UL 1995 Transition to UL 60335-2-40

JULY 31
2019

Existing products impacted by, but do not yet comply with the new Electric Heat Back-up Protection requirements or the Ultraviolet Light (UV) requirements noted in UL 1995, 5th edition must be evaluated for compliance

JANUARY 1
2024

All products shall comply with UL 60335-2-40 3rd edition by January 1, 2024. Today, products may be listed to either UL 1995 or UL 60355-2-40. However, with minimum equipment efficiency changes scheduled for 2023 and 2024, coupled with Low GWP refrigerant requirements expected in several states, all equipment within the scope of UL 1995 shall be retested to the requirements in the 3rd edition UL 60335-2-40

DECEMBER
2018

UL 60335-2-40 3rd edition is out for ballot. This edition contains A2L refrigerant specific requirements. The scope now aligns with UL 1995

FEBRUARY 6
2019

60335-2-40 ballot closes

SEPTEMBER 15
2017

UL 60335-2-40, 2nd edition published

- Includes requirements for air-conditioners rated up to 15kV, partial units, and revised electric heat requirements.
- Includes requirements for the use of A2 and A3 (flammable) refrigerants.

JULY 15
2015

UL 1995, 5th edition published

The 5th Edition covers all products..

NOVEMBER 30
2012

UL 60335-2-40, 1st edition published

- Covers products rated less than 600 Volts.
- Does not include requirements for the use of A2 and A3 (flammable) refrigerants.

Currently, manufacturers may have UL 1995 Certified products evaluated to UL 60335-2-40. UL 1995 will remain a valid certification standard through January 1, 2024, when it will be effectively obsoleted. At that time, UL 1995 will no longer be used to certify new products.

Empowering Trust™

Case History – Examples of Valsir Pex-Al-Pex Gas Pipe and Fitting Systems used in Europe and Australia / New Zealand

Chaffers dock - Wellington (New Zealand)

Torri Camuzzi - Pescara (Italy)

I Navigli - Padova (Italy)

INTERNATIONAL

Designation: F1281 – 17

An American National Standard

Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe[1]

This standard is issued under the fixed designation F1281; 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 a coextruded crosslinked polyethylene composite pressure pipe with a welded aluminum tube reinforcement between the inner and outer layers. The inner and outer crosslinked polyethylene layers are bonded to the aluminum tube by a melt adhesive. Included is a system of nomenclature for the crosslinked polyethylene-aluminum-crosslinked polyethylene (PEX-AL-PEX) pipes, the requirements and test methods for materials, the dimensions of the component layers and finished pipe, adhesion tests, and the burst and sustained pressure performance. Also given are the requirements and methods of marking. The pipe covered by this specification is intended for use in potable water distribution systems for residential and commercial applications, water service, underground irrigation systems, and radient panel heating systems, baseboard, snow- and ice-melt systems, and gases that are compatible with the composite pipe and fittings.

1.2 This specification covers only composite pipes incorporating a welded aluminum tube. Pipes consisting of metallic layers not welded together are outside the scope of this specification.

1.3 Specifications for connectors for use with pipe meeting the requirements of this specification are given in Annex A1.

1.4 This specification excludes polyethylene-aluminum-polyethylene pipes (see Specification F1282).

1.5 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.6 The following precautionary caveat pertains only to the test methods 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, health and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D618 Practice for Conditioning Plastics for Testing
D883 Terminology Relating to Plastics
D1598 Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
D1599 Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings
D1600 Terminology for Abbreviated Terms Relating to Plastics
D1898 Practice for Sampling of Plastics (Withdrawn 1998)[3]
D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
D2765 Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics
D3350 Specification for Polyethylene Plastics Pipe and Fittings Materials
E8 Test Methods for Tension Testing of Metallic Materials
F412 Terminology Relating to Plastic Piping Systems
F1282 Specification for Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe
F1974 Specification for Metal Insert Fittings for Polyethylene/Aluminum/Polyethylene and Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene Composite Pressure Pipe

2.2 *National Sanitation Foundation Standard:*

Standard No. 61 Drinking Water System Components—Health Effects[4]

[1] This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.11 on Composite.

Current edition approved Aug. 1, 2017. Published August 2017. Originally approved in 1990. Last previous edition approved in 2011 as F1281 – 11. DOI: 10.1520/F1281-17.

[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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140, http://www.nsf.org.

***A Summary of Changes section appears at the end of this standard**

Standard No. 14 Plastics Piping System Components and Related Materials[4]

2.3 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipments (Civil Agencies)[5]

2.4 *Military Standard:*

MIL-STD-129 Marking for Shipment and Storage[5]

2.5 *Uniform Classification Committee Standard:*

Uniform Freight Classification[6]

2.6 *National Motor Freight Traffic Association Standard:*

National Motor Freight Classification[7]

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology F412, and abbreviations are in accordance with Terminology D1600, unless otherwise specified.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *assembly*—the joint between a fitting and a length of pipe.

3.2.2 *PEX-AL-PEX pipe*—composite pipe produced by coextrusion or extrusion of layers of polyethylene/aluminum/polyethylene bonded together with a melt adhesive and crosslinked by irradiation or chemical means in combination heat and moisture.

3.2.3 *pipe hoop stress*—for simplicity the value of the hoop stress quoted assumes a homogeneous wall. Local values of stress will vary with the different layers (see 3.2.3.1).

3.2.3.1 *Discussion*—Thick walled plastic pipes produced from one material have hoop stresses that vary through the wall, and are usually described by the Lame Theory. The composite nature of the PEX-AL-PEX pipe, composed of materials with very different Young's Modulus values, will, on pressurization, not have a uniform stress distribution through the thickness of the wall of the pipe. The PEX-AL-PEX pipes have a hoop stress distribution that differs substantially from both the thick and thin walled pipe cases.

4. Pipe Classification

4.1 *Pipe Diameter*—The PEX-AL-PEX pipes are classified by the outside diameter.

4.2 *Pipe Dimension Ratio*—The concept of dimension ratio is not relevant to PEX-AL-PEX composite pipes, and cannot be used to relate pressure rating with total wall thickness.

5. Materials

5.1 *General*—The PEX-AL-PEX pipe is composed of one metallic layer, two layers of polymeric adhesive, and two layers of crosslinked polyethylene. For pipe made to this specification the constituent materials must meet the following requirements:

5.2 *Aluminum*—The aluminum shall have a thickness as specified in Table 1. The material shall have minimum elongations and ultimate tensile strengths of 20 % and 100 MPa (14 600 psi), respectively. The tests shall be conducted according to Test Methods E8.

5.3 *Crosslinked Polyethylene:*

5.3.1 The polyethylene shall be, in the final finished state in the pipe, crosslinked as defined in Terminology D883.

5.3.2 Polyethylene plastics used to make pipe meeting the requirements of this specification shall be virgin resin meeting the requirements of either Grade PE20A, B, or C; Grade PE23A, B, or C; Grade PE30A, B, or C; or Grade PE33A, B, or C in accordance with Specification D3350.

5.3.3 Class B compounds shall have sufficient ultraviolet (UV) stabilizers to protect the pipe from deleterious effects due to continuous outdoor exposure during storage and shipping. Pipe produced from Class B compounds are not suitable for exposed outdoor application. Class A, B, and C compounds shall have sufficient antioxidants to meet the requirements in Specification D3350.

5.4 *Melt Adhesive*—The material shall have a density cell of 1, 2, or 3; a melt index cell of 1, 2, or 3; and a color code of A or B, in accordance with Specification D3350.

[5] Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, http://quicksearch.dla.mil.

[6] Available from the Uniform Classification Committee, Suite 1106, 222 South Riverside Plaza, Chicago, IL 60606.

[7] Available from the National Motor Freight Traffic Association, Inc., National Motor Freight Classification, American Tracking Associations, Inc., Traffic Dept., 1616 P St., NW, Washington, DC 20036.

TABLE 1 Outside Diameters, Aluminum Thickness, and Tolerances for PEX-AL-PEX

Diameter Nominal (DN)	Nominal Pipe Size (NPS)	Minimum Outside Diameter, mm (in.)	Tolerance on Minimum, mm (in.)	Maximum Out-of-Roundness,[A] mm (in.)	Minimum Aluminum Thickness, mm (in.)	Tolerance on Thickness, mm (in.)
12	⅜	12.00 (0.472)	+0.30 (0.012)	0.3 (0.012)	0.18 (0.007)	+0.09 (+0.0035)
16	¼	16.00 (0.630)	+0.30 (0.012)	0.4 (0.016)	0.18 (0.007)	+0.15 (+0.006)
20	⅝	20.00 (0.787)	+0.30 (0.012)	0.5 (0.020)	0.23 (0.009)	+0.23 (+0.009)
25	¾	25.00 (0.984)	+0.30 (0.012)	0.5 (0.020)	0.23 (0.009)	+0.09 (+0.0035)
26	⅞	26.00 (1.022)	+0.30 (0.012)	0.5 (0.020)	0.53 (0.021)	+0.10 (+0.004)
32	1	32.00 (1.260)	+0.30 (0.012)	0.5 (0.020)	0.28 (0.011)	+0.09 (+0.0035)
40	1¼	39.95 (1.573)	+0.30 (0.012)	0.5 (0.020)	0.33 (0.013)	...
50	1½	49.90 (1.964)	+0.30 (0.012)	0.5 (0.020)	0.47 (0.018)	...
63	2	62.90 (2.484)	+0.40 (0.016)	0.5 (0.020)	0.57 (0.022)	...
75	2¼	75.10 (2.957)	+0.60 (0.024)	1.0 (0.039)	0.67 (0.026)	...

[A] The out-of-roundness specification applies only to tubing prior to coiling.

5.5 *Rework Material*—The use of reclaimed, recycled, or rework plastics is not permitted.

6. Requirements

6.1 *General*—The requirements and test methods in this specification cover PEX-AL-PEX pipes. Tests on the individual layers that comprise this composite pipe are outside the scope of this specification. The raw materials used, however, must conform to the requirements as set out in Section 5.

6.2 *Dimensions and Tolerances of Pipe:*

6.2.1 *Pipe Diameter*—The minimum outside diameter and tolerances of the pipe shall meet the requirements given in Table 1, when measured in accordance with 9.1 and 9.1.2. Maximum and minimum (out-of-roundness) tolerances apply only to measurements made on pipe prior to coiling.

6.2.2 *Pipe Wall Thickness*—The total pipe wall thickness shall meet the requirements given in Table 2, when measured in accordance with 9.1 and 9.1.3. The minimum wall thickness at any point of measurement of the pipe shall not be less than the value specified in Table 2.

6.2.3 *Inner and Outer Crosslinked Polyethylene Layer Thicknesses*—The thicknesses of the inner and outer layers of crosslinked polyethylene in the PEX-AL-PEX pipe shall have minimum values and tolerance as specified in Table 2, except for the polyethylene material in the outer PEX layer overlaying the weld, which shall have a minimum thickness of half those specified in Table 2. The polyethylene thicknesses shall be measured in accordance with 9.2.

6.2.4 *Pipe Length*—The pipe shall be supplied coiled or in straight lengths as agreed upon with the purchaser and with an allowable tolerance of −0 mm (−0 in.).

6.3 *Adhesion Test:*

6.3.1 For Sizes 0912 (⅜) to 2532 (1) there shall be no delamination of the PEX and AL, either on the bore side or the outside (see Fig. 1). The test shall be conducted in accordance with 9.3.1.

6.3.2 The adhesion test of the PEX-layer to the aluminum for Sizes 3240 (1¼) to 6075 (2½) is carried out by a separation test. The minimum adhesive force is specified in Table 3. The adhesive force shall not fall below these levels. The test shall be conducted in accordance with 9.3.2.

6.4 *Apparent Tensile Strength of Pipe*—The pipe rings, when tested in accordance with 9.4, shall meet the minimum strength specifications defined in Table 4.

6.5 *Burst Pressure*—The minimum burst pressure for PEX-AL-PEX pipe shall be as given in Table 4, when determined in accordance with 9.5.

6.6 *Sustained Pressure*—The PEX-AL-PEX pipe shall not fail, balloon, burst, or weep, as defined in Test Method D1598, when tested for 10 h at the test at the test pressure given in Table 5 at a temperature of 82°C (180°F) in accordance with 9.6.

6.7 *Gel Content*—When tested in accordance with 9.7, the gel content of the inner and outer tubes of crosslinked polyethylene shall have minimum values of either 65 % for the fully crosslinked silane material or 60 % for radiation crosslinked polyethylene. Test Methods D2765 defines gel content (see Note 2).

NOTE 1—The gel test is one of several methods capable of indicating the degree of crosslinking. The different methods for assessing degree of crosslinking do not necessarily agree, so conformity to this specification requires degree of crosslinking to be determined in accordance with 9.7 only.

7. Workmanship

7.1 The pipe shall be free of visible cracks, holes, foreign inclusions, blisters, and other known injurious defects. The pipe shall be as uniform as practicable in color, opacity, density, and other physical properties.

8. Sampling and Conditioning

8.1 *Sampling*—Take a sample of the PEX-AL-PEX pipe sufficient to determine conformance with this specification. The number of specimens designated for each test shall be taken from pipe selected at random in accordance with the random sampling plan of Practice D1898.

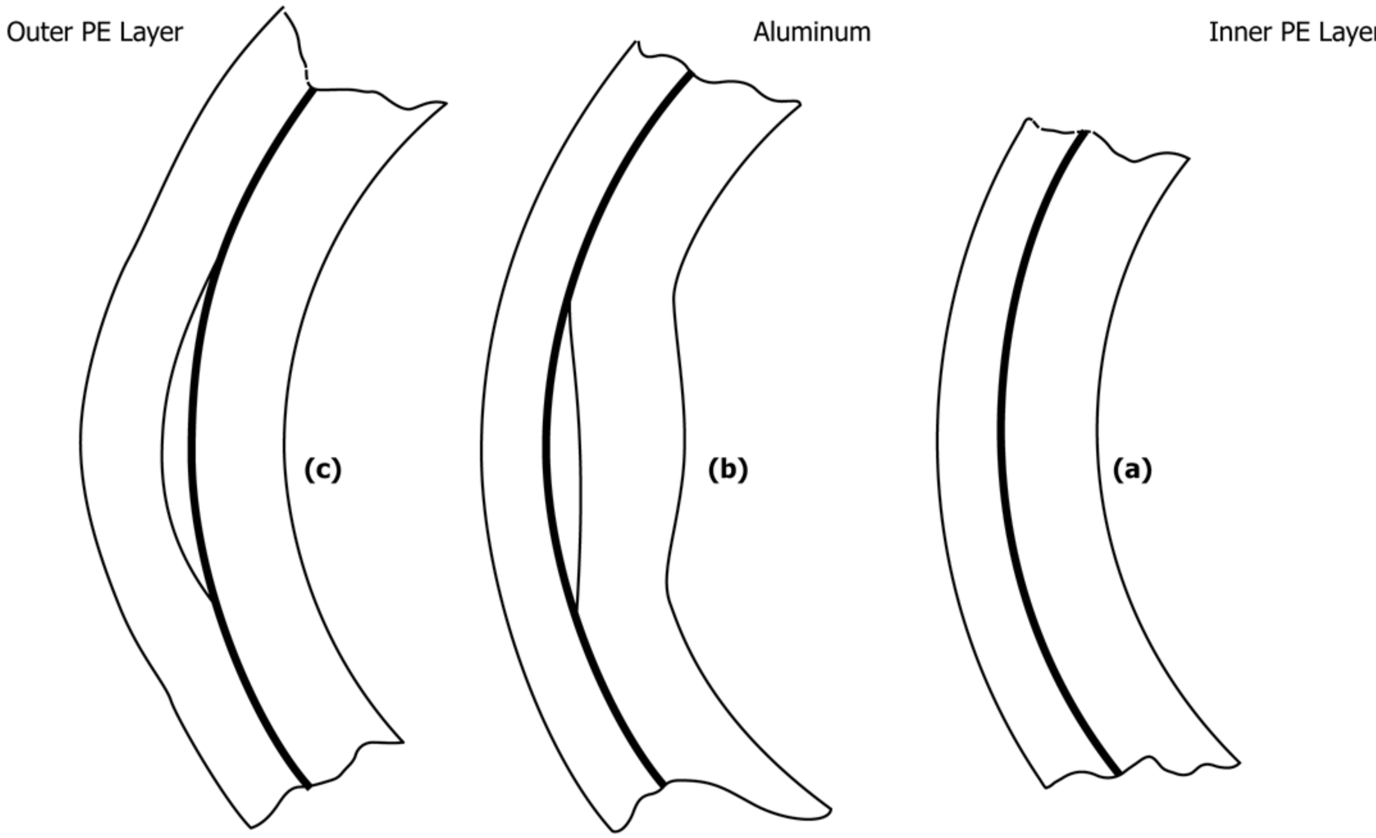
NOTE 2—Sample size and testing frequency of lots for quality control must be established by the manufacturer to ensure conformance to the specification. Sampling and frequency will vary with the specific circumstances.

8.2 *Test Specimens*—Not less than 50 % of the test specimens required for any pressure test shall have at least part of the marking in their central sections. The central section is that portion of the pipe that is at least one pipe diameter away from an end closure.

8.3 *Conditioning*—Condition the specimens at 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 5 % relative humidity for not less than 40 h prior to test in accordance with Procedure A of

TABLE 2 Wall Thickness for PEX-AL-PEX Composite Pipe

Diameter Nominal (DN)	Nominal Pipe Size (NPS)	Total Wall Thickness, min, mm (in.)	Wall Tolerance (+) mm (in.)	Outer PEX Layer Thickness, min, mm (in.)	Inner PEX Layer Thickness, min, mm (in.)
12	⅜	1.60 (0.063)	0.40 (0.016)	0.40 (0.016)	0.70 (0.028)
16	¼	1.65 (0.065)	0.65 (0.022)	0.40 (0.016)	0.90 (0.035)
20	⅝	1.90 (0.075)	0.40 (0.016)	0.40 (0.016)	0.96 (0.038)
25	¾	2.25 (0.089)	0.50 (0.020)	0.40 (0.016)	1.10 (0.043)
26	⅞	3.00 (0.118)	0.33 (0.013)	0.40 (0.016)	1.32 (0.052)
32	1	2.90 (0.114)	0.60 (0.024)	0.40 (0.016)	1.34 (0.053)
40	1¼	3.40 (0.134)	0.60 (0.024)	0.40 (0.016)	1.45 (0.057)
50	1½	4.00 (0.157)	0.60 (0.024)	0.40 (0.016)	1.75 (0.069)
63	2	4.60 (0.181)	0.60 (0.024)	0.40 (0.016)	1.75 (0.069)
75	2¼	7.25 (0.285)	0.60 (0.024)	0.40 (0.016)	2.80 (0.110)



NOTE 1—(a) Good pipe showing no delamination, (b) Delamination between the inner layer and the aluminum, and (c) Delamination between the outer layer and the aluminum.

