IAPMO PS 117-~~2018~~2019

PUBLIC REVIEW DRAFT

Press ~~and Nail~~ Connections

IAPMO Standard

IAPMO PS 117-~~2018~~2019
Press ~~and Nail~~ Connections
Published: ~~April 2018~~Month 2019
Previous Editions: September 2000, December 2001, January 2004, June 2004, April 2005, June 2005, August 2005, October 2006, May 2008, April 2012, September 2012, May 2016, August 2017, November 2017, April 2018

Published by
International Association of Plumbing and Mechanical Officials (IAPMO)
4755 East Philadelphia Street, Ontario, California, 91761, USA
1-800-854-2766 • 1-909-472-4100

Visit the IAPMO Online Store at: www.IAPMOstore.org
Visit the IAPMO Standards website at: www.IAPMOstandards.org

Printed in the United States of America

IAPMO Notes

(1) The use of the singular does not exclude the plural (and vice versa) when the sense allows.

(2) The use of IAPMO Standards is completely voluntary; their existence does not in any respect preclude anyone, whether he has approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards.

(3) This standard was developed using an open process and in accordance with IAPMO Standards Policy S-001, Standards Development Process*, which is available on the IAPMO Standards website (www.IAPMOstandards.org).*

(4) During its development, this Standard was made available for public review, thus providing an opportunity for additional input from stakeholders from industry, academia, regulatory agencies, and the public at large. Upon closing of public review, all comments received were duly considered and resolved by the IAPMO Standards Review Committee.

(5) This Standard was developed in accordance with the principles of consensus, which is defined as substantial agreement; consensus implies much more than a simple majority, but not necessarily unanimity. It is consistent with this definition that a member of the IAPMO Standards Review Committee might not be in full agreement with all sections of this Standard.

(6) Although the intended primary application of this Standard is stated in its scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.

(7) IAPMO Standards are subject to periodic review and suggestions for their improvement will be referred to the IAPMO Standards Review Committee. To submit a proposal for change to this Standard, you may send the following information to the International Association of Plumbing and Mechanical Officials, Attention Standards Department, at standards@IAPMOstandards.org or, alternatively, at 4755 East Philadelphia Street, Ontario, California, 91761, and include "Proposal for change" in the subject line:

(a) standard designation (number);

(b) relevant section, table, or figure number, as applicable;

(c) wording of the proposed change, tracking the changes between the original and the proposed wording; and

(d) rationale for the change.

(8) Requests for interpretation should be clear and unambiguous. To submit a request for interpretation of this Standard, you may send the following information to the International Association of Plumbing and Mechanical Officials, Attention Standards Department, at standards@IAPMOstandards.org or, alternatively, at 4755 East Philadelphia Street, Ontario, California, 91761, and include "Request for interpretation" in the subject line:

(a) the edition of the standard for which the interpretation is being requested;

(b) the definition of the problem, making reference to the specific section and, when appropriate, an illustrative sketch explaining the question;

(c) an explanation of circumstances surrounding the actual field conditions; and

(d) the request for interpretation phrased in such a way that a "yes" or "no" answer will address the issue.

(9) ~~Attention is drawn to the possibility that some of the elements of this Standard may be the subject of patent rights. IAPMO is not to be held responsible for identifying any or all such patent rights. Users of this Standard are expressly advised that determination of the validity of any such patent rights is entirely their responsibility.~~ IAPMO does not "approve", "rate", or endorse any item, construction, proprietary device, or activity.

(10) IAPMO does not take any position with respect to the validity of any patent rights asserted in connection with any items mentioned in this Standard, and does not undertake to insure anyone utilizing this Standard against liability for infringement of any applicable patents, nor assumes any such liability. Users of this Standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their responsibility.Participation by federal or state agency representative(s) or person(s) affiliated with industry is not to be interpreted as government or industry endorsement of this Standard.

IAPMO PS 117-~~2018~~2019
Press ~~and Nail~~ Connections

1 Scope

1.1 Scope

1.1.1 This Standard covers press and nail connections made with
(a) copper or copper alloy fittings and Type K, L, and M copper tube;
(b) carbon steel fittings and Schedule 10 and 40 carbon steel pipe;
(c) stainless steel fittings and Schedule 5, 10, and 40 stainless steel pipe; or
(d) stainless steel fittings and stainless steel pipe complying with the dimensions specified in Table 1.

