaces of the clamps shall be smooth and free of foreign material. Clamps shall be free of cracks, holes, corrosion, voids, foreign inclusions, or other defects that are visible to the unaided eye that have potential to affect the clamp integrity.

9. Assembly

9.1 *Clamp Joints*—Insert fittings shall be joined to PEX tubing by deforming and locking a stainless steel clamp around the outer circumference of the tubing, forcing the tubing material into annular spaces formed by the ribs on the fitting. Insert fittings shall meet the dimensional and material requirements of F 1807. PEX tubing shall meet the requirements of Specifications F 876 or F 877. Clamps shall meet the dimensional and material requirements of this specification.

9.1.1 *Clamping Procedure*—The clamping procedure shall be as follows: slide the clamp onto the tubing, insert the ribbed end of the fitting into the end of the tubing until the tubing contacts the shoulder of the fitting or tube stop. The clamp shall then be positioned on the tubing so the edge of the clamp is 1/8

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

Nominal Tubing Size		Pressure Required for Test, psi (kPa) ^A	
in.	mm	180°F	(82.2°C)
3/8	10	250	(1724)
1/2	13	195	(1344)
3/4 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, Clamp and PEX Tubing Assemblies

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

^A The fiber stress used to derive this test pressure is 595 psi (4.1 MPa) at 210°F (99°C).

to 1/4 in. (3.2 to 6.4 mm) from the end of the tube. The ratcheting clamping tool shall be used to close the clamp. The tool will not release until the clamp is properly closed. Ratcheting hand tools shall conform to the dimensional requirements of Fig. 5.

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 as applicable, as a guide to other conditions.

10.2 *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.

10.3 *Sampling*—A sample of the fittings, clamps, and PEX tubing, sufficient to determine conformance with this specification, shall be taken. Sampling of clamps shall be random.

10.4 *Dimensions*—Randomly selected clamp or clamps, shall be used to determine dimensional conformance of clamps. Clamp dimensions shall be measured on flat clamps prior to forming (rounding). Dimensional requirements do not apply to clamps that have been flattened after forming. Measurements of clamps, tubing, and fittings shall be made in accordance with Method D 2122, except determine diameters by making measurements at four locations spaced at approximately 45° apart around the circumference.

10.5 *Burst Pressure*—Determine the minimum burst pressure in accordance with Test Method D 1599, on at least six assemblies for each temperature in Table 2. Leakage or separation at any of the joints tested, at less than the minimum burst requirements for the temperatures specified in Table 1, shall constitute a failure in this test.

10.6 *Hydrostatic Sustained Pressure*—Perform the test on at least six assemblies in accordance with Test Method D 1598, except for the following:

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

10.6.2 The external test environment shall be air or water.

TABLE 1 Minimum Hydrostatic Burst Strength Requirements for Fitting, Clamp 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)
3/4 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).