FIG. 1 Detection of Delamination

TABLE 3 Minimum Adhesive Force for PEX-Al-PEX Composite Pipe

Diameter Nominal (DN)	Nominal Pipe Size (NPS)	Minimum Adhesive Force per 10-mm (0.394-in.) Pipe Strip, N (lbf)
40	1¼	40 (9.0)
50	1½	50 (11.2)
63	2	60 (13.5)
75	2¼	70 (15.7)

TABLE 4 Minimum Pipe Ring Strengths and 23°C (73.4°F) Burst Pressure of PEX-AL-PEX Composite Pipe

Diameter Nominal (DN)	Nominal Pipe Size (NPS)	Minimum Pipe Ring Strength, Type II PE, N(lb)	Minimum Pipe Ring Strength, Type III PE, N(lb)	Minimum 23°C (73.4°F) Burst Pressure, kPa (psi)
12	⅜	2000 (448)	2100 (470)	7000 (1020)
16	¼	2100 (470)	2300 (515)	6000 (880)
20	⅝	2400 (538)	2500 (560)	5000 (730)
25	¾	2400 (538)	2500 (560)	4000 (580)
26	⅞	2400 (538)	2500 (560)	4000 (580)
32	1	2650 (598)	2500 (560)	4000 (580)
40	1¼	3200 (719)	3500 (789)	4000 (580)
50	1½	3500 (789)	3700 (832)	3800 (554)
63	2	5200 (1169)	5500 (1236)	3800 (554)
75	2¼	6000 (1349)	6000 (1349)	3800 (554)

Practice D618, for those tests where conditioning is required. In cases of disagreement, the tolerances shall be ±1°C (±1.8°F) and ±2 % relative humidity.

TABLE 5 Minimum Sustained Pressure for PEX-AL-PEX Composite Pipe

Diameter Nominal (DN)	Nominal Pipe Size (NPS)	Minimum Sustained Pressure PEX-AL-PEX, kPa (psi)
12	⅜	2720 (395)
16	¼	2720 (395)
20	⅝	2720 (395)
25	¾	2720 (395)
26	⅞	2720 (395)
32	1	2720 (395)
40	1¼	2000 (295)
50	1½	2000 (295)
63	2	2000 (295)
75	2¼	2000 (295)

8.4 *Test Conditions*—Conduct the test in the standard laboratory atmosphere of 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 5 % relative humidity, unless otherwise specified in the test methods or in this specification. In cases of disagreement, the tolerances shall be ±1°C (1.8°F) and ±2 % relative humidity.

9. Test Methods

9.1 *Dimensions and Tolerances:*

9.1.1 *Pipe*—Any length of the PEX-AL-PEX composite pipe may be used to determine dimensions.

9.1.2 *Outside Diameter*—Measure the outside diameter of the PEX-AL-PEX pipe in accordance with Test Method D2122.

9.1.3 *Wall Thickness*—Make micrometre measurements of the wall thickness in accordance with Test Method D2122 to determine the maximum and minimum values. Measure the wall thickness at both ends of the pipe to the nearest 0.01 mm (0.0004 in.).

9.2 *Inner and Outer Crosslinked Polyethylene Layer Thicknesses:*

9.2.1 *Sample Preparation*—Cut the pipe with a sharp knife or other suitable cutter, ensuring that the pipe after cutting is not more than 10 % out-of-round.

9.2.2 *Thickness Determination*—Use a hand-held magnifying glass equipped with graduated reticule, or a laboratory microscope with graduated reticule. The reticule should measure to the nearest to 0.1 mm (0.004 in.). Determine the thickness of the inner and outer layers of crosslinked polyethylene (exclusive of the adhesive layer) at six points around the circumference. One of the points only should be at the aluminum weld.

9.3 *Adhesion Tests:*

9.3.1 *Visual Test:*

9.3.1.1 *Cutting the Spiral*—Mount a Stanley 1991 or similarly sharp but rigid razor-like blade within a protective housing and angle to cut a 45 ± 5° spiral in the pipe (see Fig. 2). Choose a PEX-AL-PEX pipe at random and insert into the housing and rotate to form the spiral cut. The cut goes through the complete wall on one side of the pipe only. Run the spiral along the pipe for a minimum distance along the pipe axis equal to five times the outside diameter.

9.3.1.2 *Examining for Delamination*—Firmly hold the pipe with the spiral cut firm at the uncut end and create a ribbon of pipe material by opening out the spiral-cut pipe. Pliers can be used to grip the spiral-cut pipe. Examine the wall of the pipe visually side-on for evidence of delamination between the metal and plastic layers (see Fig. 1).

9.3.2 *Separation Test:*

9.3.2.1 *Specimen*—Five pipe sections of 10-mm (0.394-in.) length are cut at random intervals. The outer layers of the pipe (outer PEX-layer together with the aluminum) are separated mechanically from the inner PEX-layer with an appropriate device on the opposite side to the welding seam. The outer layers are separated on one side to about 5 mm from the pipe in order to allow clamping. The adhesion for the outer PEX-layer to the aluminum is then visually examined for delamination at the corresponding test sample.

9.3.2.2 *Test Equipment:*

(1) Tension Testing Device, with suitable pull-off device (see Fig. 3).

(2) D_{roller} = 95 % of the required pipe inner diameter.

(3) d_i = pipe inner diameter.

9.3.2.3 *Test Procedure*—Remove the outer layers from the pipe at 23 ± 2°C (73.4 ± 3.6°F) with a linear speed of 50 mm/min (≈2 in./min). Record the force diagram.

9.4 *Ring Test:*

9.4.1 *Sample Size and Shape*—Cut rings of the PEX-AL-PEX pipe so that the two sides are parallel and at 90 ± 2° to the pipe axis. The width of each ring shall be 25 ± 1 mm (1 ± 0.04 in.). Cut a minimum of 15 samples consecutively along the axis of the pipe.

9.4.2 *Ring Tests*—Test the 15 consecutively cut samples using a tensile testing machine. Arrange the rings so that the aluminum weld is at 90° to the tensile axis as shown in Fig. 4. The crosshead speed shall be 50 ± 2.5 mm/min (2 ± 0.1 in./min). Mount the rings of pipe on two steel rods of minimum diameter of 4 mm (0.16 in.). Record the peak force.

9.5 *Burst Pressure:*

9.5.1 *Pipe Sample*—Select a length of PEX-AL-PEX pipe at random and prepare five consecutive lengths of 300 ± 5 mm (12 ± 0.2 in.). Seal samples at the ends with the appropriate fittings and test either free- or fixed-end.

9.5.2 *Temperature Control*—Test samples at a temperature of 23 ± 2°C (73.4 ± 3.6°F). Contain samples either in a temperature controlled water bath or in air (at standard laboratory atmosphere). For samples contained in a water bath, 1 h conditioning is required. For samples tested in air, a 16 h conditioning period is required.

9.5.3 *Burst Pressure*—Determine the burst pressure in accordance with the procedure in Test Method D1599.

9.6 *Sustained Pressure Test:*

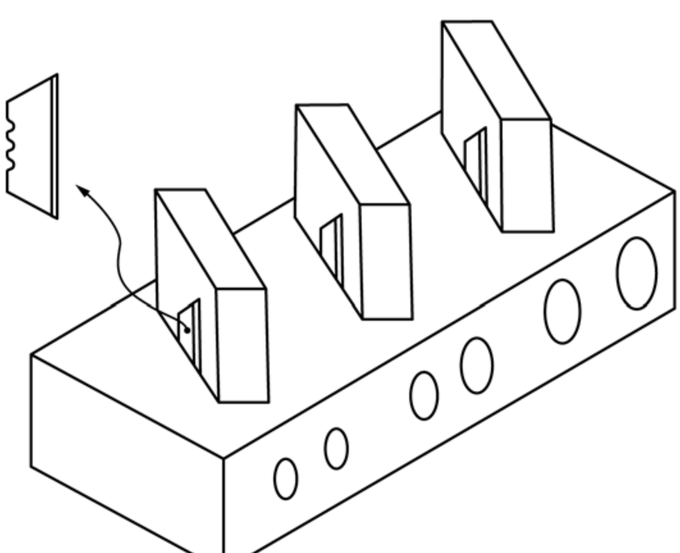


FIG. 2 Spiral Cutter for the Delamination Test

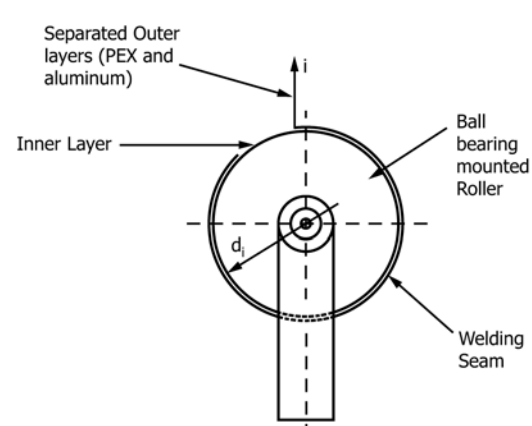


FIG. 3 Setup for Separation Test

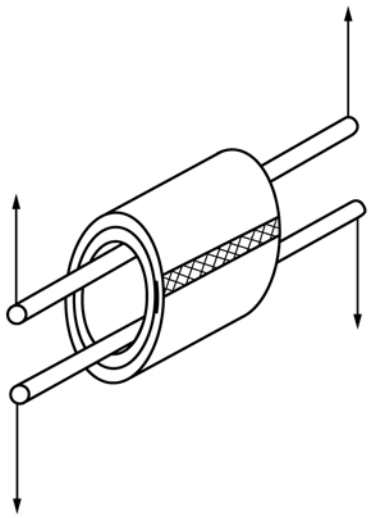


FIG. 4 Schematic Presentation of the Pipe Ring Test Showing the Aluminum Weld at 90° to the Tensile Axis

9.6.1 *Samples*—Each test sample of PEX-AL-PEX pipe shall have a minimum length between end closures of at least ten times the average outside diameter, but not less than 250 mm (10 in.). Seal specimens at both ends with the appropriate fittings and fill the samples for testing with water.

9.6.2 *Test Procedures*—Test the samples in a temperature controlled water bath or in air, in accordance with Test Method D1598. A test temperature of 82 ± 2°C (180 ± 3.6°F) is specified. For each pipe size test six samples. For testing in a water bath, condition the test samples for at least 2 h in the water bath at the test temperature prior to pressurization For testing in air, condition the samples for at least 4 h in air at the test temperature prior to pressurization. Maintain the pressure at the pressure given in Table 5 for the duration of the test.

9.6.3 *Failure*—Any continuous loss of pressure of the test sample shall constitute failure of the test. Failure of one of the six is cause for retest of six additional samples under identical conditions. Failure of one of six of the retested samples below the minimum specified lifetime constitutes failure of the test.

9.7 *Gel Content Determination:*

9.7.1 *Sample Preparation*—Condition the PEX-AL-PEX pipe in a water bath for a minimum of 24 h at a minimum temperature of 80°C (176°F) prior to testing to ensure full crosslinking of the resin. Before taking samples for gel content evaluation, put pipe in an air-circulating oven at 120°C (248°F) for 20 min. Using a lathe, remove 0.1-mm (0.004-in.) thick strands from the outside layer, and 0.2-mm (0.008-in.) thick strands from the inside layer, long enough to obtain a 0.3-g sample for testing. Care should be taken not to cut into the adhesive layer, as it will effect the test results. (See Note 3.)

9.7.2 *Test Method*—Test the sample from the inner and outer surface separately and in accordance with Sections 12 and 13 of Test Methods D2765, Test Method A.

NOTE 3—Including the adhesive in the test specimen will lower the gel content resulting in a false reading.

10. Quality Assurance

10.1 *Quality Assurance*—When the product is marked with this designation, ASTM F1281, 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. When specified in the purchase order or contract, a report of the test results shall be furnished.

11. Marking

11.1 *Quality of Marking*—The marking shall be applied to the pipe in such a manner that it remains legible (easily read) after installation.

11.2 Markings on the tubing shall include the following, spaced at intervals of not more than 1.5 m (5 ft):

11.2.1 Nominal tubing size (for example, 1216),

11.2.2 The material designation "PEX-AL-PEX,"

11.2.3 Pressure rating for water and temperature for which the pressure rating is valid,

11.2.4 ASTM designation F1281, with which the tubing complies, and

11.2.5 Manufacturer's name (or trademark) and production code.

11.2.6 Tubing intended for the transport of potable water shall also include the seal or mark of the laboratory making the evaluation and the number of the standard used for the evaluation.

NOTE 4—Manufacturers using the seal or mark of a laboratory must obtain prior authorization from the laboratory concerned.

12. Keywords

12.1 composite; crosslinked PE; PEX-AL-PEX; pipe; pressure

SUPPLEMENTARY REQUIREMENTS

GOVERNMENT/MILITARY PROCUREMENT

These requirements apply *only* to Federal/Military procurement, not domestic sales or transfers.

S1. *Responsibility for Inspection*—Unless otherwise specified in the contract or purchase order, the producer is responsible for the performance of 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 disapproved by the purchaser. 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 Government 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 material shall be packaged in accordance with the supplier's standard practice in a manner ensuring arrival at destination in a satisfactory condition and that will be acceptable to the carrier at lowest rates. Containers and packaging 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 S1.2—The inclusion of U. S. Federal 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 be in contact with potable water.

S3. 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.

CHLORINE RESISTANCE EVALUATION

The following supplemental requirements shall apply to any product intended to be used in a water system which utilizes residual free chlorine as a disinfecting agent.

S4. *Evaluation Methodology*—Multi-layer (composite) piping shall be tested and evaluated in accordance with S5 for multi-layer products using PEX materials that were tested in a solid-wall form.

S5. *Procedure for Using Data from Solid-wall PEX Testing*—The 95 % lower confidence limit of the multi-layer piping product minimum estimated failure time shall be at least 50 years when evaluated in accordance with S5.1–S5.3 using conditions of 0.55 MPa (80 psig) internal pressure, 25 % use at 60°C (140°F) and 75 % use at 23°C (73°F).

S5.1 *PEX Material Test*—The PEX material shall be tested in accordance with Test Method F2023 using solid-wall pipe samples.

S5.1.1 The test fluid shall be prepared in accordance with 9.1.1 of F2023.

S5.1.2 The regression analysis shall be performed in accordance with, and comply with the requirements of Section 13 Calculation, F2023.

S5.2 *Application to Multi-layer Construction*—Testing of the multi-layer product shall be conducted as specified in S5.2.1–S5.2.7.

S5.2.1 Determine the sizes of pipe for testing. Two sizes are required, such that one size has the inner-layer dimension ratio ($ILDR = OD_{inner\ layer} / t_{inner\ layer}$) in the lowest 25 % of the range of inner layer DR's and the other size has an ILDR in the upper 25 % of the range.

S5.2.2 Initiate testing of one specimen of each of the sizes determined in S5.2.1 at the highest temperature/pressure (for example, 115°C/60 psi) condition used for the solid wall. This is condition ML1.

S5.2.3 Initiate testing of one specimen at the same temperature, but a higher stress level (for example, 115°C/80 psi). This is condition ML2. The specimen shall be the thinnest inner-layer product of the two sizes.

S5.2.4 Initiate testing of one specimen at the same stress level and next lowest temperature used for the original solid-wall testing (for example, 105°C/80 psi). This is condition ML3. The specimen shall be the heavier inner-layer wall thickness product of the two sizes.

S5.2.5 Calculate the expected fail times (EFT) for each size being tested at each condition in accordance with S5.3.

S5.2.6 Two methods of evaluation are available for the multi-layer finished product testing. The pipe specimens tested at conditions ML1, ML2 and ML3 shall meet the requirements of S5.2.6.1 or S5.2.6.2.

S5.2.6.1 For this method, continue testing each specimen to 150 % of EFT for each condition. Failure of any specimen prior to 150 % of EFT shall constitute a failure of this test.

S5.2.6.2 For this alternate method, continue the testing of each specimen until each specimen has the following times are achieved:

(1) ML1 – 100 % of EFT
(2) ML2 – 150 % of EFT
(3) ML3 – 50 % of EFT

Failure of any specimens prior to the EFT at each test condition shall constitute a failure of this test.

S5.2.6.2.1 Examine each of the ML3 specimens to determine the amount of crack propagation through the inner wall at the location with the heaviest signs of cracking. Cracks propagating completely through the inner wall in these specimens shall be considered a failure of this test.

S5.2.6.2.2 To aid in determination of the crack propagation at the inner wall, the ML3 (50 % fail time, heaviest wall) specimen is cut longitudinally and examined microscopically. Regions exhibiting the most severe cracking and oxidation of the inner layer are then sectioned laterally. This lateral cut is examined microscopically to determine if brittle cracks have reached the aluminum layer. If the inner layer is sufficiently embrittled such that the specimen cannot be sectioned for examination, it shall be considered a failure of this test.

S5.3 *Calculation of Expected Fail Times for Multi-layer Construction*—The expected fail times used for testing the multi-layer products shall be determined in accordance with S5.3.1–S5.3.3.

S5.3.1 *Known Quantities and Symbols*— The following values must be known for each multi-layer construction in order to complete the calculations:

Tubing OD, mm
Outer PEX layer thickness, t_{opex}, mm
Aluminum thickness, t_{AL}, mm
Inner PEX layer thickness, t_{ipex}, mm
PEX tensile modulus, E_{pex}, MPa

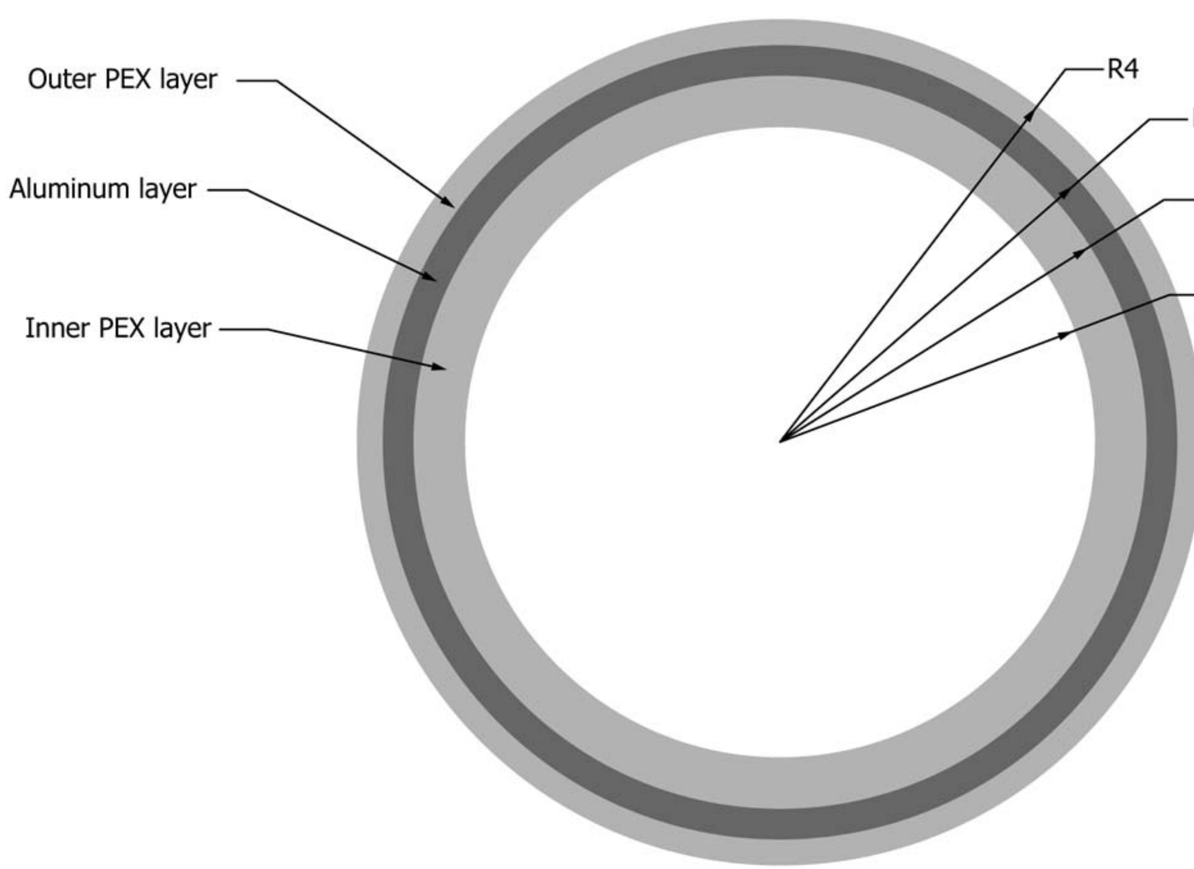


FIG. S1.1 Multi-layer Construction and Definition of Different Radii

Aluminum tensile modulus, E_{AL}, MPa
Adhesive layer thickness, mm
Internal pressure, P, MPa
Temperature, T, K
Coefficients for stress-rupture equation of solid PEX, C1, C2, C4

S5.3.2 *Preliminary Calculations*—Determine the various radii and dimension ratio as follows:

R4 = (tubing OD) / 2

R3 = R4 – (outer PEX layer thickness + outer adhesive thickness)

R2 = R3 – aluminum layer thickness

R1 = R2 – (inner PEX layer thickness + inner adhesive thickness)

Dimension ratio of aluminum, $DR_{AL} = 2 \cdot R3 \, / \, t_{AL}$

S5.3.3 *Procedure*—Determine the estimated fail time of the inner layer in accordance with S5.3.3.1–S5.3.3.5.