1.1.2 This Standard specifies requirements for materials, physical characteristics, performance testing, and markings.

1.1.3 Products covered by this Standard include fittings, tube, and pipe with press or nail connection ends combined with other types of connections (e.g., threaded, soldered, and push-fit).

1.1.4 Carbon steel fittings and pipe covered by this Standard are not intended to be used in plumbing systems.

1.2 Alternate Materials

The requirements of this Standard are not intended to prevent the use of alternate materials or methods of construction provided such alternates meet the intent of this Standard.

1.3 Terminology

In this Standard,
(a) "shall" is used to express a requirement, i.e., a provision that the user is obliged to satisfy to comply with the Standard;
(b) "should" is used to express a recommendation, but not a requirement;
(c) "may" is used to express an option or something permissible within the scope of the Standard; and
(d) "can" is used to express a possibility or a capability.

Notes accompanying sections of the Standard do not specify requirements or alternative requirements; their purpose is to separate explanatory or informative material from the text. Notes to tables and figures are considered part of the table or figure and can be written as requirements.

1.4 Units of Measurement

SI units are the primary units of record in global commerce. In this Standard, the inch/pound units are shown in parentheses. The values stated in each measurement system are equivalent in application, but each unit system is to be used independently. All references to gallons are to U.S. gallons.

1.5 Amendments

Proposals for amendments to this Standard will be processed in accordance with the standards writing procedures of IAPMO.

~~### 1.6 Patents~~

~~The user's attention is called to the possibility that compliance with this Standard may require use of an invention covered by patent rights. By publication of this Standard, no position is taken with respect to the validity of any such claim(s) or of any patent rights in connection therewith. If a patent holder has filed a statement of willingness to grant a license under these rights on reasonable and nondiscriminatory terms and conditions to applicants desiring to obtain such a license, then details can be obtained from IAPMO.~~

2 Reference Publications

This Standard refers to the following publications, and where such reference is made, it shall be to the current edition of those publications, including all amendments published thereto.

ASME B1.20.1	Pipe Threads, General Purpose (Inch)
ASME B16.3	Malleable Iron Threaded Fittings: Classes 150 and 300
ASME B16.18	Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	Wrought Copper and Copper Alloy Solder Joint Fittings
ASME B36.10	Welded and Seamless Wrought Steel Pipe
ASME B36.19	Stainless Steel Pipe
ASSE 1061	Removable and Non-Removable Push-Fit Fittings
ASTM A53	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless Pipe
ASTM A106	Standard specification for Seamless Carbon Steel Pipe
ASTM A135	Specification for Electric-Resistance-Welded Steel Pipe
~~ASTM A269~~	~~Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service[1]~~
ASTM A312	Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A403	Standard Specification for Wrought Austenitic Stainless Steel Pipe Fittings
ASTM A420	Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low Temperature Service
~~ASTM A554~~	~~Standard Specification for Welded Stainless Steel Mechanical Tubing~~
~~ASTM A778~~	~~Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products~~

ASTM A960	Standard Specification for Common Requirements for Wrought Steel Piping Fittings
ASTM B42	Standard Specification for Seamless Copper Pipe, Standard Sizes[1]
ASTM B43	Standard Specification for Seamless Red Brass Pipe, Standard Sizes
ASTM B75	Standard Specification for Seamless Copper Tube
ASTM B88	Seamless Copper Water Tube
ASTM B135	Standard Specification for Seamless Brass Tube
ASTM B251	General Requirements for Wrought Seamless Copper and Copper- Alloy Tube
ASTM B302	Standard Specification for Threadless Copper Pipe, Standard Sizes[1]
ASTM B447	Standard Specification for Welded Copper Tube[1]
ASTM B283	Copper and Copper-Alloy Die Forgings (Hot-Pressed)
ASTM B858	Standard Test Method for Ammonia Vapor Test for Determining Susceptibility to Stress Corrosion Cracking in Copper Alloys
ASTM D2000	Classification Systems for Rubber Products in Automotive Applications
ISO 6509-1	Corrosion of metals and alloys -- Determination of dezincification resistance of copper alloys with zinc -- Part 1: Test method
ISO 6957	Copper alloys -- Ammonia test for stress corrosion resistance
NSF/ANSI 61	Drinking Water System Components—Health Effects

3 Abbreviations

The following abbreviations shall apply in this Standard:

NPS — nominal pipe size

4 General Requirements

4.1 Press Connections

4.1.1 Copper or Copper Alloy Fittings

Press-connect copper or copper alloy fittings shall comply with one of the following:

(a) material requirements of ASME B16.22; or

(b) chemical composition requirements of ASTM B88.