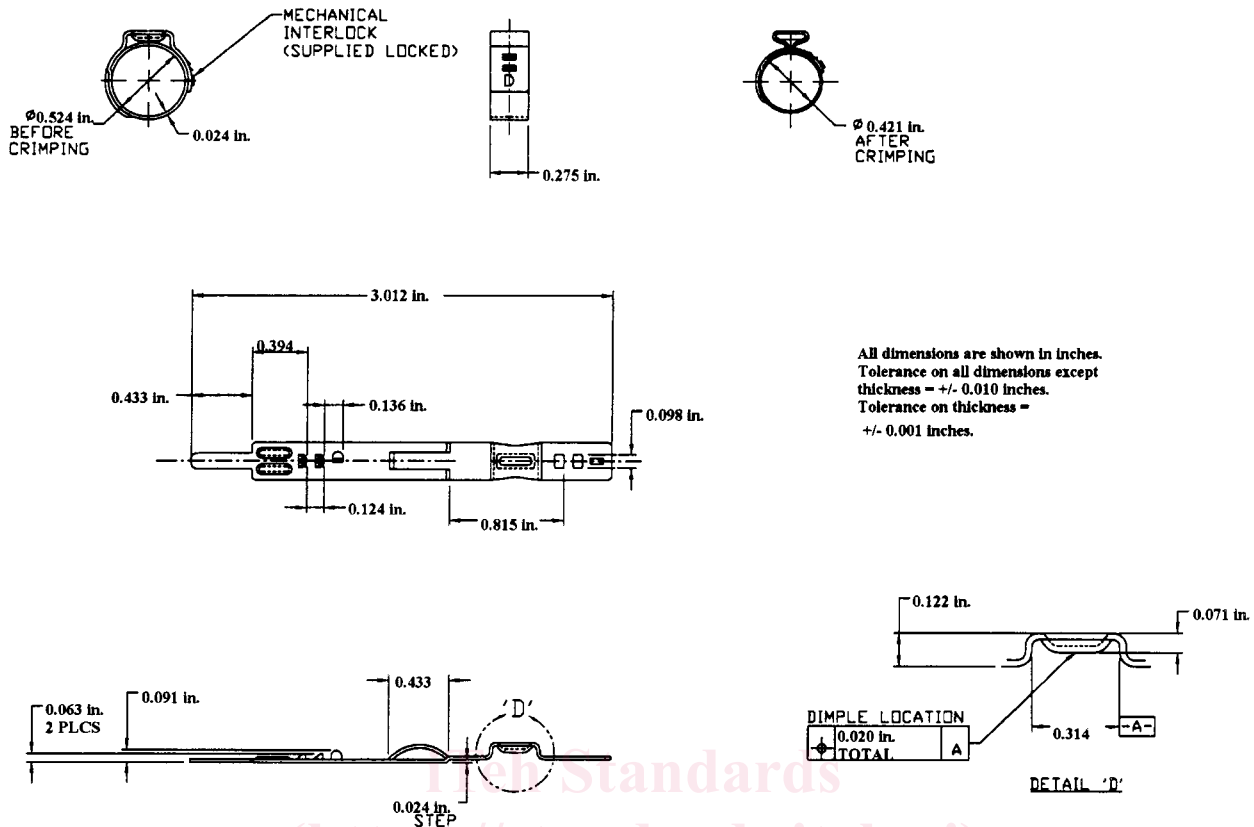


FIG. 1 Stainless Steel Clamp Dimensions, 3/8-in. nominal

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

10.6.4 Leakage or separation at any joint tested, at less than 1000 h at the sustained pressure as given in Table 2, shall constitute failure in this test.

10.7 Thermocycling:

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

10.7.2 *Apparatus*—An air or nitrogen pressure source capable of maintaining an internal pressure of 100 ± 10 psi (690 ± 69 kPa) to the specimens is required. An immersion system shall consist of two water reservoirs controlled at $60 \pm 4^\circ\text{F}$ ($16 \pm 2^\circ\text{C}$) and $180 \pm 4^\circ\text{F}$ ($82 \pm 2^\circ\text{C}$) into which the pressurized specimens will be cycled. Either samples are cycled manually using flexible connectors or alternately the hot and cold water is 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 troughs having synchronized, timer-actuated return drains. Any

automatic apparatus shall provide for complete immersion of the test specimen in the water.

10.7.3 *Specimen Assembly*—Test six assemblies. Attach the assemblies to a common manifold in such a way to allow free-end movement of the tubing. Close this 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.

10.7.4 *Procedure*—Pressurize the specimen assembly with air or nitrogen to 100 ± 10 psi (690 ± 69 kPa) and check for leaks. Eliminate any leaks before the thermocycle test is started. Thermally cycle the specimen assembly, either manually or automatically, under a constant internal pressure of 100 ± 10 psi (690 ± 69 kPa), alternating between $60 \pm 4^\circ\text{F}$ ($16 \pm 2^\circ\text{C}$) and $180 \pm 4^\circ\text{F}$ ($82 \pm 2^\circ\text{C}$), by means of immersion in water using the following test cycle:

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

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

10.7.4.1 Upon completion of 1000 cycles, visually inspect for leaks while assembly is under the test pressure. Any evidence of leakage at the fittings, or separation of the fittings from the tubing, constitutes failure.