S5.3.3.1 Calculate the circumferential strain in the aluminum layer based on internal pressure. Assume that the stress is sufficiently low that the aluminum behaves linearly.

Hoop stress in aluminum layer:

$$\sigma_{AL} = \frac{P}{2}\left(DR_{AL} - 1\right) \tag{1}$$

Circumferential strain in aluminum layer:

$$\varepsilon_{AL} = \frac{\sigma_{AL}}{E_{AL}} \tag{2}$$

S5.3.3.2 Assume the strain in the inner PEX layer is the same as the strain in the aluminum layer. Use this strain to calculate stress in the PEX layer.

NOTE 7—This assumes small, linear strains in the PEX. This will be a reasonable assumption with the aluminum reinforcing layer, provided the aluminum is still in the linear region.

Stress at inner PEX layer:

$$\sigma_{PEX} = \left(\varepsilon_{AL}\right)\left(E_{PEX}\right) \tag{3}$$

S5.3.3.3 Calculate the estimated fail time based on this stress and the temperature of interest (that is, test temperature or end-use temperature).

Fail time of inner layer:

$$\text{Log}(f) = C1 + \frac{C2}{T} + \frac{C4}{T} \cdot \text{Log}\left(\sigma_{PEX}\right) \tag{4}$$

S5.3.3.4 Adjust the expected fail time based on the ratio of the inner layer thickness to the original solid-wall test sample thickness.

Adjusted inner layer fail time:

$$f' = f\,\frac{(\text{inner layer thickness})}{(\text{solid} - \text{wall thickness})} \tag{5}$$

S5.3.3.5 This adjusted inner layer fail time is the expected fail time (EFT) for use in S5.2, Application to Multi-layer Construction.

S5.3.3.6 Calculate the 95 % lower confidence limit for the multi-layer product at an internal pressure of 5.5 MPa (80 psig) and temperature of 60°C (140°F) using Eq 6 and the pipe dimensions that result in the maximum inner layer hoop stress within the product range. Designate this result as LCL_{60}. Repeat this calculation using an internal pressure of 5.5 MPa (80 psig) and temperature of 23°C (73°F). Designate this as LCL_{23}.

95 % LCL of the expected time to failure for multi-layer product at 60°C (see ISO 9080 or a statistics text for details):

$$\text{Log}(f) = C1 + \frac{C2}{T} + \frac{C4}{T} \cdot \text{Log}\left(\sigma_{80}\right) - (t)\,(s)\left[\frac{1}{n} + X_o^T \left(X^T X\right)^{-1} X_o\right]^{1/2} \tag{6}$$

S5.3.3.7 Calculate the Miner's Rule extrapolated time using the LCL values (LCL_{60} and LCL_{23}) from S5.3.3.6 in Eq 7. Eq 7 assumes the product is operated at 23°C for 75 % of the time, and 60°C for 25 % of the time, both at an internal pressure of 80 psig.

Miner's Rule calculation for extrapolated time to failure:

$$\text{Extrapolated time (h)} = \frac{100}{\frac{25}{LCL_{60}} + \frac{75}{LCL_{23}}} \tag{7}$$

ANNEXES

(Mandatory Information)

A1. CONNECTORS

A1.1 Connectors shall be made from brass or any other material found to be suitable for the service conditions.

A1.2 The connectors shall be designed so that a seal is effected on the internal wall surface of the pipe so that the medium contained in the pipe is precluded from coming into contact with the cut end of the pipe.

A1.3 Connectors not made from brass shall be capable of meeting the short term pipe test requirements listed in 6.5 and 6.6 of this specification and the long-term hydrostatic capabilities of the pipe at elevated temperatures listed in Appendix X1.

A2. PERFORMANCE REQUIREMENTS OF CONNECTORS

A2.1 *General*—All performance testing of connectors shall be performed on assemblies of connectors and PEX/AL/PEX pipe meeting the requirements of this specification. Assembly of test specimens shall be in accordance with Appendix X3. Use separate sets of assemblies for each performance test requirement.

NOTE A2.1—Fittings manufactured in compliance with Specification F1974 meet all of the performance requirements provided in this Annex.

A2.2 *Hydrostatic Burst*—Assemblies shall meet the minimum hydrostatic burst requirements shown in Table A2.1 when tested in accordance with 9.5, except that the test temperature shall be 180°F (82.2°C).

A2.3 *Hydrostatic Sustained Pressure Strength*—Pipe and connector assemblies shall not separate or leak when tested in accordance with A2.6.2.

A2.4 *Thermocycling*—Assemblies shall not leak or separate when thermocycled 1000 cycles between the temperatures of 60°F (15.6°C) and 180°F (82.2°C) in accordance with A2.6.3.

A2.5 *Excessive Temperature–Pressure Capability*:

A2.5.1 *General*—In the event of a water heating system malfunction assemblies shall have adequate strength to accommodate short-term conditions, 48 h or 210 ± 4°F (99 ± 2°C) and 150 psi (1034 kPa) until repairs can be made.

A2.5.2 *Excessive Temperature Hydrostatic Sustained Pressure*—Assemblies shall not leak or separate when tested in accordance with A2.6.4.

A2.6 *Test Methods*:

A2.6.1 Sampling and Conditioning shall be done in accordance with Section 8.

A2.6.2 *Hydrostatic Sustained Pressure:*

A2.6.2.1 Perform the test on at least six assemblies in accordance with Test Method D1598, except for the following:

(1) The test temperature shall be at 180 ± 4°F (82.2 ± 2°C),

(2) Test pressure shall be 320 psi (2 205 kPa),

(3) The external test environment shall be air or water, and

(4) The specimens shall be filled with water at a temperature of at least 120°F (49°C).

TABLE A2.1 Minimum Hydrostatic Burst Strength Requirements for Connector and PEX/AL/PEX Pipe Assemblies

Nominal Pipe Size, mm (in.)		Minimum Burst Pressures	
		psi at 180°F	kPa at 82.2°C
1216	(½)	580	(4000)
1620	(⅝)	550	(3800)
2025	(¾)	465	(3200)
2026	(⅞)	465	(3200)
2532	(1)	465	(3200)
3240	1 (¼)	362	(2500)
4150	1 (½)	333	(2300)
5163	(2)	295	(2000)
6075	2 (½)	295	(2000)

A2.6.2.2 Leakage or separation at any joint tested at less than 1000 h at the sustained pressure shall constitute failure in this test.

A2.6.3 *Thermocycling:*

A2.6.3.1 *Summary of Test Method*—This test method describes a pass-fail test for thermally cycling assemblies comprised of insert connector and pipe 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 (82.2°C).

A2.6.3.2 *Apparatus*—A compressed air or nitrogen pressure source capable of maintaining an internal pressure of 100 ± 10 psi (690 ± 69 kPa) on the specimens is required. A dip test apparatus capable of automatically immersing test samples at prescribed intervals in temperature controlled water baths capable of providing continuous water temperatures of 60 ± 4°F (15.6 ± 2°C) and 180 ± 4°F (82.2 ± 2°C) is required.

A2.6.3.3 *Specimen Preparation*—Six assemblies of the type of connector to be tested shall be prepared. The connectors with suitable lengths of pipe meeting the requirements of the applicable standard shall be assembled and attached to a common manifold. Assemble strictly according to the instructions of the connector manufacturer. Close the specimen assembly with any suitable end closures that allow "free end" mounting and will not leak under the thermocycling conditions, and connect the specimen assembly to the pressure source.

A2.6.3.4 *Procedure*—Correction to correspond with 100 ± 10 psi (690) ± 69 kPa), immerse in 60 ± 4°F (15.6 ± 2°C) water, and check for leaks. Eliminate all leaks before the thermocycling test is started. With the specimen assembly pressurized to 100 ± 10 psi (690 ± 69 kPa), thermally cycle it between 60 ± 4°F (15.6 ± 2°C) and 180 ± 4°F (82.2 ± 2°C) by means of immersion in water using the following test cycle (see Note A2.2):

Water immersion at 180°F (82.2°C)	2 min minimum
Air immersion at ambient	2 min maximum
Water immersion at 60°F (15.6°C)	2 min minimum
Air immersion at ambient	2 min maximum

NOTE A2.2—If the test must be interrupted before completion, samples are to be kept at room temperature until the test is restarted.

(1) Upon completion of 1000 cycles, immerse the specimen assembly again in 60°F (15.6 ± 2°C) water, and check for leaks. Any evidence of leakage at the connectors or separation of the connectors from the pipe constitutes failure.

(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 D1599. Leakage or separation during the hydrostatic burst test of any of the joints in the assembly at less than the pressure shown in Table A2.1 shall constitute failure of this test.

A2.6.3.5 *Interpretation of Results*—Failure of any one of six specimens in the assembly shall constitute failure of this test.

A2.6.4 *Excessive Temperature and Pressure Capability:*

A2.6.4.1 Test six assemblies in accordance with Test Method D1598, except the following:

(1) The test temperature shall be 210 ± 4°F (99 ± 2°C),

(2) The test pressure shall be 150 psi (1 034 kPa),

(3) The external test environment shall be air,

(4) The specimens shall be filled with water at a temperature of at least 120°F (49°C).

A2.6.4.2 Leakage or separation at any joint tested at less than 720 h at the test pressure shall constitute failure in this test.

A2.7 Product Marking of Connectors:

A2.7.1 *Quality Assurance*—When the connector or connector packing is marked with the ASTM Designation F1281, 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.

A2.7.2 *Quality of Marking*—The marking shall be applied to the connectors in such a manner that it remains legible after installation and inspection.

A2.7.3 *Content of Marking:*

A2.7.3.1 Marking on connectors shall include:

(1) Manufacturer's name or trademark, or some other identifying mark, and

(2) F1281 or F1281/2, the standard designation.

A2.7.3.2 Marking on packaging shall include:

(1) Manufacturer's name,

(2) Connector size, and

(3) "ASTM F1281".

A2.7.3.3 Marking on crimp rings shall include the code letters, PAP.

APPENDIXES

(Nonmandatory Information)

X1. PRESSURE RATING

X1.1 The hydrostatic design basis-pressures for water recommended by the Plastic Pipe Institute are used to pressure rate the PEX-AL-PEX composite pipe covered by this specification. These design basis-pressures are 2.76 MPa (400 psi) at 23°C (73.4°F), 2.21 MPa (320 psi) at 60°C (140°F) and 1.72 MPa (250 psi) at 83°C (180°F). These hydrostatic design basis-pressures apply only to pipe meeting all of the requirements of this specification.

X1.2 The PEX-AL-PEX composite pipe meeting the requirements of this specification shall be pressure rated for maximum water pressures of 1.38 MPa (200 psi) at 23°C (73.4°F), 1.10 MPa (160 psi) at 60°C (140°F) or 0.86 MPa (125 psi) at 83°C (180°F), or a combination thereof.

X2. STORAGE

X2.1 *Outside Storage*—Pipe should be stored on a flat surface and supported in a manner that will prevent distortion.

X3. JOINING

X3.1 Cut the pipe square to the proper length.

X3.2 Select the proper size tool (if required) for pipe preparation/joining. Only use tools specific to the design of the connector system.

X3.3 Assemble and complete the joint in accordance with the manufacturer's instructions specific to the type of connectors being used.

SUMMARY OF CHANGES

Committee F17 has identified the location of selected changes to this standard since the last issue (F1281–11) that may impact the use of this standard.

(1) Removed dimensions from "Nominal Pipe Size" in Table 1, Table 2, Table 3, Table 4, and Table 5 corrected values for NPS.

(2) Added inner PEX layer to 6.2.3 and 9.2 to be consistent with Table 2.

INSTALLATION MANUAL

PEXALGAS

JONES STEPHENS™
We Got It

ATTENTION!

The installation of Jones Stephens Flexible Gas piping must be performed by a trained installer as required by the state and local administrative authority administering the provisions of the code where the gas piping is installed.

All systems using Jones Stephens piping shall be designed and installed according to the requirements of this guide.

Only Jones Stephens piping components may be used in the system. Components from other PEX-AL-PEX systems are not interchangeable. Only components supplied or specified by Jones Stephens shall be used.

Installation shall be in accordance with local codes, or in their absence, in accordance with the National Fuel Gas Code ANSI Z223.1 in the USA, and CAN/CGA - B149.1 & B149.2 in Canada. In cases where the requirements of this guide conflict with the local code, the local code must take precedence, unless the local authority having jurisdiction approves a variance, or change.

Inspection, testing, and purging shall be performed according to the procedures in Part 4 of the National Fuel Gas Code, ANSI Z223.1, and CAN/CGA - B149 installation Codes or in accordance with local codes.

This system and related components shall be used only in gas piping systems where the operating gas pressure does not exceed 72 psi (5 bar).

Piping may be buried underground or in concrete. Underground pipes must be laid at a distance of at least 3 feet from any waste pipes and they must be positioned above the same. The piping does not require any protection in particular when laid underground, as long as an appropriate bedding is prepared for the pipes and the same are covered with a layer of at least 8 inches of fine sand or strained clay. Underground pipes that enter the building must be fitted with a sealed sleeve at the end, in order to prevent water, gas and animals from entering the building. Jones Stephens does not recommend burial of brass fittings or components.

The PEX-AL-PEX pipe is typically routed:

- Beneath, through and alongside floor joists
- Inside interior wall cavities
- On top of ceiling joists in attic space

Carefully unwind and route the piping from the reel to the required location, making certain not to kink, tangle or apply excessive force.

Piping end must be temporarily capped closed prior to installation to prevent contamination from foreign material.

When installing Jones Stephens piping avoid sharp bends, stretching, kinking, twisting, or contacting sharp objects. The tubing shall be replaced if damage occurs.

IMPORTANT - READ ENTIRE MANUAL

INTRODUCTION

USER WARNINGS

The use of fuel gas can be dangerous. Special attention must be given to the proper design, installation, testing and application of the gas piping system. Sound engineering practices and principles must be exercised, as well as diligent adherence to the proper installation procedures to ensure the safe operation of the piping system. All installed systems must pass customary installation inspections by the local building official have authority prior to being placed into service. This document is intended to provide the user with general guidance when designing and installing a Jones Stephens piping system, its use with any other gas tubing system is inappropriate and may result in serious bodily injury and property damage. When local gas or building codes impose greater requirements than this document, you should adhere to the local code requirements. Performance of accessory devices, such as pressure regulators and shut off valves, should be reconfirmed by contacting the accessory device manufacturer and receiving the latest technical data on sizing, installation, and performance.

Improper installation methods or procedures could lead to accidents such as explosions, fires, gas poisoning, asphyxiation, etc. This system shall be installed with strict adherence to this guide as well as local building codes. All installed systems must pass installations inspections by the authorized local building official prior to being placed into service. Jones Stephens shall have no responsibility for any misinterpretation of the information contained in this manual or any improper installation, repair work, or deviation from the procedures recommended in this manual, whether pursuant to local building codes or engineering specifications.

Jones Stephens piping components shall not be used with other PEX-AL-PEX piping systems from other manufacturers.

Jones Stephens piping shall be used only in gas piping systems where the operation gas pressure does not exceed 72 psi (5 bar). Accessories for systems shall be rated for the operating gas pressure used. Thus, for example, accessories for 25 psi systems shall be rated for 25 psi service. Performance of accessory devices, such as pressure regulators and shut-off valves should be reconfirmed by contacting the accessory device manufacturer and receiving the latest technical data on sizing, installation, and performance.

A gas delivery system consisting of Jones Stephens piping offers significant advantages over other gas delivery systems because of its wall dimensions and design. In contrast to copper or rigid steel pipe, Jones Stephens piping does not require intermediate joints in most installations because the piping is capable of being installed in one continuous run, reducing not only the total number of joints, but also the potential for leaks at joints. Jones Stephens piping's flexibility also affords more installation options because an installer can avoid existing obstacles, and it eliminates repetitive measuring, cutting, threading and joint assemble that are common with rigid piping systems. Jones Stephens piping's flexibility offers further safety advantages in geographic areas that are prone to seismic activity because the tubing provides greater flexibility to withstand certain movement of the ground or structural shifts. Although Jones Stephens piping provides significant advantages over more rigid gas delivery systems, its wall dimensions may make it more likely than steel pipe to be punctured by a nail or other objects, or damaged by extraordinary forces such as a lightning strike, depending on the circumstances. Jones Stephens fittings are insulated to eliminate metal to metal contact between pipe and fittings. To maximize protection of the entire structure from lightning damage, installation of a lightning protection system shall be installed per NFPA 780 and other standards, particularly in areas prone to lightning. Note that lightning protections systems set forth in NFPA 780 and other standards go beyond the scope of this manual. Users of Jones Stephens piping systems shall consider all the limitations and benefits of Jones Stephens piping systems for their particular situation.