Note: *Copper or Copper Alloy Fittings covered in item (b) of this section are 84%, by weight, minimum copper content, a limit specified by the referenced standards ASME B16.22.*

(c) The additional tests specified in Section 5.2 for alloys with ≥56% and <84% by weight copper content, and zinc content of 15% or more by weight.

4.1.2 Copper Tube

4.1.2.1 Copper tube with press connections shall comply with ASTM B88.

4.1.2.2 Dimensions for copper tube
(a) straight ends shall be as specified in Table 2 of ASTM B88, as applicable; and
(b) press connection ends shall be as specified by the manufacturer.

4.1.3 Carbon Steel Fittings
Carbon steel fittings shall comply with ASME B16.3, ASTM A420, or ASTM A960.

4.1.4 Carbon Steel Pipe
Carbon steel pipe shall comply with ASME B36.10, ASTM A53, ASTM A106, or ASTM A135.

4.1.5 Stainless Steel Fittings
Stainless steel fittings shall comply with ASTM A403.

4.1.6 Stainless Steel Pipe
Stainless steel pipe with press connection ends shall comply with ASTM A312~~, ASTM A554, or ASTM A778~~.

~~**4.2 Nail Connections**~~

~~**4.2.1** Copper fittings with nail connection ends utilizing rubber gaskets shall be made of copper alloy UNS C37700, as specified in ASTM B283.~~
~~**Note:** *Nail connections are intended for use with seamless copper tube, valves, and fittings.*~~

~~**4.2.2** Nails shall be made of copper alloy UNS C38500, as specified in ASTM B283.~~

4.~~3~~2 O-rings
O-rings shall be made of synthetic rubber that complies with ASTM D2000 and NSF/ANSI 61.

4.~~4~~3 Toxicity
Fittings, pipe, and components intended for use in potable water systems shall comply with the applicable requirements of NSF/ANSI 61.
Note: *See Section 6.1 for marking requirements for products intended for use in potable water systems.*

4.~~5~~4 Alternate Connections

4.~~5~~4.1 Solder-Joint Ends
Ends for solder joints made of
(a) cast copper alloys shall comply with the dimensional requirements of ASME B16.18; and
(b) wrought copper and copper alloys shall comply with the dimensional requirements of ASME B16.22.

4.~~5~~4.2 Threaded Ends
Threaded ends shall comply with ASME B1.20.1.

4.~~5~~4.3 Push-Fit Fittings

4.~~5~~4.3.1 Push-fit fittings shall comply with ASSE 1061.

4.~~5~~4.3.2 Assemblies comprising push-fit fittings crimped to press fittings shall be tested in accordance with Sections 5.6 and 5.7 of this Standard (hydraulic shock and vibration tests) and Sections 3.3 and 3.4 of ASSE 1061 (separation and rupture tests).

4.~~5~~4.4 Fittings for PEX Tubing
Fittings intended to connect to PEX tubing shall comply with the dimensional requirements specified in the applicable ASTM or CSA standards.

5 Testing Requirements

5.1 General

5.1.1 Test specimens shall be assembled by joining fittings and pipes or tubes with plain ends, or a tube with press connection end with a plain-end tube, in accordance with the manufacturer's instructions, unless otherwise specified in the test procedure.

5.1.2 Copper and copper alloy fitting and tubes with press connection ends shall be tested on hard drawn Type K and Type M copper tube, unless otherwise specified in the test procedure. Copper fittings shall be tested with copper tube only.

5.1.3 Carbon steel fittings shall be tested on Schedule 10 and Schedule 40 steel pipe, unless otherwise specified in the test procedure. Carbon steel fittings shall be tested with carbon steel pipe only.

5.1.4 Stainless steel fittings shall be tested on Schedule 5 hard drawn and annealed steel pipe unless otherwise specified in the test procedure. Stainless steel fittings shall be tested with stainless steel pipe only.