LIMITATION OF MANUAL

This document is intended to aid the user in the design, installation and testing of Jones Stephens piping systems to distribute fuel gas in residential housing units and commercial structures. It would be impossible for this guideline to anticipate and cover every possible variation in housing configuration, appliance loads and local restrictions. Therefore, there may be applications which are not covered in this manual. For applications beyond the scope of this guide, contact Jones Stephens. The techniques included within this guide are recommend practice for generic applications. These practices must be reviewed for compliance with all applicable local fuel gas and building codes. Accordingly, where local gas or building codes impose greater requirements than this manual, you should adhere to the local code requirements. This system and related components should only be used as fuel gas piping where the operation gas pressure does not exceed 72 psi (5 bar).

LISTING OF APPLICABLE CODES AND STANDARDS

Jones Stephens Gas Piping Systems comply with the following codes:

2021, 2018, 2015, 2012 and 2009 International Fuel Gas Code® (IFGC)

2021, 2018, 2015, 2012 and 2009 International Residential Code® (IRC)

2021, 2018, 2015, 2012 and 2009 Uniform Plumbing Code® (UPC)

Jones Stephens Gas Piping Systems comply with the following standards:

ASTM F1287 Standard Specification for Cross-linked Polyethylene/Aluminum/Cross-linked Polyethylene

DESCRIPTION OF SYSTEM AND COMPONENTS

Piping

The Jones Stephens (PEX-AL-PEX) Gas Piping System has been engineered, tested, and certified to meet the performance requirements of American Fuel Gas systems. As such is acceptable for use with all recognized fuel gases, including natural gas and propane (LPG).

The Jones Stephens Gas multilayer system combines the positive feature that are typical of crosslinked polyethylene PE-Xb and also those of aluminum; crosslinked polyethylene PE-Xb guarantees excellent mechanical, physical and chemical properties and the butt-welded aluminum pipe strengthens mechanical resistance introducing excellent characteristics of flexibility and malleability, fundamental features for accelerating and simplifying installation operations.

The result is a product that is composed of different layers of material, connected to each other, that allows excellent properties to be reached that otherwise would not be possible with a pipe made of one single material.

The Jones Stephens Gas Piping system is certified for systems with working pressures up to 72 psi.

Attention: Do not store or install PEX-AL-PEX exposed to direct sunlight.

Fittings

Jones Stephens Press Fittings is a system of press fittings suitable for a variety of applications. By using a portable pressing machine equipped with a suitable jaw, the pipe is shaped around the fitting insert. Even in the presence of temperature fluctuations, the joint remains perfectly gastight and cannot be loosened thanks to the stainless-steel sleeve that covers the portion of pipe in contact with the insert. The sleeve has inspection holes to verify the correct insertion of the pipe on the fitting.

The Jones Stephens Press Fittings require the use of a press tool that utilizes a TH profile pressing jaw.

Protection Devices:

Protective devices are to be used when piping passes through studs, joists, or other building materials that limit or restrict the movement of the flexible piping making it susceptible to physical damage from nails, screws, drill bits and other puncture threats.

- Stud Guards attach directly to studs and joists.
- Strip wound metallic conduit can be used in locations where additional protection may be required.

Pressure Regulators:

Required to be used to reduce elevated pressure, over 14 inches water column (1/2 PSI,) to standard low pressure required for most appliances.

Manifolds:

• Multiport gas distribution manifolds supply multiple gas appliances in parallel arrangement from a main distribution point.

• Multiple sizes and configurations ranging in female NPT sizes ½ through 2 with 3, 4 and 6 port cross manifold configurations.

Shutoff Valves:

Used to control the gas flow. Ball valves shut off the gas supply at appliances, manifolds, & regulators. Valves can be utilized at manifold locations reducing the number of joints due to the integrated fitting connection.

SYSTEM OVERVIEW

INTRODUCTION

The following section will be used to assist you while you design and size your Jones Stephens Gas multilayer system. At any point in which you require further assistance with this process you can visit our webpage (www.jonesstephens.com) or contact Jones Stephens.

It is required by this standard to provide installation instructions which include proper sizing tables and methods of sizing.

SYSTEM DESIGN

In order to properly design a fuel gas piping system, you must first recognize all the important criteria. Requirements for a proper system design include:

• Verify your system meets all local codes. When local codes conflict with the manufactures guidelines the local codes must always take precedence.

• Determine the supply pressure coming from the meter by means of a gauge or a rating supplied by the gas company.

• Determine your total system demand for all appliances as well as the largest single load.

• Prepare a floor plan sketch with the load and length combinations for all appliances.

• Determine your allowable pressure drop.

NOTE:

Please note that Jones Stephens sizing tables refer only to the pipe without including any other losses. Sizing must be done in accordance with NFPA 54 (National Fuel Gas Code), using both the TUBES and the FITTINGS sizing tables: this means that the results will be perfectly sized for the real installation. When choosing a pressure drop to size a Jones Stephens Gas multilayer system the minimum operating pressure of the appliance must be considered. Choosing a pressure drop that will reduce the supply pressure below the minimum operating pressure of the appliance will cause the appliance to perform poorly or not at all.

General Installation Practices

ATTENTION:
JONES STEPHENS GAS PIPING SYSTEM IS AN ENGINEERED FUEL GAS PIPING SYSTEM AND AS SUCH, THE TUBING AND FITTINGS ARE NOT INTERCHANGEABLE WITH OTHER PEX-AL-PEX MANUFACTURER'S PRODUCTS. THE USE OF OTHER PEX-AL-PEX PRODUCTS WITH THE JONES STEPHENS GAS PIPING SYSYEM IS PROHIBITED.

A. All System hardware should be stored in its original package in a clean dry location prior to installation. Care must be taken to ensure the PEX-AL-PEX piping is not damaged prior to installation.

B. Piping ends must be temporarily capped or plugged prior to installation to prevent dirt or other foreign debris from entering the tubing.

C. Piping exposed to extreme low temperatures should be allowed to come up to room temperature prior to installation, uncoiling, or bending. However, Jones Stephens PEX-AL-PEX piping can be installed in below zero conditions down to -40°F.

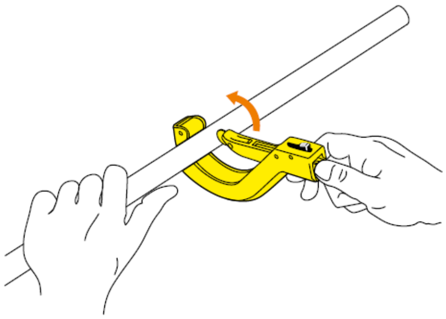
D. Care must be taken to not kink, tangle, twist, stretch or apply excessive force to the piping or fittings. The Jones Stephens Gas Piping is a flexible piping system and can be bent during installation around obstructions. Avoid stressing the tubing with tight bends. Refer to the table for the recommended bend radius.

Piping Size	**Minimum Bend Radius**
16	**2"**
20	**3"**
26	**3"**
32	**5"**

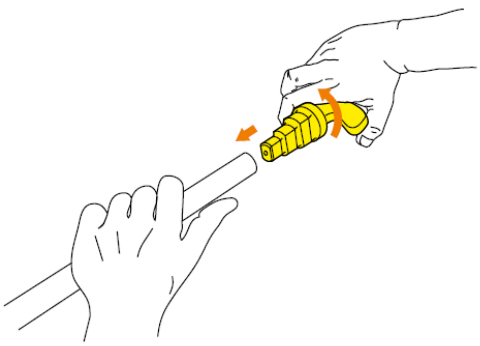
E. When installing in, through or around sharp metal structures (i.e. metal studs, sheet metal, I-beams), rubber grommets or protective tubing should be used to prevent any direct contact which could subject the piping to damage.

F. Tubing should be supported in a workman like manner with metallic pipe straps, bands, brackets, hangers or building structural components suitable for the size of piping support intervals are not to exceed those shown in the table below. A proper support is one which is designed to be used as a pipe hanger, does not damage the piping during installation, and provides full support of the tubing once installed. Plastic zip ties or cable ties are not to be used as the primary support for the PEX-AL-PEX tubing.

FITTING ASSEMBLY

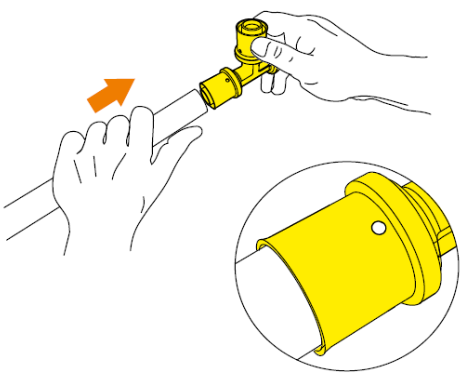


1. Cut the pipe at a right angle using a suitable pipe cutter. Check the tidiness and the sharpening of the blade to avoid any ovalization or damage to the pipe.

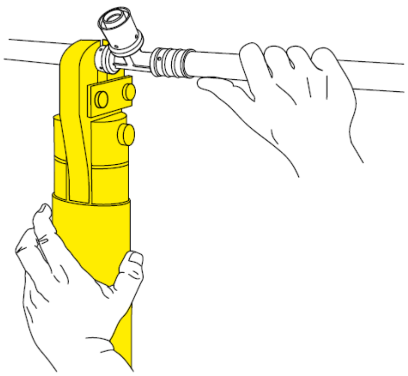


2. Calibrate and chamfer the pipe to obtain a perfectly round inner circumference of the pipe.

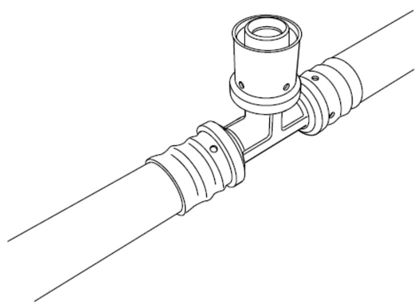
Always make sure that the reamer has no dents or damage as they would damage the pipe and compromise the seal.



3. Insert the fitting on the pipe checking through the sleeve inspection holes that the pipe has been properly inserted.
Remove any residual material left inside the pipe.



4. Position the pressing machine so that the pressing jaw is aligned and in position with respect to the body of the fitting and tighten by pressing the start button on the pressing machine (for more details refer to the instructions supplied with the pressing machine). Use pressing jaws provided by Jones Stephens whose pressing profile (TH) is compatible with the fitting that you are installing.



5. Remove the pressing jaw and verify through the metal sleeve inspection holes that the pipe has remained fully inserted during the whole connecting process.

NPT Threaded Connections.

Use Teflon (PTFE) tape or pipe thread sealants is acceptable if needed. Wrap PTFE tape clockwise 3-4 times. Apply thread sealant starting at the opening of the fitting that is significantly thick enough to fill the grooves of the first half of the thread only. The proper method of assembling tapered threaded connectors is to assemble them finger tight and then wrench tighten further to the specified number of turns from finger tight (T.F.F.T.) given in the table. Tightening torque should not exceed the values listed in the table below.

Connection Size (NPT)	T.F.F.T.	Maximum Torque (ft-lb)
½"	2 – 3	30
¾"	2 – 3	37
1"	1.5 – 2.5	52

Do not use Teflon tape or thread sealant on any PEX-AL-PEX press connections. Ensure thread sealant does not contact pipe or remain inside the fittings.

TUBING ROUTING

VERTICAL RUNS

Vertical runs inside hollow wall cavities are the preferred location for installation of vertical sections. To avoid damage, tubing should be free to move within the wall cavity without immediate supports between floors but must be supported at the point of penetration between floors. Vertical run support spacing is not to exceed 10 feet, requiring hangers only where the height of each floor is greater than 10 feet. The run must conform to Section x Protection, if it is installed in a location that it will be concealed.

HORIZONTAL RUNS

Areas beneath, alongside, or through floor and ceiling joists or other structural members are typical installation locations for both residential and commercial applications. Structural members may be considered supports for horizontal tubing if they meet the requirements as specified in the table below. The run must conform to Protection Section of this manual, if it is installed in a location that it will be concealed.

Piping Size	Minimum Hanger Spacing
16	40”
20	50”
26	60”
32	80”

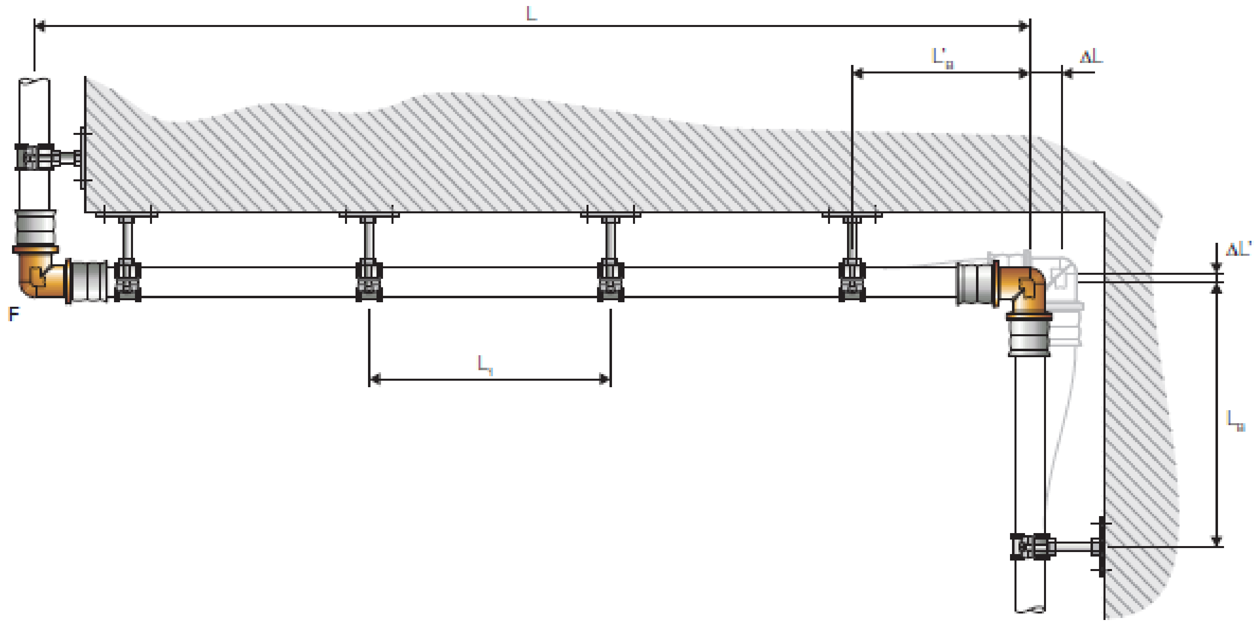
Expansion/Contraction of Piping

The coefficient of linear expansion of PEX-AL-PEX is 0.1”/100ft/10°F. Jones Stephens PEX-AL-PEX hangers make use of the flexibility of the pipes to accommodate the expansion and contraction of the straight lengths of pipe of the Jones Stephens Gas System.

Use of rigid clamps require accommodation for liner expansion and contraction of pipe. There are several techniques that can be used.

Compensation using a flexible arm (Type L)

This type of compensation avails of the changes of direction of the pipes; the segment of pipe (flexible arm) of length L_B accommodates the movement as a result of the thermal expansion of a segment of pipe of length L perpendicular to it. In this case, the correct distance of the pipe from the walls must be guaranteed to allow the movement, it is therefore necessary to install the brackets according to the structure of the flexible arm.



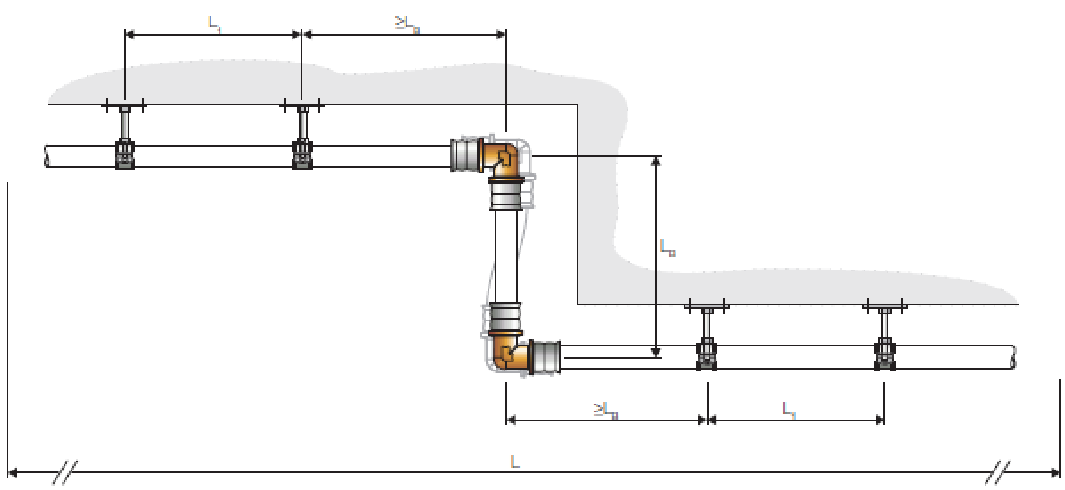
The length of the flexible arm L_B [mm] is calculated using the formula (represented also in the following diagram):

$$L_B = C \cdot \sqrt{De \cdot \Delta L}$$

where C is the material constant, which for Jones Stephens multilayer pipes is 33, De is the diameter of the pipe [mm] and ΔL is the change in length of the segment of pipe to be accommodated.

Compensation using flexible arm misalignment (Type Z)

This type of compensation avails of a misalignment of the pipe; the section of pipe (flexible arm) of length L_B accommodates the expansions of the pipe of length L perpendicular to it.
The distance between the flexible arm and the brackets must not be shorter than the length of the flexible arm L.

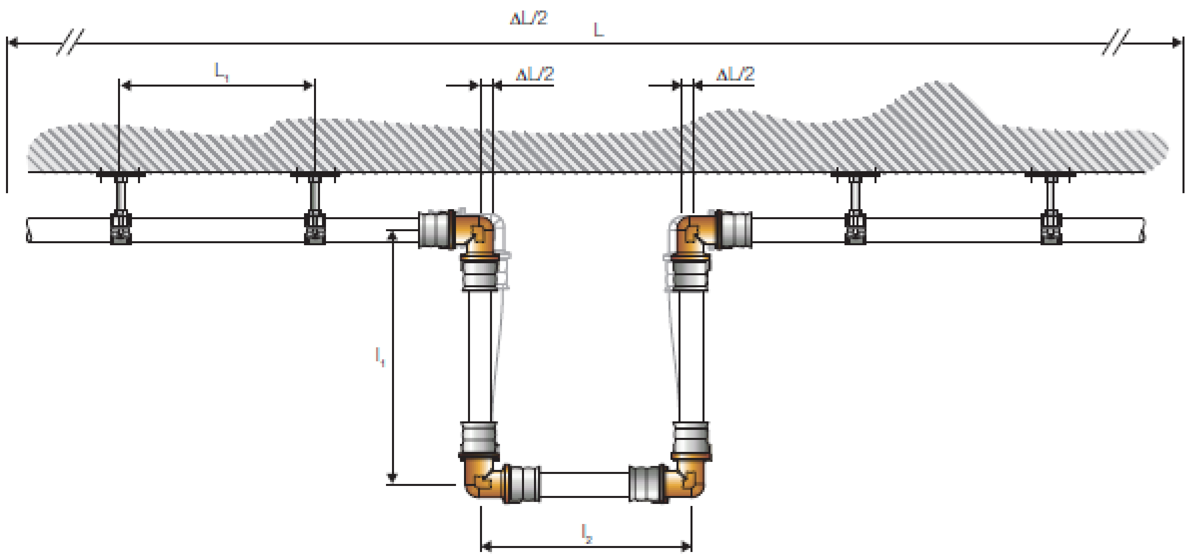


The length of the flexible arm L_B [mm] is calculated using the formula (also shown in the following diagram):

$$L_B = 0.65 \cdot C \cdot \sqrt{De \cdot \Delta L}$$

where, C is the material constant, which for Jones Stephens multilayer pipes is 33, De is the pipe diameter [mm] and ΔL is the change in length of the segment of pipe to be accommodated.