5.2 Press-Connect Copper Alloy with ≥56% and <84% Copper Content

5.2.1 Press-connect copper alloy fittings in contact with potable water shall have a copper (Cu) content not less than 56% by weight.

5.2.2 Press-connect copper alloy fittings in contact with water and containing more than 15% zinc (Zn) by weight shall be resistant to dezincification. When tested in accordance with ISO 6509-1, the maximum depth of dezincification shall not exceed 200 µm.

5.2.3 Press-connect copper alloy fittings in contact with water and containing more than 15% zinc (Zn) by weight shall be resistant to stress corrosion. There shall be no evidence of cracking when tested in accordance with ASTM B858 or ISO 6957 in a test solution of 9.5 pH.

5.3~~-~~ Unrestrained Hydrostatic Pressure Tests

5.3.1 Unrestrained Hydrostatic Pressure Test at 20 ºC (68ºF)

5.3.1.1 Test Procedure

The unrestrained hydrostatic pressure test at 20 ºC (68ºF) shall be conducted as follows:

(a) Assemble the test specimen in accordance with Section 5.1.1.
(b) Connect gauges to the test specimen to measure the joint displacement.
(c) Fill the test specimen with water at 20 ± 3 ºC (68 ± 5ºF).
(d) Pressurize the test specimen to 4,137 ± 48 kPa (600 ± 7 psi) or two times the manufacturer's rated pressure, whichever is greater.
(e) Maintain the test pressure for 48 h.
(f) Measure the slippage 1 h after pressurizing and at the completion of the test.

5.3.1.2 Performance Requirements

There shall be no leakage. In addition, the maximum slippage per joint shall be as specified in Table 2.

5.3.2 Unrestrained Hydrostatic Pressure Test at 93 ºC (200ºF)

5.3.2.1 Test Procedure

The unrestrained hydrostatic pressure test at 93 ºC (200ºF) shall be conducted as specified in Section 5.2.1.1, except that the water temperature shall be 93 ± 3 ºC (200 ± 5ºF).

5.3.2.2 Performance Requirements

There shall be no leakage. In addition, the maximum slippage per joint shall be as specified in Table 2.

5.4 Static Torsion Test for Press Connections

5.4.1 Test Procedure

The static torsion test for press connections shall be conducted as follows:

(a) Assemble the test specimen using fittings and Type L hard drawn copper tube, un-annealed stainless steel pipe, or Schedule 10 carbon steel pipe.
(b) Rotate the joint 10º by applying a torque load on the pipe or tube.
(c) Fill the test specimen with water at 20 ± 3 ºC (68 ± 5ºF).
(d) Pressurize the test specimen to 2,758 ± 48 kPa (400 ± 7 psi).
(e) Maintain the test pressure for 48 h.

5.4.2 Performance Requirement

There shall be no leakage.

5.5 Bending Test

5.5.1 Test Procedure

The bending test shall be conducted as follows:

(a) Assemble the test specimen by joining a coupling with an internal stop and two 1,000 mm (40 in) long hard drawn copper tubes or stainless steel pipes. The tubes or pipes shall not have press connection ends.
(b) Place the test specimen on supports 1,830 mm (6 ft) apart.
(c) Apply a concentrated load at the center of the coupling, in accordance with Table 3.
(d) Pressurize the test specimen to 2,758 ± 48 kPa (400 ± 7 psi).
(e) Maintain the test pressure for 1 h.

5.5.2 Performance Requirement

There shall be no leakage.

5.6 Vacuum Test

5.6.1 Test Procedure

The vacuum test shall be conducted as follows:

(a) Assemble the test specimen in accordance with Section 5.1.1.
(b) Subject the test specimen to a vacuum of 82.9 ± 1.7 kPa (12 ± 0.25 psi).
Note: *82.9 ± 1.7 kPa (12 ± 0.25 psi) is equivalent to 622 ±13 mm (24.5 ±0.5 in) of mercury.*
(c) Once the vacuum is established, isolate the test specimen and monitor the vacuum for 1 h.

5.6.2 Performance Requirement

The change in vacuum shall not exceed 5 kPa (0.73 psi).
Note: *5 kPa (0.73 psi) is equivalent to 38 mm (1.5 in) of mercury.*

5.7 Hydraulic Shock (Water Hammer) Test

5.7.1 Test Procedure

The hydraulic shock (water hammer) test shall be conducted as follows:

(a) Assemble the test specimen in accordance with Section 5.1.1.
(b) Fill the test specimen with water at 20 ± 3 ºC (68 ± 5ºF) at atmospheric pressure.
(c) Subject the test specimen to a hydraulic shock consisting of a rapid increase in pressure to 2,758 ± 200 kPa (400 ± 29 psi) lasting 0.01 ± 0.005 s.
(d) Repeat the hydraulic shock once every 2 s for 10,000 times.

5.7.2 Performance Requirement

There shall be no leakage.

5.8 Vibration Test

5.8.1 Test Procedure

The vibration test shall be conducted as follows:

(a) Assemble the test specimen by joining six lengths of tube or pipe with plain-ends, three couplings, and two elbows, as illustrated in Figure 1.
(b) Mount the test specimen in a test apparatus capable of vibrating it while pressurized.
(c) Fill the test specimen with water at 20 ± 3 ºC (68 ± 5ºF).
(d) Pressurize the test specimen to 2,414 ± 48 kPa (350 ± 7 psi).
(e) Subject the test specimen to 1,000,000 vibration cycles. A vibration cycle shall be a forward and reverse movement of 1.6 mm (0.065 in) [3.2 mm (0.13 in) total amplitude] at a frequency of 25 ± 2 Hz.
(f) At the completion of 1,000,000 cycles, increase the test specimen pressure to 2,758 ± 48 kPa (400 ± 7 psi).
(g) Maintain the pressure in step (f) for 48 h.

5.8.2 Performance Requirement

There shall be no leakage.

5.9 Thermal Cycling Test

5.9.1 Test Procedure

The thermal cycling test shall be conducted as follows:

(a) Assemble the test specimen using fittings and Type L hard drawn copper tube, un-annealed stainless steel pipe, or Schedule 10 carbon steel pipe as illustrated in Figures 2(a) or 2(b).
(b) Mount the test specimen in a test apparatus capable of flowing water at a pressure of 1,000 ± 48 kPa (145 ± 7 psi), or the manufacturer's rated pressure, whichever is greater.
(c) Subject NPS-2 and smaller test specimens to 5,000 thermal cycles by flowing water through the test specimen at:
    (i) 20 ± 3 ºC (68 ± 5ºF) for 15 min; and
    (ii) 93 ± 3 ºC (200 ± 5ºF) for 15 min.
(d) Subject NPS-2-1/2 and larger test specimens to 2,500 thermal cycles by flowing water through the test specimen at:
    (i) 20 ± 3 ºC (68 ± 5ºF) for 30 min; and
    (ii) 93 ± 3 ºC (200 ± 5ºF) for 30 min.
(e) Ensure that the water temperature change during each thermal cycle occurs within 2 min.

5.9.2 Performance Requirement

There shall be no leakage.

5.9.3 Alternate Thermal Cycling Test

5.9.3.1 Alternate Test Procedure

Alternatively, the thermal cycling test may be conducted as follows:

(a) Assemble six test specimens consisting of fittings and Type L hard drawn copper tube, un-annealed stainless steel pipe, or Schedule 10 carbon steel pipe, in accordance with the manufacturer's installation instructions. The tubes or pipes shall not have press connection ends.
(b) Pressurize the test specimens with nitrogen or air to 690 ± 69 kPa (100 ± 10 psi).
(c) Immerse the test specimens in water at 20 ± 3 ºC (68 ± 5ºF).
(d) Check the test specimens for leaks.
(e) If there are no leaks, subject the test specimens to 2,500 cycles of temperatures, with each complete cycle consisting of the following four steps in the following order:
    (i) immersion in water at 93 ± 3 ºC (200 ± 5ºF) for 2 min ± 5 s;
    (ii) immersion in air at laboratory ambient temperature for 2 min ± 5 s;
    (iii) immersion in water at 20 ± 3 ºC (68 ± 5ºF) for 2 min ± 5 s; and
    (iv) immersion in air at laboratory ambient temperature for 2 min ± 5 s.

5.9.3.2 Performance Requirements for the Alternate Test Method

There shall be no leakage or separation of the joints.