"Omega" expansion bend (U type)
This type of compensation is generally employed in risers or in basement collectors when the expansions cannot be accommodated by the changes in direction of the pipes. Whereas in the case of deflection arm compensation, changes in direction of the system are used, in this case the configuration must be created especially.



The total length of the "omega" expansion bend L_B [mm] is calculated using the formula (also shown in the following diagram):

$$L_B = 2 \cdot l_1 + l_2 = C \cdot \sqrt{De \cdot \Delta L}$$

where, C is the material constant, which, for Jones Stephens multilayer pipes is 33, De is the pipe diameter [mm], ΔL is the change in length of the pipe section to be accommodated, l_1 and l_2 are the sides of the "omega" expansion bend. The "omega" compensation must be configured depending on the available space; however, where possible, it is recommended to maintain the following dimensional ratio:

$$l_1 = 2 \cdot l_2$$

and therefore:

$$l_1 = 0.4 \cdot L_B$$

$$l_2 = 0.2 \cdot L_B$$

PROTECTION

INTRODUCTION

Jones Stephens piping shall be protected from physical damage caused by screws, nails, drill bits, etc. The piping is most susceptible to puncture at all points of support. The best practice is to install the piping in those areas where the likelihood of physical damage is minimized, and no protection is needed; for
example:

A. Where piping is supported at least 3 inches from any outside edge of a stud, joist, etc. or wall surface.

B. Where any unsupported piping can be displaced in the direction of potential penetration at least 3 inches.

C. Where piping is supported under the joist in basements or crawl spaces and is not concealed by wall board or ceilings.

When Jones Stephens piping is installed in locations where the potential of physical damage exists, the use of Stud Guards, listed for use with plastic piping, must be used. The tubing may also be routed inside strip wound conduit or schedule 40 pipe when protection is required.

In areas where penetration through studs, joists, plates, and other similar structural members occur striker protection is required when all of the following criteria apply:

1. When the piping system is installed in a concealed location and is not viewable.
2. When the piping system is installed in a location that does not allow free movement to avoid puncture threats.
3. When the piping system is installed within 3 inches of possible points of penetration.

STUD GUARDS

Stud guards are used to prevent piping damage in areas where potential penetration threats exist through studs, joists, plates, and other similar structural members. For installations where all three above criteria apply the following striker plate protection must be applied.

A. At concealed support points and points of penetration less than 2 inches from any edge of a stud, joist, plate, etc. shielding is required at the area of support and extending 5 inches in one or both directions (if appropriate).

B. At concealed support points and points of penetration within 2 to 3 inches from any stud, joist, plate, etc., listed quarter stud guards are required at the area of support.

C. Piping routed horizontally through structural members shall be protected from puncture threats with the appropriate shielding material. At penetration joints, listed stud guards of the appropriate size shall be utilized. Piping between constraints that are less than 24 inches apart and meeting the criteria requiring full striker plates, shall be additionally protected by stripwound metal-conduit, or schedule 40 pipe.

D. Piping greater than 20x2 nominal diameter installed within a concealed hollow wall cavity of 2” x 4” construction shall be protected along the entire concealed run length with stripwound metal conduit, or schedule 40 pipe.

E. Should an unfinished ceiling (I.e. basement) be covered at a later date, quarter striker plates should be replaced with appropriate protection devices that provide adequate protection for potential penetration threats.

STRIPWOUND METAL CONDUIT

A. At termination points not covered by ANSI specifications, standard stripwound metal conduit shall be installed as additional protection. Stripwound conduit shall not be used as a substitute for striker plates where tubing passes through structural members.

B. Stripwound conduit shall also be used to shield piping from puncture threats when the piping is installed in a concealed location where it cannot be displaced a minimum 3” from a potential puncture threat or the distance between supports is less than 24 inches.

INSTALLATION IN INSULATED WALLS

Rigid installations present significant puncture threats for Jones Stephens PEX-AL-PEX in concealed spaces.

In concealed spaces, e.g. wall cavities, rigid insulation will prevent PEX-AL-PEX from being displaced. Jones Stephens piping shall not be installed in a wall cavity with foam insulation without additional protection as described below.

A. Piping shall be routed through an approved conduit in walls where “foamed in” insulation is to be used i.e. rigid steel pipe or conduit. Approved conduit shall be secured according to local building practice.

B. Protection methods such as pipe, conduit and strip wound hose, supply protection and give the piping space in which to move. On exterior walls the tubing may be fastened to the sheathing with cable clamps or secured with sticks/wires sprung between studs to center tubing between interior and exterior surfaces.

C. When piping is installed inside walls with batt insulation the tubing shall be routed between the face (craft paper/vapor barrier) and the wall surface. If installed in a concealed location where it cannot be displaced a minimum 3” from a potential puncture threat the run shall be protected with stripwound conduit.

D. Jones Stephens PEX-AL-PEX piping does not need additional protection where it is more than three inches from any puncture threats although consideration must be given to the chance that it may migrate toward penetration threats as the insulation is applied and during curing.

METER-CONNECTIONS

UNSUPPORTED METERS
A. Meters which depend on the service and house piping for support shall not be directly connected to the flexible gas piping.

B. The use of an outdoor termination fitting mounted to the exterior of the structure, meter stubout or other rigidly mounted termination fitting are acceptable transitional methods.

SELF SUPPORTED METER
A. Meters which are independently supported by a bracket may be directly connected to Jones Stephens PEX-AL-PEX
B. If practical a 3 to 6 in. loop of piping should be included to compensate for meter movement and differential setting.

NOTE: JONES STEPHENS DOES NOT REQUIRE MECHANICAL PROTECTION FOR OUTDOOR METER CONNECTIONS MORE THAN 6 FT. ABOVE GRADE HOWEVER, LOCAL CODES MUST BE CONSIDERED. CHECK WITH YOUR LOCAL CODE AUTHORITY.

APPLIANCE CONNECTIONS

MOVEABLE APPLIANCES

IMPORTANT JONES STEPHENS PIPING AND FITTINGS ARE NOT RATED AS FLEXIBLE APPLIANCE CONNECTORS AND MUST NOT BE DIRECTLY CONNECTED TO MOVABLE APPLIANCES.

A. When using Jones Stephens Gas piping with moveable appliances such as a ranges or dryers, the piping must be rigidly terminated before the appliance. Appliance stub outs, termination fittings or transitioning to rigid black pipe are acceptable means to terminate PEX-AL-GAS prior to the appliance.

B. Final connection from PEX-AL-PEX termination point to a movable appliance shall be made with a flexible appliance connector or another approved connection device.

NON-MOVEABLE APPLIANCE

A. Jones Stephens piping can be directly connected to a non-moveable appliance such as a furnace or water heater (be sure to check with local code if this is acceptable prior to installation).

B. In this type of application, no termination fitting is required, and the piping should be terminated at the appliance shut off valve.

SPECIAL APPLICATIONS

Prolonged UV exposure due to direct sunlight is detrimental to all PEX-AL-PEX piping. Jones Stephens does not recommend or warrant using PEX-AL-PEX in direct sunlight. For outdoor installations, special care must be provided that the Jones Stephens PEX-AL-PEX is not left exposed to sunlight and special care shall be made to protect the piping system from accidental damage.

Infrared Heaters

Infrared heaters mounted from ceilings and walls of structures shall be connected to the Jones Stephens gas piping system ANSI 383.6 “Standard for gas fired infrared heaters”.

Pad Mounted Gas Appliances

Gas appliances mounted on concrete pads or blocks, such as heat pumps, air conditioners, pool heaters and NGV refueling systems, shall be connected to the Jones Stephens gas piping system at a termination fitting using either rigid pipe or an approved outdoor appliance connector. Pad mounted equipment (in most cases) is considered “fixed” if not moved for cleaning, maintenance, etc. (i.e. A/C units).

Gas Fireplaces

Attention: Jones Stephens Gas piping shall not be routed directly into a metallic fireplace enclosure. The piping connection shall be made outside of the enclosure to a section of rigid metallic pipe.

A. When routing Jones Stephens Gas piping through masonry construction, for connection to gas fireplaces and gas logs, the piping is required to be sleeved in a nonmetallic conduit through the masonry structure. The annular space between the piping and sleeve should be caulked at both the interior and exterior locations.

B. For any fireplace application where installation of Jones Stephens Gas piping is desired, a Fireplace Stubout shall be used to terminate the piping outside the enclosure. While other listed installation practices are acceptable this method is preferred to prevent inadvertent damage, that can be caused by the fireplace enclosure, to the PEX-AL-PEX.

C. Adherence to local codes and manufacturer’s instructions are required, be sure to know and understand all requirements prior to installation.

PRESSURE REGULATORS and VENT LINE INSTALLATION GUIDELINES

A Jones Stephens Gas piping system utilizing gas line pressures above ½ PSI are required to use a line pressure regulator upstream of the appliances to reduce the line pressure to less than ½ PSI. The regulator shall incorporate construction which will “lock up” under no-flow conditions to limit the downstream pressure to not more than

1/2 psi. The guidelines below highlight requirements from most Fuel Gas Codes and are for your reference only. The regulator shall comply with a nationally recognized standard for pressure regulators. Installation of the regulator must be done in accordance with the manufacturer's instructions and local fuel gas code requirements.

Regulators used to reduce elevated system pressure for appliance use must also conform to the following:

Sized to supply the required appliance load.

Equipped with an acceptable vent limiting device, supplied by the manufacturer, or be capable of being vented to the outside atmosphere.

Installed in accordance with manufacturer's printed instructions.

Installed in an accessible location.

A CSA Design Certified shut-off valve must be installed upstream of the pressure regulator.

REGULATOR VENTING REQUIREMENTS

VENT LINES

Venting is required for all regulators to avoid a gas buildup in an enclosed area in the event that the regulator diaphragm ruptures. Vent lines should be properly sized per the manufacturer's instructions and installed to ensure proper operation.

VENT LINE INSTALLATION GUIDELINES:

The vent line shall not be smaller than the vent connected to the pressure regulator.

The recommended minimum size vent line for the regulator is 1/4 in. nominal ID copper tubing or other approved material. The maximum length installed for this size vent line should be less than 30 feet. Larger diameter vent lines can be used if necessary. In determining the proper size vent line for a particular installation, a test may be necessary with the vent line and regulator under normal use to ensure proper regulator operation. Consult with the regulator manufacturer for limitations of length and size of the vent line.

The vent shall be designed and installed to prevent the entry of water, insects or other foreign materials that could cause blockage.

Under no circumstances shall a regulator be vented to the appliance flue or building exhaust system.

VENT LIMITER OPTION:

Vent limiters are an alternate venting option available some regulators. When a vent limiter is desired all installation guidelines for the vent limiter and regulator must be followed to ensure proper operation of the unit.

VENT LIMITER INSTALLATION GUIDELINES:

Regulators must be installed in the horizontal upright position and in a well-ventilated area when using a vent limiter. Consult with local code before installation.

Only a vent limiter supplied by the regulator manufacturer may be used, no piping shall be installed between the regulator and vent limiting device.

Leak detection fluids may not be used on vent limiters as they can cause corrosion and operational failure.

Remove the vent limiter and check the vent opening if a leaking diaphragm is suspected. Remember, regulators will "breathe" when regulating, creating a bubble - A leak will blow bubbles constantly. Do not leak test the vent limiter with liquid leak test solution. This action will contaminate the internal ball check mechanism or plug the breathing hole, resulting in erratic regulator operation.

Vent limiters shall not be used outside or anyplace where they are subject to damage from the environment. Vent protection devices shall be used in outdoor installations.

OVER PRESSURIZATION PROTECTION

Gas systems using pressures above 2 psi up to 5 psi must use OPD (Over Pressure Protection Devices).

PRESSURE TESTING AND INSPECTION PROCEDURE

• The final installation is to be inspected and tested for leaks at 1 1/2 times the maximum working pressure, but not less than 3 psi, using procedures specified in Chapter 7 "Inspection, Testing and Purging" of the National Fuel Gas Code, NFPA 54/ANSI Z223.1. In Canada, refer to the applicable sections of the CAN/CGA - B149 Installation codes.

• Maximum test pressures recommended - 40 PSI MAX.

• Do not connect appliances until after pressure test is completed.

• Inspect the installed system to ensure:
    • Presence of listed stud guards and other protective devices at all required locations.
    • Acceptable physical condition of the tubing.
    • Presence of fittings (properly pressed).
    • Correct regulator and manifold arrangement with proper venting requirements.

- All gas outlets for appliance connections should be capped during pressure testing.
- Pressure testing should be performed during rough construction of the facility (before interior walls are finished). This will permit a more complete inspection of the piping system during the pressure testing.

• The elevated pressure system requires a two-part pressure test.

- The first part is performed on the elevated pressure section, between the meter connection and the pressure regulator.
- The second part is performed on the low-pressure section, between the pressure regulator and the individual gas appliance outlets.

ELECTRICAL BONDING

Jones Stephens Gas piping system press fittings dielectrically isolate the metal fitting from the internal aluminum pipe layer. As such, there are no additional bonding requirements in this manual for the Jones Stephens Gas piping system in the same manner as the minimum requirements for rigid metal piping. However, installers must always adhere to any local requirements that may conflict with these instructions.

ALL OWNERS should consult a lightning safety consultant to determine whether installation of a lightning protection system would be required to achieve sufficient protection for all building components from lightning. Factors to consider include whether the area is prone to lightning.

Lightning protection systems are beyond the scope of this manual and installation guidelines, but are covered by National Fire Protection Association, NFPA 780, the Standard for the Installation of Lightning Protection Systems, and other standards.

Consult local building codes as to required separations for piping from such continuous metallic systems including metallic chimney liners, metallic appliance vents, metallic ducting and piping, and insulated or jacketed electrical wiring and cables.

Sizing Tables

Jones Stephens sizing tables reflect the real pressure drop of the pipe and fittings. Sizing must be done in accordance with NFPA 54 (National Fuel Gas Code), using both the TUBES and the FITTINGS sizing tables: this means that the results will be perfectly sized for the real installation.

Natural Gas <1.5 psi

Working Conditions		
Cr	0.6094	-
ΔH	0.500	WC [inch]

Imperial diam.	3/8"	1/2"	3/4"	1"
Pipe [mm]	16	20	26	32
Thickness [mm]	2	2	3	3
ID [mm]	12	16	20	26
ID [inch]	0.472	0.630	0.787	1.024
Lenght [ft]	Flow rate Natural gas [ft^3/h]			
5.0	122	259	465	925
10.0	84	178	319	636
15.0	67	143	257	511
20.0	57	122	220	437
25.0	51	108	195	387
30.0	46	98	176	351
35.0	42	90	162	323
40.0	40	84	151	300
45.0	37	79	142	282
50.0	35	74	134	266
55.0	33	71	127	253
60.0	32	67	121	241
65.0	30	65	116	231
70.0	29	62	111	222
75.0	28	60	107	214
80.0	27	58	104	206
85.0	26	56	100	200
90.0	25	54	97	194
95.0	25	53	95	188
100.0	24	51	92	183
105.0	23	50	90	178
110.0	23	49	87	174
115.0	22	47	85	170
120.0	22	46	83	166
125.0	21	45	81	162
130.0	21	44	80	159
135.0	20	44	78	156
140.0	20	43	77	152
145.0	20	42	75	150
150.0	19	41	74	147
155.0	19	40	73	144
160.0	19	40	71	142

Natural Gas >1.5 psi

Working Conditions		
Cr	0.6094	-
Y	0.9992	-
P1	2.000	[Psi]
P2	1.000	[Psi]

Imperial diam.	3/8"	1/2"	3/4"	1"
Pipe [mm]	**16**	**20**	**26**	**32**
Thickness [mm]	2	2	3	3
ID [mm]	12	16	20	26
ID [inch]	0.472	0.630	0.787	1.024
Lenght [ft]	**Flow rate Natural gas [ft^3/h]**			
5.0	1124	2390	4292	8541
10.0	772	1643	2950	5870
15.0	620	1319	2369	4714
20.0	531	1129	2027	4034
25.0	471	1001	1797	3576
30.0	426	907	1628	3240
35.0	392	834	1498	2981
40.0	365	776	1393	2773
45.0	342	728	1307	2602
50.0	323	688	1235	2458
55.0	307	653	1173	2334
60.0	293	623	1119	2227
65.0	281	597	1071	2132
70.0	270	573	1029	2049
75.0	260	552	992	1974
80.0	251	533	958	1906
85.0	243	516	927	1844
90.0	235	500	899	1788
95.0	229	486	873	1737
100.0	222	473	849	1689
105.0	216	460	827	1645
110.0	211	449	806	1604
115.0	206	438	787	1566
120.0	201	428	769	1530
125.0	197	419	752	1497
130.0	193	410	736	1466
135.0	189	402	722	1436
140.0	185	394	707	1408
145.0	182	387	694	1381
150.0	178	380	682	1356
155.0	175	373	670	1333
160.0	172	367	658	1310

Propane <1.5 psi

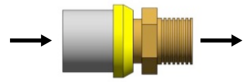
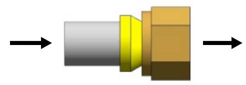
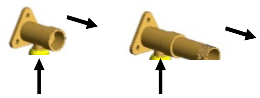
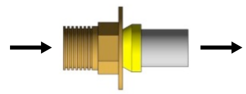
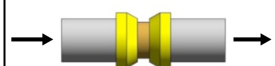
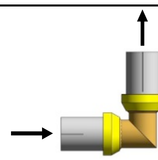
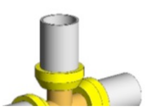
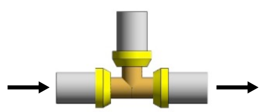
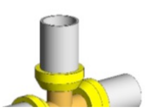
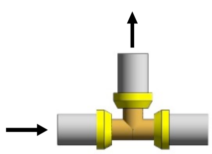
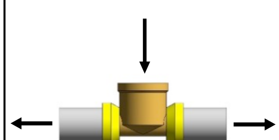
Working Conditions		
Cr	1.2462	-
ΔH	0.500	WC [inch]