5.10 Dynamic Torsion Test for Press Connections

5.10.1 Test Procedure

The dynamic torsion test for press connections shall be conducted as follows:

(a) Assemble two test specimens using a press coupling to join two lengths of Type L hard drawn copper tube, un-annealed stainless steel pipe, or carbon steel pipe. The tubes or pipes shall not have press connection ends.
(b) Mount one test specimen in a dynamic torsion test apparatus capable of rotating the test specimen 5º in both directions.
(c) Fill one test specimen with water at 20 ± 3 ºC (68 ± 5ºF).
(d) Subject the test specimen to 10,000 cycles, with each cycle consisting of a 5º rotation in one direction, reversing to the starting point, rotating 5º in the other direction, and rotating back to the starting point.
(e) Fill the second specimen with water at 93 ± 3 ºC (200 ± 5ºF).
(f) Subject the second test specimen to the procedure specified in step (d).
(g) At the completion of the cycling tests, pressurize the test specimens to 2,758 ± 48 kPa (400 ± 7 psi) with water at 20 ± 3 ºC (68 ± 5ºF).
(h) Maintain the pressure and temperature in step (g) for 48 h.

5.10.2 Performance Requirement

No leakage shall occur.

6 Markings and Accompanying Literature

6.1 Markings

Fittings, tube, and pipe complying with this Standard shall be marked with the:

(a) manufacturer's name or trademark;

(b) nominal size; and

(c) legend “PW” or “Potable Water”, when intended for potable water applications (see Section 4.4).

~~**6.2** In addition to the marking requirements specified in Section 6.1,~~

~~(a) copper tube or pipe shall be marked in accordance with ASTM B42, ASTM B43, ASTM B75, ASTM B88; ASTM B135, ASTM B251, ASTM B302, or ASTM B447~~

~~(b) stainless steel pipe and tubing shall be marked in accordance with ASME B36.19, ASTM A269, ASTM A312, ASTM A554, or ASTM A778; and~~

~~(c) carbon steel pipe shall be marked in accordance with ASME B36.10 or ASTM A53.~~

6.~~3~~2 Visibility

Markings shall be permanent or indelible and in legible letters and numerals.

Table 1
Dimensional Requirements of Stainless Steel Fittings and Pipe other than Schedule 5, 10, and 40
(See Section 1.1.1)

	Dimensions	
NPS	**OD in (mm)**	**Wall Thickness in (mm)**
1/2	0.50 (12.7)	0.024 to 0.031 (0.6 to 0.8)
5/8	0.63 (15.9)	0.024 to 0.031 (0.6 to 0.8)
3/4	0.75 (19.1)	0.031 to 0.039 (0.8 to 1.0)
7/8	0.875 (22.3)	0.031 to 0.039 (0.8 to 1.0)
1	1.00 (25.4)	0.039 to 0.047 (1.0 to 1.2)
1-1/8	1.13 (28.7)	0.039 to 0.047 (1.0 to 1.2)
1-1/4	1.25 (31.8)	0.039 to 0.047 (1.0 to 1.2)
1-3/8	1.37 (33.9)	0.039 to 0.047 (1.0 to 1.2)
1-1/2	1.50 (38.1)	0.059 to 0.079 (1.5 to 2.0)
1-5/8	1.63 (41.2)	0.059 to 0.079 (1.5 to 2.0)
1-7/8	1.88 (47.6)	0.059 to 0.079 (1.5 to 2.0)
2	2.00 (50.8)	0.059 to 0.079 (1.5 to 2.0)
2.1/2	2.50 (63.5)	0.059 to 0.079 (1.5 to 2.0)
3	3.00 (76.2)	0.059 to 0.079 (1.5 to 2.0)
3.1/2	3.50 (88.9)	0.059 to 0.079 (1.5 to 2.0)
4	4.00 (101.6)	0.059 to 0.079 (1.5 to 2.0)
4-1/4	4.25 (108.0)	0.059 to 0.079 (1.5 to 2.0)

Wall tolerance ±10 % of specified wall thickness.

Table 2
Maximum Slippage per Joint
(See Sections 5.2.1.2 and 5.2.2.2)

Nominal Pipe Size	Maximum Slippage per Joint		
	During the First Hour of Testing, mm (in)	After the First Hour and Until the Conclusion of the Test	
		at 20 ºC (68ºF), mm (in)	at 93 ºC (200ºF), mm (in)
1/2	0.3 (0.012)	0.05 (0.002)	0.05 (0.002)
3/4	0.3 (0.012)	0.05 (0.002)	0.05 (0.002)
1	0.8 (0.032)	0.05 (0.002)	0.05 (0.002)
1-1/4	1.0 (0.039)	0.05 (0.002)	0.05 (0.002)
1-1/2	1.5 (0.059)	0.05 (0.002)	0.05 (0.002)
2	2.0 (0.079)	0.05 (0.002)	0.05 (0.002)
2-1/2	2.5 (0.098)	0.10 (0.004)	0.05 (0.002)
3	3.0 (0.118)	0.10 (0.004)	0.05 (0.002)
3-1/2	3.5 (0.138)	0.10 (0.004)	0.05 (0.002)
4	4.0 (0.157)	0.10 (0.004)	0.05 (0.002)

Table 3
Static Loads
(See Section 5.4.1)

Nominal Pipe Size	Static load, kg (lb)
1/2	11 (25)
3/4	18 (40)
1	24 (53)
1-1/4	31 (68)
1-1/2	38 (84)
2	50 (110)
2-1/2	63 (139)
3	77 (170)
3-1/2	92 (203)
4	109 (240)