Imperial diam.	3/8"	1/2"	3/4"	1"
Pipe [mm]	**16**	**20**	**26**	**32**
Thickness [mm]	2	2	3	3
ID [mm]	12	16	20	26
ID [inch]	0.472	0.630	0.787	1.024
Lenght [ft]	**Flow rate Propane [ft^3/h]**			
5.0	83	176	316	628
10.0	57	121	217	432
15.0	46	97	174	347
20.0	39	83	149	297
25.0	35	74	132	263
30.0	31	67	120	238
35.0	29	61	110	219
40.0	27	57	102	204
45.0	25	54	96	191
50.0	24	51	91	181
55.0	23	48	86	172
60.0	22	46	82	164
65.0	21	44	79	157
70.0	20	42	76	151
75.0	19	41	73	145
80.0	18	39	70	140
85.0	18	38	68	136
90.0	17	37	66	132
95.0	17	36	64	128
100.0	16	35	62	124
105.0	16	34	61	121
110.0	16	33	59	118
115.0	15	32	58	115
120.0	15	31	57	113
125.0	14	31	55	110
130.0	14	30	54	108
135.0	14	30	53	106
140.0	14	29	52	104
145.0	13	28	51	102
150.0	13	28	50	100
155.0	13	27	49	98
160.0	13	27	48	96

Propane >1.5 psi

Working Conditions		
Cr	1.2462	-
Y	0.991	-
P1	2.000	[Psi]
P2	1.000	[Psi]

Imperial diam.	3/8"	1/2"	3/4"	1"
Pipe [mm]	**16**	**20**	**26**	**32**
Thickness [mm]	2	2	3	3
ID [mm]	12	16	20	26
ID [inch]	0.472	0.630	0.787	1.024
Lenght [ft]	**Flow rate Propane [ft^3/h]**			
5.0	760	1616	2901	5774
10.0	522	1111	1994	3969
15.0	419	892	1601	3187
20.0	359	763	1371	2728
25.0	318	677	1215	2417
30.0	288	613	1101	2190
35.0	265	564	1013	2015
40.0	247	525	942	1875
45.0	231	492	884	1759
50.0	219	465	835	1661
55.0	208	442	793	1578
60.0	198	421	756	1505
65.0	190	403	724	1442
70.0	182	388	696	1385
75.0	176	373	670	1334
80.0	170	361	647	1288
85.0	164	349	627	1247
90.0	159	338	607	1209
95.0	154	329	590	1174
100.0	150	320	574	1142
105.0	146	311	559	1112
110.0	143	304	545	1085
115.0	139	296	532	1059
120.0	136	290	520	1035
125.0	133	283	509	1012
130.0	130	277	498	991
135.0	128	272	488	971
140.0	125	266	478	952
145.0	123	261	469	934
150.0	121	257	461	917
155.0	119	252	453	901
160.0	117	248	445	886

FITTINGS PRESSURE LOSSES IN EQUIVALENT PIPE LENGHT (ft)						
FITTING		**DESCRIPTION**	**16X2**	**20X2**	**26x3**	**32X3**
		**NPT male couplings**	3.28	3.28	3.28	3.28
		**NPT female couplings**	3.28	3.28	3.28	3.28
		**Wingback elbows**	4.92	1.64	3.28	-
		**Floor/Wall mountings**	1.64	0.82	0.82	0.82
		**Couplings**	1.64	0.82	0.82	0.82
		**Press & NPT elbows**	3.28	1.64	0.82	3.28
		**Tees**	1.64	1.64	1.64	1.64
		**Tees**	3.28	3.28	4.92	6.56
		**NPT female tees**	3.28 20x1/2"	4.92 26x3/4"	4.92 32x3/4"	6.56 32x1"

Jones Stephens Gas Piping System - List of Materials

NO.	Ferguson Enterprises Part Numbers	Jones Stephens Part Numbers	Product Description
1	JPGP16328	PGP16328	16MMX100M PIPE COIL PEXALGAS
2	JPGP20328	PGP20328	20MMX100M PIPE COIL PEXALGAS
3	JPGP26164	PGP26164	26MMX50M PIPE COIL PEXALGAS
4	JPGP32164	PGP32164	32MMX50M PIPE COIL PEXALGAS
5	JPMPT16	PMPT16	16X2X1/2 MPT ADAPTER PEXALGAS
6	JPMPT20	PMPT20	20X2X1/2IN ADAPTER MPT PEXALGAS
7	JPMPT26	PMPT26	26X3/4IN ADAPTER MPT PEXALGAS
8	JPMPT32	PMPT32	32X1IN ADAPTER MPT PEXALGAS
9	JPFPT16	PFPT16	16X2X1/2IN ADAPTER FPT PEXALGAS
10	JPFPT20	PFPT20	20X2X1/2IN ADAPTER FPT PEXALGAS
11	JPFPT26	PFPT26	26X3/4IN ADAPTER FPT PEXALGAS
12	JPFPT32	PFPT32	32X1IN ADAPTER FPT PEXALGAS
13	JPC16	PC16	16X16 COUPLING PEXALGAS
14	JPC20	PC20	20X20 COUPLING PEXALGAS
15	JPC26	PC26	26X26 COUPLING PEXALGAS
16	JPC32	PC32	32X32 COUPLING PEXALGAS
17	JPT16	PT16	16X16X16 TEE PEXALGAS
18	JPT20	PT20	20X20X20 TEE PEXALGAS
19	JPT26	PT26	26X26X26 TEE PEXALGAS
20	JPT32	PT32	32X32X32 TEE PEXALGAS
21	JPT162016	PT162016	16X20X16 REDUCING TEE PEXALGAS
22	JPT201616	PT201616	20X16X16 REDUCING TEE PEXALGAS
23	JPT201620	PT201620	20X16X20 REDUCING TEE PEXALGAS
24	JPT202016	PT202016	20X20X16 REDUCING TEE PEXALGAS
25	JPT202620	PT202620	20X26X20 REDUCING TEE PEXALGAS
26	JPT261626	PT261626	26X16X26 REDUCING TEE PEXALGAS
27	JPT262026	PT262026	26X20X26 REDUCING TEE PEXALGAS
28	JPT321632	PT321632	32X16X32 REDUCING TEE PEXALGAS
29	JPT262020	PT262020	26X20X20 REDUCING TEE PEXALGAS
30	JPT262620	PT262620	26X26X20 REDUCING TEE PEXALGAS
31	JPT322626	PT322626	32X26X26 REDUCING TEE PEXALGAS
32	JPT322032	PT322032	32X20X32 REDUCING TEE PEXALGAS
33	JPT322632	PT322632	32X26X32 REDUCING TEE PEXALGAS
34	JPE916	PE916	16X16 90 DEG ELBOW PEXALGAS
35	JPE920	PE920	20X20 90 DEG ELBOW PEXALGAS
36	JPE926	PE926	26X26 90 DEG ELBOW PEXALGAS
37	JPE932	PE932	32X32 90 DEG ELBOW PEXALGAS
38	JPDE916D	PDE916D	16X1/2IN FPT WB ELBOW PEXALGAS
39	JPDE920D	PDE920D	20X1/2IN FPT WB ELBOW PEXALGAS
40	JPDE920F	PDE920F	20X3/4IN FPT WB ELBOW PEXALGAS
41	JPDE926F	PDE926F	26X3/4IN FPT WB ELBOW PEXALGAS
42	JPFPT916D	PFPT916D	16X1/2IN FPT ELBOW PEXALGAS
43	JPFPT920D	PFPT920D	20X1/2IN FPT ELBOW PEXALGAS
44	JPFPT920F	PFPT920F	20X3/4IN FPT ELBOW PEXALGAS
45	JPFPT926G	PFPT926G	26X1IN FPT ELBOW PEXALGAS
46	JPFPT926F	PFPT926F	26X3/4IN FPT ELBOW PEXALGAS
47	JPFPT932G	PFPT932G	32X1IN FPT ELBOW PEXALGAS
48	JPMPB32	PMPB32	MANUAL PIPE BENDER PEXALGAS
49	JPIPB16	PIPB16	16MM INT SPRING BENDER PEXALGAS
50	JPIPB20	PIPB20	20MM INT SPRING BENDER PEXALGAS
51	JPIPB26	PIPB26	26MM INT SPRING BENDER PEXALGAS
52	JPEPB16	PEPB16	16MM EXT SPRING BENDER PEXALGAS
53	JPEPB20	PEPB20	20MM EXT SPRING BENDER PEXALGAS
54	JPHR16	PHR16	16MM HAND REAMER PEXALGAS
55	JPHR20	PHR20	20MM HAND REAMER PEXALGAS
56	JPHR26	PHR26	26MM HAND REAMER PEXALGAS
57	JPHR32	PHR32	32MM HAND REAMER PEXALGAS
58	JPHR162026	PHR162026	16X20X26 HAND REAMER PEXALGAS
59	JPHDR16	PHDR16	16MM DRILL REAMER PEXALGAS
60	JPHDR20	PHDR20	20MM DRILL REAMER PEXALGAS
61	JPHDR26	PHDR26	26MM DRILL REAMER PEXALGAS
62	JPHDR32	PHDR32	32MM DRILL REAMER PEXALGAS
63	JPCJ16	PCJ16	16MM CRIMP JAWS PEXALGAS
64	JPCJ20	PCJ20	20MM CRIMP JAWS PEXALGAS
65	JPCJ26	PCJ26	26MM CRIMP JAWS PEXALGAS
66	JPCJ32	PCJ32	32MM CRIMP JAWS PEXALGAS
67	JPMC16202632	PMC16202632	MANUAL CRIMPER PEXALGAS
68	JPPC	PPC	PIPE CUTTER PEXALGAS
69	JPFWM16D	PFWM16D	16X1/2IN WALL/FLOOR MNT PEXALGAS
70	JPFWM20D	PFWM20D	20X1/2IN WALL/FLOOR MNT PEXALGAS
71	JPFWM20F	PFWM20F	20X3/4IN WALL/FLOOR MNT PEXALGAS
72	JPFWM26F	PFWM26F	26X3/4IN WALL/FLOOR MNT PEXALGAS
73	JPFWM26G	PFWM26G	26X1IN WALL/FLOOR MNT PEXALGAS
74	JPFWM32G	PFWM32G	32X1IN WALL/FLOOR MNT PEXALGAS

= pipe
= Fittings
= Installation tooling

TECHNICAL DATA SHEET

PEXALGAS

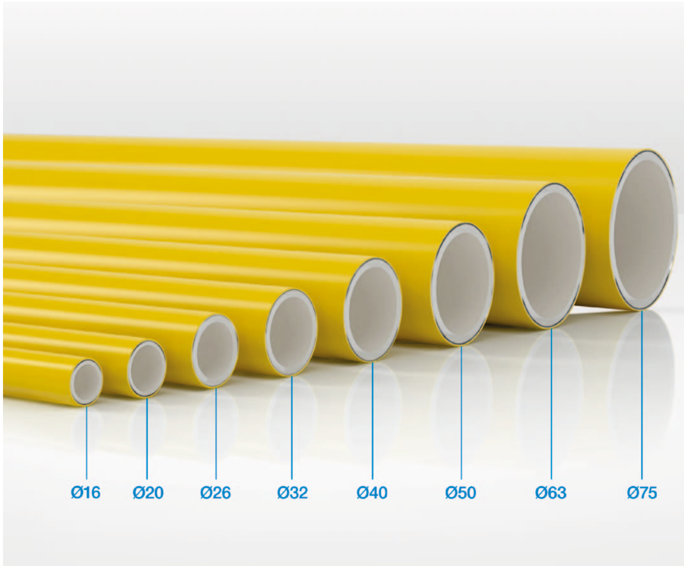
JONES STEPHENS™

We Got It

PEXALGAS

The product

The Pexal® Gas multilayer system combines the positive feature that are typical of crosslinked polyethylene PE-Xb and also those of aluminium; crosslinked polyethylene PE-Xb guarantees excellent mechanical, physical and chemical properties and the butt-welded aluminium pipe strengthens mechanical resistance introducing excellent characteristics of flexibility and malleability, fundamental features for accelerating and simplifying installation operations.
The end result is a product that is composed of different layers of material, connected to each other, that allows excellent properties to be reached that otherwise would not be possible with a pipe made of one single material.

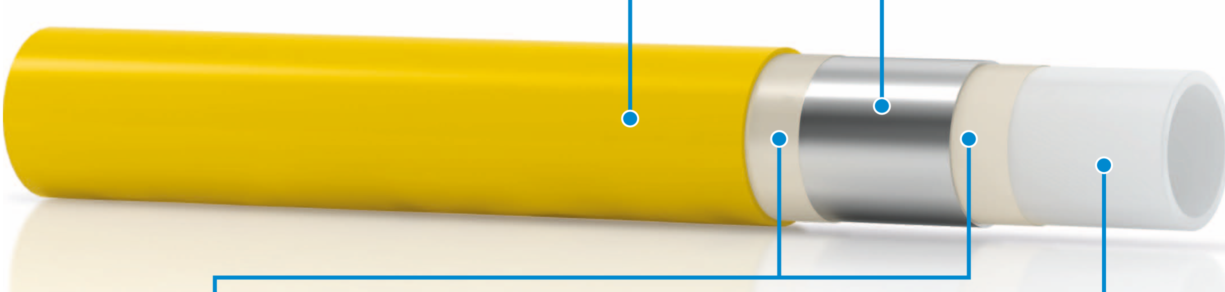


The Pexal® Gas system is manufactured in compliance with European Standard EN ISO 21003 and the international standards for the production of gas multilayer systems (UNI TS 11344, AS4176.8). Its reliability and quality are guaranteed by the most strict approval bodies that control and verify performance with meticulous frequency within the production plants.

Figure Pipe stratigraphy

External layer
This layer is produced with crosslinked polyethylene PE-Xb and acts as a mechanical, electrical and chemical protection for the aluminium layer thus shielding it from blows, scratches and electrochemical attacks by water, cement and other substances in the ground.

Intermediate layer
This is made up of a pipe in aluminium alloy that is butt-welded longitudinally and which guarantees an absolute barrier to oxygen, gas and light giving the pipe an excellent mechanical resistance and flexibility during installation.



Bonding layers
These are made up of a powerful adhesive that bonds the intermediate layer in aluminium with the internal and external layers.

Internal layer
The internal layer of the pipe is made up of a crosslinked polyethylene PE-Xb pipe characterised by an extremely smooth surface which significantly reduces pressure losses.

Features

The characteristics of the Pexal® Gas pipes make this product highly reliable and extremely easy to install.

Durability and mechanical strength

The system has a durability of at least 50 years guaranteed by the product standards.
The mechanical characteristics of the Pexal® Gas pipes are such that the bursting pressure at room temperature (in relation to the pipe diameter) is more than 100 bar!

Smoothness and resistance to scale formation

The extreme smoothness of the inner surface (roughness of 0.007 mm) prevents the formation of deposits such as limescale and also ensures low pressure drops over time.

Resistance to abrasion

Crosslinked polyethylene is abrasion resistant, and this is a synonim of durability, since the pipes are not affected by the abrasive action of impurities that are carried.

Flexibility and shape stability

The combination of crosslinked polyethylene and aluminium guarantees excellent flexibility features in bending (laso manual bending). The Pexal® Gas pipe can be bent manually up to the 32 mm diameter and mechanically for the larger diameters, with curvature radii of up to 2.5 times the diameter.
The excellence of the Pexal® Gas pipes resides also in its extraordinary shape stability: once bent and installed, it maintains the configuration over time allowing a reduction of the number of anchoring clips needed, which in surface mounting is reduced by 40% of the clips required for plastic pipes such as PE-X, PE-RT, PP-R, PB, PVC-C etc. Thanks to these features, the Pexal® Gas pipes are also the ideal solution in areas subjected to earthquakes.

Thermal expansion

Thermal expansion is about 8 times lower than that of plastic pipes and is comparable to that of metal pipes.
A 10 m Pexal® pipe subjected to a 50°C temperature difference will expand by 13 mm in contrast to a plastic pipe (crosslinked polyethylene) that expands by 90 mm.

Lightweight

The pipes are extremely lightweight compared to metal pipes: the weight is 1/3 compared to that of a corresponding copper pipe and 1/10 compared to that of a corresponding steel pipe.

Acoustic insulation

Crosslinked polyethylene is elastic and absorbs vibrations and therefore offers excellent acoustic insulation.

Oxygen and light barrier

The butt-welded aluminium layer represents a permanent oxygen and light barrier, avoiding in this way the two main causes of algae formation and corrosion in plastic pipes.

Ecology

Pexal® is manufactured with fully recyclable materials, the production processes are energetically efficient in order to have a low impact on the environment. Valsir adopts Green Building principles, with an eye on environmental protection and conservation of resources.

Technical data

Table Typical technical data.

Features	Values	Testing methods
Material	Crosslinked polyethylene internal layer PE-Xb, internal bonding layer, intermediate aluminium layer, external bonding layer, crosslinked polyethylene external layer PE-Xb	-
Colour	Yellow RAL 1023	-
Dimensions	16÷75 mm	-
Application	Gas supply	-
Fittings	Pexal® Gas fittings	-
Minimum operating temperature(1)	-60°C	-
Maximum temperature(2)	+95°C/+100°C	-
Density at 23°C	> 0,950 g/cm³ (crosslinked polyethylene)	-
Softening temperature	135°C	-
Thermal expansion coefficient	0,026 mm/m·K	-
Thermal conductivity	0,42÷0,52 W/m·K	-
Internal roughness	0,007 mm	-
Oxygen permeability	0 mg/l	-
Halogen levels	Halogen-free	-

Pexal® Gas pipe characteristic

Pexal® Gas is the result of the years of experience gained by Valsir in the production of multilayer systems for combustible gas in residential buildings:
the international certifications obtained over recent years for Pexal® Gas in Italy, Australia, New Zealand and Ukraine are proof of the reliability and quality of the system.

Table Pexal® Gas pipe features (diameters from 16 to 26 mm).

External diameter	**[mm]**	16	20	26
Thickness	**[mm]**	2	2	3
Internal diameter	**[mm]**	12	16	20
Weight	**[g/m]**	113	156	286
Thermal expansion coefficient	**[mm/m·K]**	0,026	0,026	0,026
Thermal conductivity	**[W/m·K]**	0,44	0,47	0,47
Internal roughness	**[mm]**	0,007	0,007	0,007
Oxygen permeability	**[mg/l]**	0	0	0

Table Pexal® Gas pipe features (diameters from 32 to 75 mm).

External diameter	**[mm]**	32	40	50	63	75
Thickness	**[mm]**	3	3,5	4	4,5	5
Internal diameter	**[mm]**	26	33	42	54	65
Weight	**[g/m]**	390	545	833	1232	1603
Thermal expansion coefficient	**[mm/m·K]**	0,026	0,026	0,026	0,026	0,026
Thermal conductivity	**[W/m·K]**	0,50	0,49	0,50	0,51	0,52
Internal roughness	**[mm]**	0,007	0,007	0,007	0,007	0,007
Oxygen permeability	**[mg/l]**	0	0	0	0	0

Features of the multilayer Pexal® Gas pipe with corrugated protective sheath

Pexal® Gas pipes are available covered in the factory with a protective corrugated insulating sleeve.

Table Features of the multilayer Pexal® Gas pipe with corrugated protective sheath.

Pipe	Sheath thickness	External diameter of the pipe including the sheath	Weight	Crushing
	[mm]	[mm]	[g/m]	[N/m]
16x2	0,85	26,5	172	320
20x2	1,05	30,5	235	320
26x3	1,1	36	380	320

The features of the material used for the production of the corrugated protective sheath are indicated in the table.

Table Features of the material used for the production of the corrugated protective sheath.

Features	Unit	Value
Material	-	High density polyethylene
Density	[kg/m³]	961
Thermal conductivity	[W/m·K]	0,38
Traction resistance	[N/mm²]	> 22
Ultimate elongation	[%]	> 350
Steam permeability	-	> 100.000

Approvals:

The approvals of Valsir® Gas systems are available on the website: www.valsir.com

Brass press fittings

Table Pressing profiles for Pexal® Gas.

Diameter	Pressing profiles
16x2	H, TH, U
20x2	H, TH, U
26x3	H, TH, C
32x3	VAL, H, TH, U
40x3.5	VAL, TH, U
50x4	VAL, TH, U
63x4.5	VAL, TH, U
75x5	VAL, U

Marking

The marking of the Pexal® Gas pipes contains all the information required by current regulations as well as all the data necessary to trace the product.

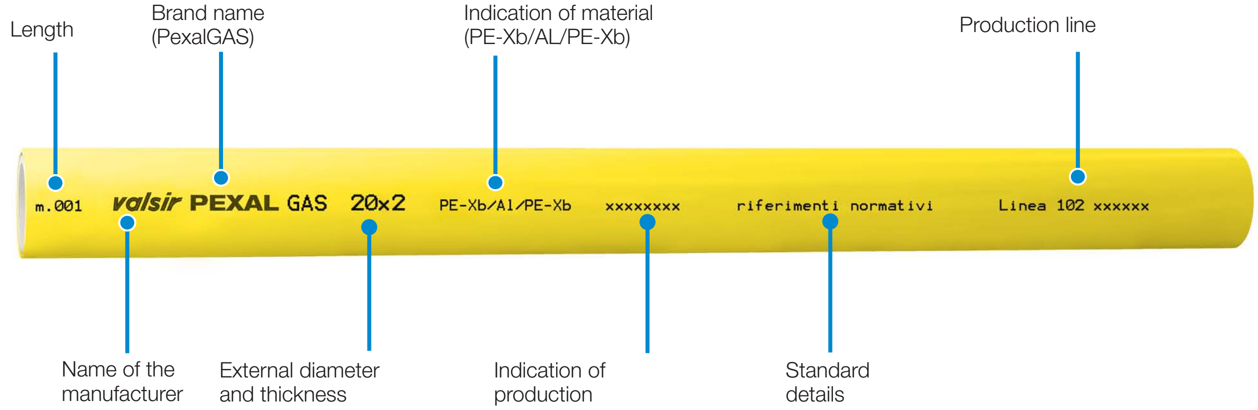


Table Pressure losses of Gas fittings expressed in equivalent meters of pipe (m)

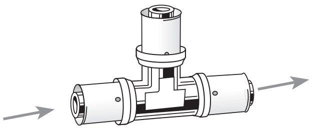
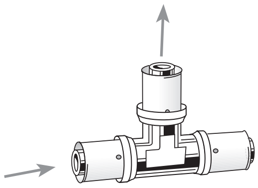
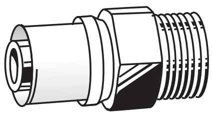
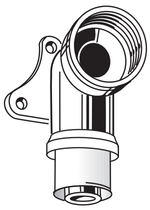
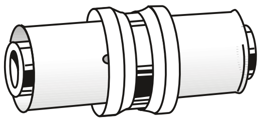
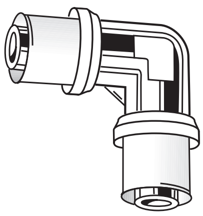
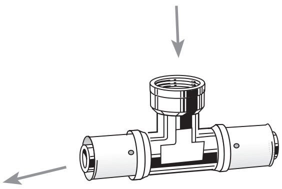
FITTING	DESCRIPTION	PIPE DIAMETERS 16	20	26	32	40	50	63	75
	Union tee	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1
	Union tee	1	1	1.5	2	2.5	2.5	2.5	2.5
	Male threaded coupling	1	1	1	1	1	1	1.5	2
	Wingback elbow	1,5	0,5	1	-	-	-	-	-
	Intermediate coupling	0.5	0.25	0.25	0.25	0.25	0.25	0.5	1
	Intermediate Elbow	1	0.5	0.25	1	1.5	2.5	3	4
	Female threaded union tee	1	1	1.5	2	2.5	3.5	4.5	3.5

Table Pressure losses of Gas fittings expressed in equivalent meters of pipe (m)

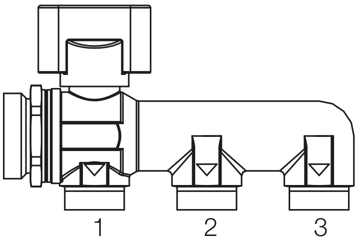
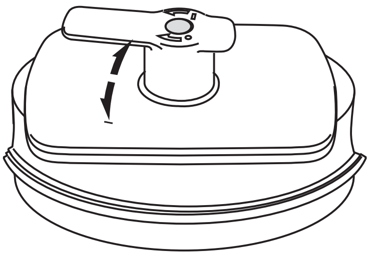
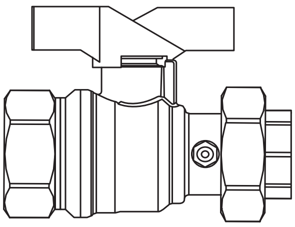
FITTING	DESCRIPTION	OUTLET 1	OUTLET 2	OUTLET 3
	**Manifold of distribution**	1	0.5	0.5
	**In-wall gas stop valve with casing**	0.5	-	-
	**Gas meter valve with pressure port**	0.5	-	-

Table Pressure losses for Pexal Gas pipes (Natural gas)

Pipe [mm]	16	20	26	32	40	50	63	75
Thickness [mm]	2	2	3	3	3,5	4	4,5	5
Di [mm]	12	16	20	26	33	42	54	65
Virtual lenght [m]	Gas flow rate [m³/h]							
1	3,60	7,76	14,07	28,33	53,50	101,77	198,92	326,13
2	2,45	5,28	9,57	19,27	36,40	69,24	135,34	221,90
3	1,96	4,22	7,64	15,39	29,06	55,28	108,05	177,14
4	1,67	3,59	6,51	13,11	24,77	47,11	92,09	150,98
5	1,47	3,17	5,76	11,59	21,88	41,62	81,35	133,38
6	1,33	2,87	5,20	10,47	19,77	37,61	73,51	120,53
7	1,22	2,63	4,77	9,61	18,15	34,52	67,48	110,64
8	1,14	2,44	4,43	8,92	16,85	32,06	62,66	102,72
9	1,06	2,29	4,15	8,36	15,78	30,03	58,69	96,22
10	1,00	2,16	3,92	7,88	14,89	28,32	55,35	90,75
11	0,95	2,05	3,71	7,48	14,12	26,86	52,50	86,07
12	0,91	1,95	3,54	7,12	13,45	25,59	50,02	82,01
13	0,87	1,87	3,38	6,81	12,87	24,48	47,84	78,44
14	0,83	1,79	3,25	6,54	12,35	23,49	45,91	75,28
15	0,80	1,72	3,13	6,29	11,88	22,61	44,19	72,45
16	0,77	1,66	3,02	6,07	11,46	21,81	42,63	69,89
17	0,75	1,61	2,92	5,87	11,09	21,09	41,22	67,58
18	0,72	1,56	2,82	5,69	10,74	20,43	39,93	65,47
19	0,70	1,51	2,74	5,52	10,42	19,82	38,75	63,53
20	0,68	1,47	2,66	5,36	10,13	19,27	37,66	61,74
25	0,60	1,30	2,35	4,74	8,95	17,02	33,27	54,55
30	0,54	1,17	2,13	4,28	8,09	15,38	30,06	49,29
35	0,50	1,08	1,95	3,93	7,42	14,12	27,60	45,25
40	0,46	1,00	1,81	3,65	6,89	13,11	25,62	42,01
45	0,43	0,94	1,70	3,42	6,45	12,28	24,00	39,35
50	0,41	0,88	1,60	3,22	6,09	11,58	22,64	37,11
55	0,39	0,84	1,52	3,06	5,77	10,98	21,47	35,20
60	0,37	0,80	1,45	2,91	5,50	10,47	20,46	33,54
70	0,34	0,73	1,33	2,67	5,05	9,61	18,78	30,78
80	0,32	0,68	1,23	2,48	4,69	8,92	17,43	28,58
90	0,30	0,64	1,16	2,33	4,39	8,35	16,33	26,77
100	0,28	0,60	1,09	2,19	4,14	7,88	15,40	25,25

Table Pressure losses for Pexal Gas pipes (GPL)

Pipe [mm]	16	20	26	32	40	50	63	75
Thickness [mm]	2	2	3	3	3,5	4	4,5	5
Di [mm]	12	16	20	26	33	42	54	65
Virtual lenght [m]	Gas flow rate [m³/h]							
1	2,98	6,42	11,63	23,42	44,23	84,14	164,46	269,64
2	2,03	4,37	7,92	15,94	30,09	57,25	111,90	183,46
3	1,62	3,49	6,32	12,72	24,02	45,70	89,33	146,46
4	1,38	2,97	5,39	10,84	20,48	38,95	76,13	124,82
5	1,22	2,62	4,76	9,58	18,09	34,41	67,26	110,27
6	1,10	2,37	4,30	8,66	16,35	31,10	60,78	99,65
7	1,01	2,18	3,95	7,95	15,00	28,54	55,79	91,47
8	0,94	2,02	3,66	7,38	13,93	26,50	51,80	84,93
9	0,88	1,89	3,43	6,91	13,05	24,82	48,52	79,55
10	0,83	1,79	3,24	6,52	12,31	23,41	45,76	75,03
11	0,79	1,69	3,07	6,18	11,67	22,21	43,40	71,16
12	0,75	1,61	2,93	5,89	11,12	21,16	41,35	67,80
13	0,72	1,54	2,80	5,63	10,64	20,24	39,56	64,85
14	0,69	1,48	2,69	5,41	10,21	19,42	37,96	62,24
15	0,66	1,43	2,58	5,20	9,82	18,69	36,53	59,90
16	0,64	1,38	2,49	5,02	9,48	18,03	35,25	57,79
17	0,62	1,33	2,41	4,85	9,16	17,44	34,08	55,87
18	0,60	1,29	2,34	4,70	8,88	16,89	33,01	54,13
19	0,58	1,25	2,27	4,56	8,62	16,39	32,04	52,52
20	0,56	1,21	2,20	4,43	8,37	15,93	31,14	51,05
25	0,50	1,07	1,95	3,92	7,40	14,07	27,51	45,10
30	0,45	0,97	1,76	3,54	6,68	12,72	24,86	40,75
35	0,41	0,89	1,61	3,25	6,14	11,67	22,82	37,41
40	0,38	0,83	1,50	3,02	5,70	10,84	21,18	34,73
45	0,36	0,77	1,40	2,83	5,34	10,15	19,84	32,53
50	0,34	0,73	1,32	2,67	5,03	9,57	18,71	30,68
55	0,32	0,69	1,26	2,53	4,77	9,08	17,75	29,10
60	0,31	0,66	1,20	2,41	4,55	8,65	16,91	27,73
70	0,28	0,61	1,10	2,21	4,18	7,94	15,52	25,45
80	0,26	0,56	1,02	2,05	3,88	7,37	14,41	23,63
90	0,24	0,53	0,96	1,92	3,63	6,91	13,50	22,14
100	0,23	0,50	0,90	1,81	3,42	6,51	12,73	20,88

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Lightning Test for Jones Stephens Brand Pex-Al-Pex Gas Piping and Fittings System (manufactured by Valsir in Italy)

Test and Test Facility:

Test Report No. LT-19-4825, Rev. (-)
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www.nts.com

NTS

Test Report of

Lightning Testing on 24 Assorted Gas Pipes

Issue Date: 16 August 2019

Prepared For: **Ferguson Enterprises**
12500 Jefferson Ave
Newport News, VA 23602 US

Prepared By: **Lightning Technologies, an NTS Company**
10 Downing Industrial Parkway
Pittsfield, MA 01201-3890

Project No. PR102377

NTS

Test Report No. LT-19-4825, Rev. (-)

ADMINISTRATIVE DATA

A. PURPOSE OF TESTS

Voltage breakdown, voltage ramp, and high current tests were performed on 24 assorted gas pipes to provide a comparison of their electrical performance to lightning related voltages and currents. The test results contained in this report relate only to the test items/part numbers tested.

Tests were performed by R. J. Wood, B. S. Robillard, D. A. DeBlois, and E. M. Montrond of Lightning Technologies (LTI) at the LTI facility in Pittsfield, MA during the period of 24 - 26 July 2019 and 7 - 8 August 2019. Testing was conducted in accordance with the Ferguson Enterprise "NTS Request for Test" (Ref. 1). Voltage breakdown and voltage ramp tests were performed according to the general guidelines of IEEE 60060-1 (Ref. 2), while high current tests were conducted according to the general guidelines of ANSI LC 1-2016/CSA 6.26-2016 (Ref. 3). Testing was performed in accordance with the requirements shown in Table 1.

Table 1 – Test Requirements

Test Type	Nomenclature
Voltage Breakdown Tests	Apply a 1.2 x 50 µs Lightning Impulse Voltage to the Test Specimens and Look for Voltage Breakdown and Puncture of the Dielectric Jacket.
Voltage Ramp Tests	End to End Voltage Ramp Test to Look for Voltage Breakdown Level Between Connectors.
High Current Tests	Apply test currents with a 10 µs x 1000 µs waveform from a rod electrode 1/8-inch above the gas pipe.

B. DESCRIPTION OF TEST ITEMS

Tests were performed on 24 assorted gas pipes from different manufacturers to provide product comparisons to lightning related transients. The test items are defined in Table 2. A representative Pexal Gas pipe manufactured by Valsir is shown in Figure 1.

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Table 2 – Test Items

Quantity	Nomenclature	Part Size
3	CSST with Brass End Connections	5 Feet Long
3	Carbon Steel Pipe	3 Feet, ¾ inch Long
3	PE Coated Copper	5 Feet Long
3	Iron Pipes	5 Feet Long
3	PEX-AL-PEX	5 Feet Long, 16 mm in Diameter
3	PEX-AL-PEX	5 Feet Long, 20 mm in Diameter
3	PEX-AL-PEX	5 Feet Long, 26 mm in Diameter
3	24, 23, 22, PEX-AL-PEX	5 Feet Long, 32 mm in Diameter

Figure 1 – Representative Pexal Gas Pipe

Camera 1 at Discharge

Camera 2 at Discharge

Figure A1 – Test Photographs for Test No. 4; Sample No. 1

List of test components:

Sample Description

Sample ID	TA#	Item Description	NTS Sticker Information
1	16	Valsir Pexal Gas Tube 16x2 with ½" NPT Fittings	08/08/2019 COMP - 3.71 kA, 5.68c; TEST # - 16
2	18	Valsir Pexal Gas Tube 16x2 with ½" NPT Fittings	08/08/2019 COMP - 3.68 kA, 5.4c; TEST # - 14
3	17	No Markings Present. Visually Similar to: Valsir Pexal Gas Tube 16x2 with ½" NPT Fittings	08/08/2019 COMP - 3.65 kA, 5.52c; TEST # - 15
4	20	Valsir Pexal Gas Tube 20x2 with ½" NPT Fittings	08/08/2019 COMP - 3.7 kA, 5.8c; TEST # - 18
5	15	Valsir Pexal Gas Tube 20x2 with ½" NPT Fittings	08/08/2019 COMP - 3.69 kA, 5.44c; TEST # - 19
6	19	Valsir Pexal Gas Tube 20x2 with ½" NPT Fittings	08/08/2019 COMP - 3.69 kA, 5.88c; TEST # - 17
7	22	Valsir Pexal Gas Tube 26x3 with ¾" NPT Fittings	08/08/2019 COMP - 3.67 kA, 5.6c; TEST # - 25
8	21	Valsir Pexal Gas Tube 26x3 with ¾" NPT Fittings	08/08/2019 COMP - 3.67 kA, 5.72c; TEST # - 21
9	14	Valsir Pexal Gas Tube 26x3 with ¾" NPT Fittings	08/08/2019 COMP - 3.68 kA, 5.8c; TEST # - 24
10	13	Valsir Pexal Gas Tube 32x3 with 1" NPT Fittings	08/08/2019 COMP - 3.72 kA, 5.56c; TEST # - 27
11	23	Valsir Pexal Gas Tube 32x3 with 1" NPT Fittings	08/08/2019 COMP - 3.72 kA, 5.56c; TEST # - 22
12	24	Valsir Pexal Gas Tube 32x3 with 1" NPT Fittings	08/08/2019 COMP - 3.68 kA, 5.8c; TEST # - 24
13	11	ProFlo 1/2x36 Black Steel Pipe API 5L PSL1 Heat#: A017 635 039	08/08/2019 COMP - 3.7 kA, 5.52c; TEST # - 6
14	10	ProFlo 1/2x36 Black Steel Pipe API 5L PSL1 Heat#: A017 635 039	08/08/2019 COMP - 3.7 kA, 5.52c; TEST # - 5
15	12	ProFlo 1/2x36 Black Steel Pipe API 5L PSL1 Heat#: A017 635 039	08/07/2019 COMP - 3.7 kA, 5.48c; TEST # - 7
16	04	Mueller Steamline GasShield ½" Copper Gas Tube	08/07/2019 COMP - 3.7 kA, 5.52c; TEST # - 11
17	05	Mueller Steamline GasShield ½" Copper Gas Tube	08/07/2019 COMP - 3.7 kA, 5.52c; TEST # - 12
18	06	Mueller Steamline GasShield ½" Copper Gas Tube	08/07/2019 COMP - 3.72 kA, 5.48c; TEST # - 11
19	02	½" Wardflex Flexable Fuel Gas Tubing 3-1820-2YY 15A/19 ASTM E84	08/07/2019 COMP – 3.65 kA, 5.48c; TEST # - 9
20	03	½" Wardflex Flexable Fuel Gas Tubing 3-1820-2YY 15A/19 ASTM E84	08/07/2019 COMP – 3.66 kA, 5.56c; TEST # - 10
21	01	½" Wardflex Flexable Fuel Gas Tubing 3-1820-2YY 15A/19 ASTM E84	08/07/2019 COMP – 3.65 kA, 5.48c; TEST # - 8
22	07	½" Tracpipe Counterstrike AR FGP-CS-500	08/07/2019 COMP - 3.36 kA, 5.04c; TEST # - 2
23	09	½" Tracpipe Counterstrike AR FGP-CS-500	08/07/2019 COMP - 3.32 kA, 5.32c; TEST # - 4
24	08	½" Tracpipe Counterstrike AR FGP-CS-500	08/07/2019 COMP - 3.32 kA, 5.32c; TEST # - 3

Test Summary

Test Summary

Test ID	Characteristic	Test Method(s)	Requirement	Results	Conforms (Yes / No / Not Applicable)
A1 – A4	Visual Examination	N/A	N/A	All Samples Examined See Discussion	N/A
B	Low Pressure Test	N/A	No Leaks	Samples 1 – 12 and 22 – 24 Tested See Table 1	N/A
C	High Pressure Test	N/A	600 psi or until failure	Samples 3, 4, 7, and 11 Tested See Table 1	Yes
D1 – D4	Cross Sectioning of Ends and Lightning Strike Location	ASTM E3	N/A	Samples 9 and 12 Sectioned. See Figures 9 – 16 and Discussion	N/A

Discussion

All samples were visually examined at the lightning strike location and fitting ends for holes or other defects. No holes were visually observed on any of the sample's fitting ends.