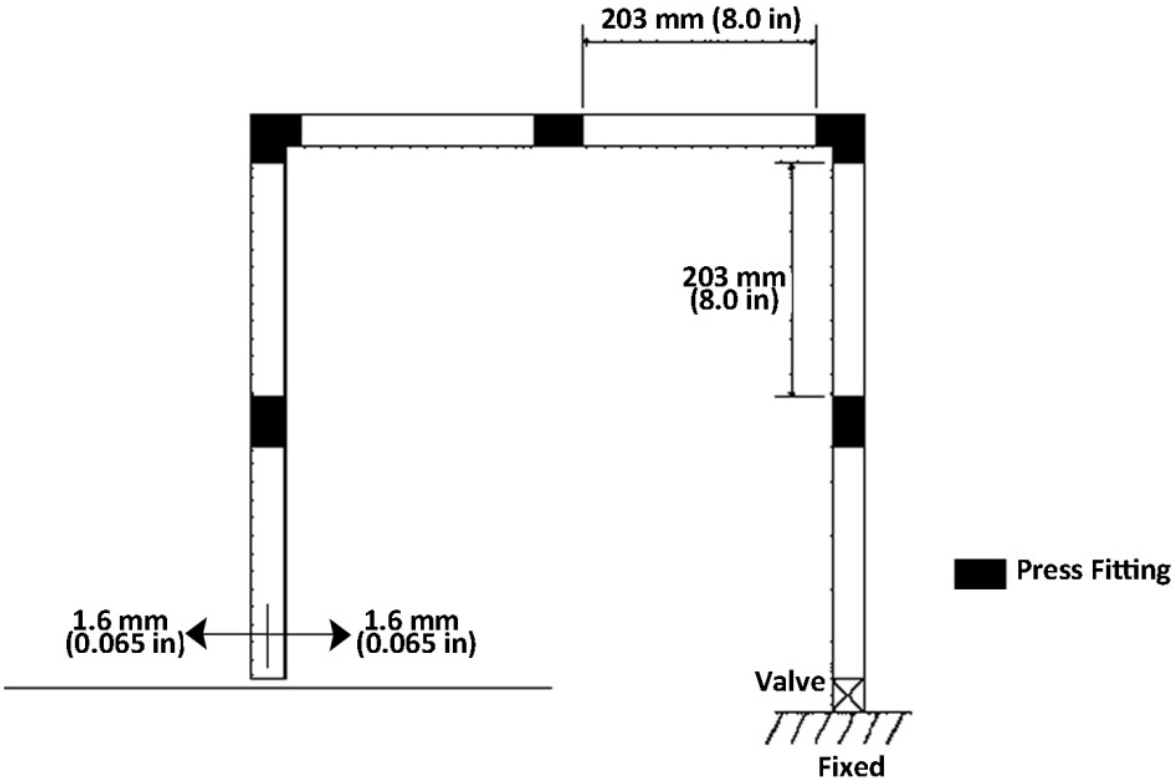
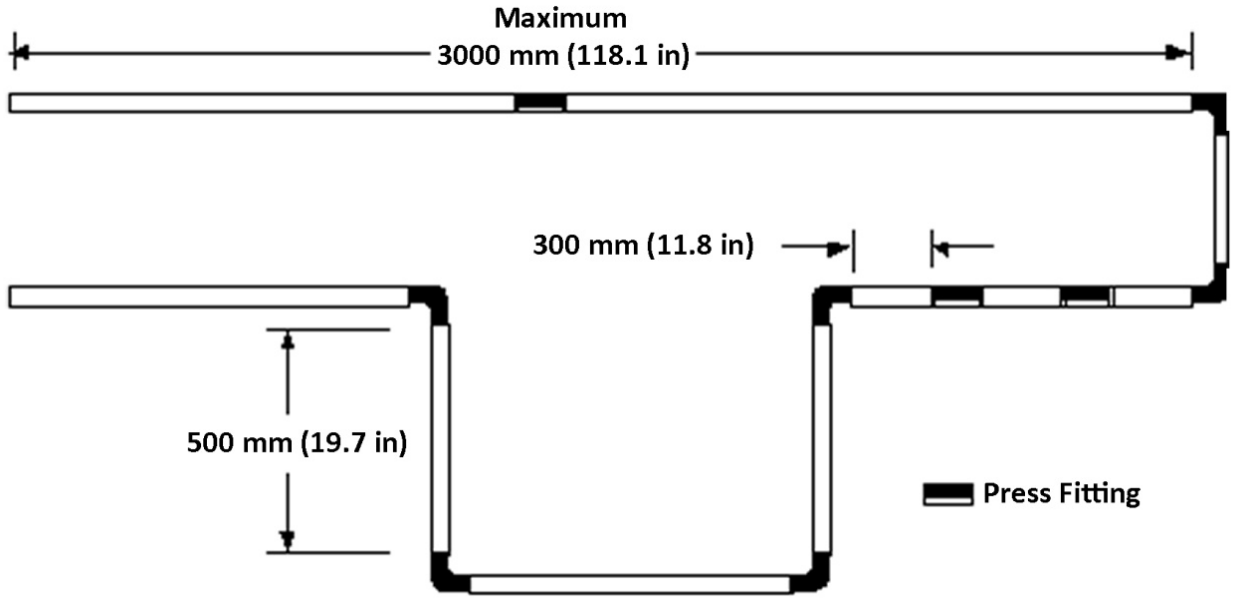
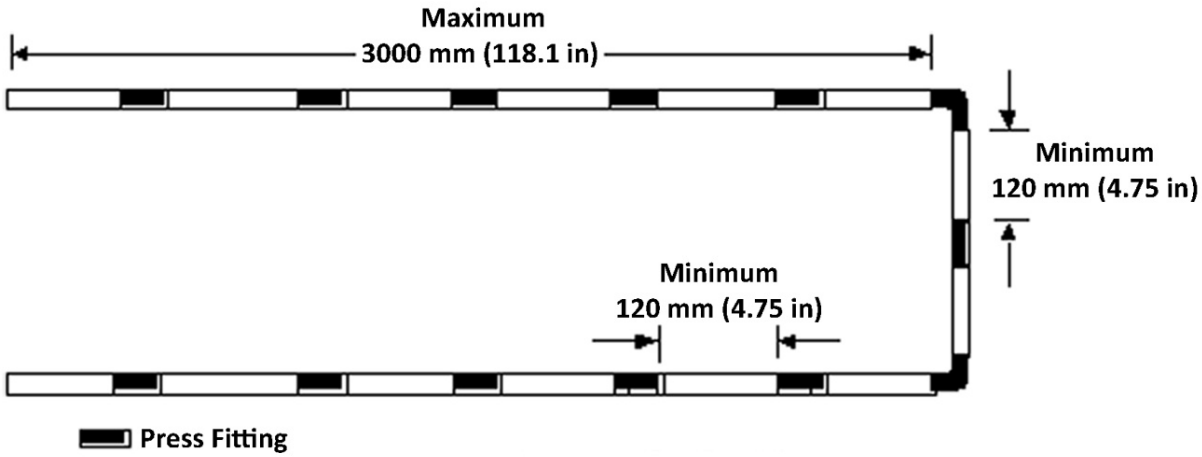


Figure 1
Vibration Test Set Up
(See Section 5.7.1)



(a) Test Specimen for NPS-2 and Smaller Sizes



(b) Test Specimen for NPS-2-1/2 and Larger Sizes

Figure 2
Thermal Cycling Test Specimens
(See Section 5.8.1)