Samples 1 – 12
Black marks were observed on the sample fitting ends (Figures 1 – 2). The lightning strike location on the OD of the tube punctured the OD PEX tube on all the samples. The aluminum core was also punctured on samples 1 – 9 and 11. It was difficult to determine if the lightning strike affected the ID PEX visually. Because of this, one end was capped, and light was shone down the tube. The lightning strike location was viewed in the dark to determine if light could be seen through the lightning strike location. No light was observed on samples 10 and 12. Opaque light was observed on samples 1 – 9 and 11 (Figures 3 – 4).

The fitting ends and lightning strike location of samples 9 and 12 were sectioned and photographed (Figures 9 – 16). The lightning strike did not penetrate the inner PEX tube on samples 9 and 12 (Figures 15 – 16).

Samples 13 – 15
No holes or penetration was observed on the OD of the pipe (Figure 5).

Samples 16 – 18
A through wall hole was observed at the lightning strike location (Figure 6).

Samples 19 – 21
A through wall hole was observed at the lightning strike location (Figures 7).

Samples 22 – 24
The black coating was penetrated at the lightning strike location. No visible holes were observed on the corrugated stainless-steel tube, only a slight discoloration (Figure 8).

Example of Steel Pipe (top) and copper pipe (below)

Figure 5:

Sample 15

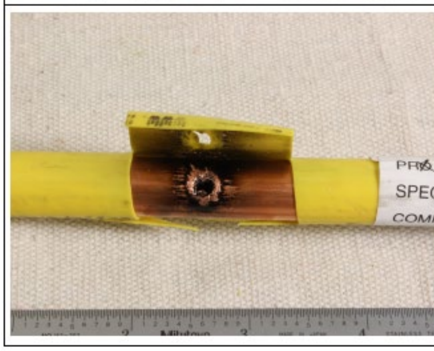

Figure 6:

Sample 17

Example of CSST (Wardflex top, Counterstrike bottom)

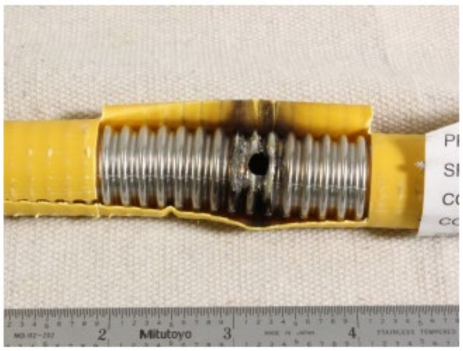

Figure 7:

Sample 21

Figure 8:

Sample 22

Worst case for Valsir Pex-Al-Pex (hole in outer pex and aluminum, but inner pex held pressure up to 600 PSI)

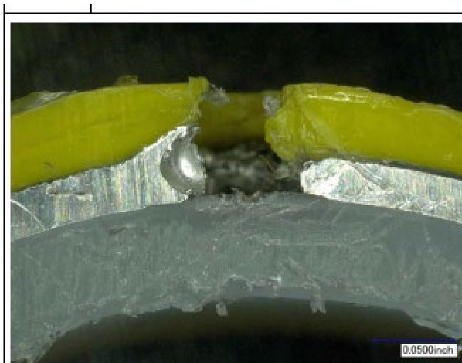

Figure 15:

Sample 9
Cross Section of Lightning Strike Location
50x

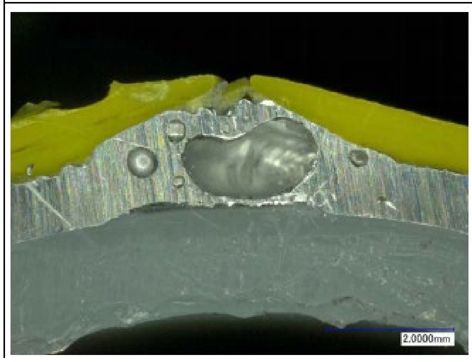

Figure 16:

Sample 12
Cross Section of Lightning Strike Location
50x

Test ID:	B / C	Characteristic:	Low- and High-Pressure Test	Test Method(s):	N/A

Sample ID	Low Pressure Test Conditions	Low Pressure Test Results	High Pressure Test Conditions	High Pressure Test Results
1	**Max Pressure:** 6 psig **Starting Pressure:** 2 psig **Leak Check Points:** 2, 4, and 6 psig **Dwell Time per Interval:** 5 mins **Temperature:** Room Temperature	Pass	**Max Pressure:** 600 psi or until failure **Leak Check Points:** 6, 20, 60 and 600 psi **Ramp Rate:** Slow Ramp from 60 to 600 psi **Dwell Time at Max psi:** 1 min **Temperature:** Room Temperature	N/A
2		Pass		N/A
3		Pass		600 psi – Did not fail
4		Pass		600 psi – Did not fail
5		Pass		N/A
6		Pass		N/A
7		Pass		600 psi – Did not fail
8		Pass		N/A
9		Pass		N/A
10		Pass		N/A
11		Pass		600 psi – Did not fail
12		Pass		N/A
22		Failed at 2 psig at Lightning Strike		N/A
23		Pass		N/A
24		Failed at 2 psig at connector and corrugated pipe interface		N/A

Table 1: Pressure Test Results

Conclusion:

After identical simulated lighting strikes on each of these piping samples,

1) All Valsir Pex-Al-Pex piping (samples 1-12) passed, held pressure up to 600 PSI (limit of test equipment)
2) All Steel pipe (samples 13-15) passed
3) All Copper pipe (samples 16-18) failed with visible holes
4) All Wardflex brand CSST (samples 19-21) failed with visible holes
5) All Omega Flex Counterstrike brand CSST (Samples 22-24) showed black coating penetration but no visible holes, then 2 of the 3 samples failed to hold pressure at 2 PSIG

*Add Table 506 'Minimum Capacities for Residential Water Heaters' as follows:

TABLE 506
MINIMUM CAPACITIES FOR RESIDENTIAL WATER HEATERS 1, 2, 3

Fuel		**Gas**	**Elec.**	**Gas**	**Elec.**	**Gas**	**Elec.**	**Gas**	**Elec.**
# of Bedrooms		1		2		3		~- '...	
1 to 1 Yz Baths	FHR (gal)	42	36	47	.40	50	.43	----	----
# of Bedrooms		2		3		4		5	
2 to 2Yz Baths	FHR (gal)	49	.42	60 .	55	62	57	69	65
# of Bedrooms		3		4		5		6	
3 to 3 112 Baths	FHR(gal)	60	55	67	·62	69	65	71	·67

Fl-lk=First Hour Ratmg, 1 gal=3.7854 L, 1 gph=1.05 mLis

1. Tankless Water Heaters shall be sized and installed per manufacturer's recommendations.

2. Water heaters for single family dwellings having more than six bedrooms and/or 3 'IS baths shall be sized per manufacturer's recommendations.

3. Table 506 reflects the minimum requirements for one or multiple water heating units.

5 March 2021

GA Department of Community Affairs
Plumbing, Mechanical and Fuel Gas Amendments Subcommittee
60 Executive Park South, NE
Atlanta, GA 30329-2231

Attention: Mr. Windell Peters

Subject: PEX-AL-PEX Multi-Layer Piping Systems

This correspondence addresses a code proposal, which was presented to the Amendments Subcommittee at its February 25, 2021 meeting, requesting approval of PEX-AL-PEX multi-layered piping for use in fuel gas piping systems for outdoors, indoors and underground applications. It is the opinion of OmegaFlex that PEX-AL-PEX piping products meet neither the prescriptive requirements nor the intent of the International Fuel Gas Code (IFGC) and Chapter 24 of the International Residential Code (IRC) for fuel gas service. We, therefore, strongly recommend that the Amendments Subcommittee deny the request for approval.

Non-Compliance

As part of their application package, the proponent seeking approval of multi-layer piping submitted an ICC-ES PMG report. This report indicates that the product complies with the ASTM F1281 standard, but the scope of ASTM-F1281 is not specifically intended for use with fuel gas. The report also indicates that the product complies with several different editions of both the IFGC and the IRC. However, upon closer examination one discovers that the ASTM-F1281-2017 is not included as a referenced standard in any edition of the IFGC or the IRC(g). In fact, composite tubing products have not been approved for fuel gas service in the US other than for direct burial underground.

The PMG report is, therefore, misleading. The Amendments Subcommittee should proceed cautiously regarding any claims of compliance with the model codes. Because the product standard (ASTM-F1281) is not listed in the IFGC or the IRC(g) codes, product compliance with the IFGC or the IRC needs to be evaluated based on Section 105.2 of the IFGC and Section R104.11 of the IRC that permit the use of alternative materials, design and methods of construction and equipment.

Alternative Materials

The alternative materials sections of both the IFGC and the IRC are intended to allow the local authority having jurisdiction to permit materials and methods not specifically prescribed by the code so long as they are *'not less than the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety'*. The multi-layer piping system proposed for unrestricted use with fuel gas is far less than equivalent to any metallic pipe and tubing materials currently prescribed by the Code in terms of fire resistance, safety and effectiveness. In fact, the ASTM committee that administers the F1281 standard is the plastic piping committee (F17).

Fire Resistance

Steel pipe, copper tubing and stainless steel tubing are required to be joined using a method and material having a melting point in excess of 1000F. Both the CSA LC-1 and LC-4 standards for CSST and press-connect fittings (for pipe and tubing) respectively contain fitting leakage tests performed at 1000F for one hour. The purpose of this requirement is to prevent significant leakage of combustible gas contained within the piping system in the event of a building fire. There is no performance test or other provisions for an equivalent test in the ASTM-F1281 for the multi-layer piping. It has been determined in previous research (ref 1) that PEX-AL-PEX will not pass a comparable 1000F test. Inclusion of PEX-AL-PEX (in the Georgia Fuel Gas Code) without compliance with a 1000F test would clearly fail to meet the level of equivalency specifically required for fuel gas piping by the current code.

In addition to the prescribed leakage test at 1000F, these composite tubing products are not subjected to other fire rating tests that are commonly required for other similar fuel gas, piping products such as CSST. For example, PEX-AL-PEX products listed to ASTM-F1281 are not required to be evaluated for smoke density and flame spread in accordance with the UL S102 or E84. Typically, plastic materials such as tubing coverings must be rated below threshold values in order to be installed in certain areas. Without these fire ratings, routing of the PEX-AL-PEX in plenums and stairwells (for example) within residential and commercial buildings would not be allowed.

Safety

Sections 310.1, 310.2 and 310.3 all stipulates that aboveground metallic pipe and tubing shall be electrically continuous and bonded to an effective ground fault current path. The ASTM-F1281 standard stipulates that the tubing connectors be designed so that the seal is effected on the internal (non-metallic) wall surface of the tubing. The manufacturer's installation instructions for Jones Stephens PEX-AL-PEX indicates that their fittings are dielectrically isolated (by design) from the internal aluminum layer to avoid galvanic corrosion. This dielectric isolation of the fitting from the metallic portion of the tubing would render the system electrically discontinuous and, therefore, not in compliance with the code. This condition creates a safety risk when the tubing becomes electrically energized, and there is no pathway to ground to clear the fault.

Effectiveness

It would appear that the proponents are requesting approval to install PEX-AL-PEX tubing in the same manner as CSST without any restrictions. However, PEX-AL-PEX products are made from Class B compounds that must be protected from continuous exposure to direct sunlight, and the deleterious UV breakdown of the outer polymer layer. The Jones Stephens installation guide prohibits the use of its PEX-AL-PEX product outdoors above ground for this very reason.

Given the use of plastic materials and its thin wall construction, care must be taken to protect PEX-AL-PEX piping systems from mechanical puncture threats. The experience with CSST demonstrates that conventional striker plates bought at a local plumbing supply house are not adequate to defeat typical nailing threats. Providers of multi-layer, fuel gas piping systems must be required to provide hardened metallic plates (similar to those required for CSST in the CSA LC-1 Standard) as part of their listed system.

Conclusion

PEX-AL-PEX multi-layer piping systems meet neither the prescriptive requirements (a referenced standard), nor critical performance requirements (as an equivalent alternative material) provided for in the code. The ASTM-F1281 Standard does not appear to be the best suited product standard for the purpose of listing multi-layered piping for use with fuel gas. The deficiencies in the fire resistance, effectiveness and safety of the product make it inappropriate for use as a fuel gas piping for applications above grade and within buildings.

Proponents for the code amendment have been disingenuous regarding the true limits of their product, and have not clearly met the burden of proof necessary to establish equivalency as defined in the IFGC. PEX-AL-PEX should not be considered a type of metallic piping, and should only be installed in accordance with Section 404.17.1 of the IFGC and limited to outdoors installations underground only.

Very truly yours,

Robert Torbin

Director of Codes and Standards

OnmegaFlex, Inc.

Ref 1: Composite Tubing Evaluation For Multi-Family Buildings, prepared by: Foster-Miller, Inc., Waltham, MA, prepared for: Southern California Gas Company, September 1993.

Georgia Department of Community Affairs
Attention: Ted Miltiades
60 Executive Park S
Atlanta, GA 30329

March 10, 2021

To: Georgia Department of Community Affairs

From: MAACA (Metropolitan Atlanta Air Conditioning Contractors Association)

Re: Responses to IFGC – 2022 – Items 7, 8, 9, 10; Articles 403.6, 404.3, 404.17.1

MAACA has reviewed and discussed the above referenced proposed Georgia Code Amendments to the 2018 IFGC. On behalf of MAACA, who represents Heating and Air Conditioning contractors throughout metropolitan Atlanta, we are opposed to using the PEX piping products, specifically the PEX AL PEX product, to supply fuel gas to residential and commercial buildings. It is our opinion that this PEX product is not proven enough to deliver fuel gas safely at this time.

Our contractors believe it to be a safety issue. Something as simple as a screw or pneumatic nail could easily penetrate it, causing fuel gas to leak into the building resulting in a potential explosion. Any underground sleeve which is not properly sealed or develops leaks remains a potential corrosive threat in our opinion. The zinc coated fittings have shown long term degradation especially when exposed to water or moisture which can cause fuel leaks. Delivering water thru PEX products is one thing but distributing gas thru PEX brings up many more safety issues which we do not believe have been fully tested with confidence at this time.

As the PEX AL PEX does not appear to meet the current 2018 IFGC standards for listed materials we unanimously oppose the use of this PEX product to distribute fuel gas in Georgia under the current acceptable standards.

Keeping Georgian's safe is one of our utmost concerns.

Sincerely,

Alan G. Ferguson

Alan G. Ferguson
MAACA

Is PEX-AL-PEX OK to Use for Fuel Gas Piping in Buildings?

Ted Lemoff, TLemoff Engineering*

At least one manufacturer of PEX-AL-PEX tubing is currently promoting its use for indoor fuel gas piping systems in homes and other buildings in many states. As a gas engineer who has been a member of the National Fuel Gas Code committee for 35 years, I have concerns and reservations about this use due to the possibility of fire in buildings.

PEX-AL-PEX is a tubing material with an inner and outer layer of cross-linked polyethylene with a thin layer of aluminum sandwiched between the layers of polyethylene. PEX-AL-PEX has been used commercially for many years for water distribution in homes. Jones Stephens, a distributor of piping and plumbing products, is now promoting the use of PEX-AL-PEX for fuel gas service in buildings. They have implied that the NFPA 54, National Fuel Gas Code and the International Fuel Gas Code allow this type of tubing based on its aluminum core. They cite an ICC-ES PMG Product Certificate that states the product is compliant with the 2021, 2018, 2015, 2012 and 2009 editions of the International Fuel Gas Code® (IFGC), however, compliance does not mean approval. The standard cited by the proponent (ASTM F1281) is administered by the ASTM Committee on Plastic Piping Systems. IFGC, Section 403.5 covers plastic pipe and tubing, and only allows polyethylene complying with ASTM D2513 and polyamide complying with ASTM F2945 for pipe and tubing. In addition, IFGC 404.17 limits plastic pipe to installation outdoors and underground only. Identical requirements are found in NFPA 54, paragraphs 5.5.4 and 7.1.7. The fact is that neither PEX-AL-PEX nor its listing standard ASTM F1281 are included in either code as an approved material for fuel gas service.

Fuel gas codes have allowed only metal pipe and tubing for fuel gas service inside buildings because of the probable failure of plastic pipe and tubing in a fire.

The thickness of the PEX-AL-PEX aluminum core varies with tubing size. The ASTM F1281 listing standard requires an aluminum core thickness of 0.23-mm (0.009-in) for ¾ inch tubing. This is much thinner than metal gas tubing (¾-inch type K copper tubing has a wall thickness of 1.65-mm (0.065-in)). The IFGC and NFPA 54 require metal gas fittings to withstand a 1000F for at least 1 hour. It is not known if PEX-AL-PEX has been tested under fire conditions, or if the PEX-AL-PEX fittings will leak fuel gas and feed a fire, or how long to failure in a fire. Previous research has determined that this type of tubing will not survive 1000F and fire conditions.

For these reasons, states and municipal AHJs and fire officials should defer local acceptance of this type of plastic piping material until the NFPA 54 and IFGC Technical Committee complete a technical review of this class of piping products, determined if it is equivalent with approved metallic piping products, and considered all aspects of its safe use.

If you have any questions on this subject, or would like more information, please contact me at tlemoffengineering@gmail.com.

** I have consulted for a manufacturer of metallic tubing used for fuel gas service. The opinions expressed here are my own and not those of the manufacturer.*

Conditioned Air Association of Georgia

P.O. Box 910, Hartwell, GA 30643
678-646-2224 Fax 1-866-267-3792
Email: tucker@caag.org Web: www.caag.org
Tucker Green, Associate Director

March 30, 2021

To whom it may concern:

The **Conditioned Air Association of Georgia** represents over 500 licensed HVAC contractors in Georgia along with over 100 state and local associate members. The CAAG Officers and Directors voted unanimously at our Board Meeting on March 18, 2021 to take the position of opposing PEX AL PEX for fuel gas lines. We oppose the use of PEX piping products, specifically the PEX AL PEX product, to supply fuel gas to residential and commercial buildings. It is the position of our association that this PEX product is not proven enough to deliver fuel gas safely at this time. We do not have confidence in the testing of this product. Please see the attached petition of signatures from many of our members officially opposing the use of this product. Our goal is to take a position that is both beneficial and safe for our industry professionals and consumers. Please contact CAAG with any questions.

Sincerely,

Tucker Green
Conditioned Air Association of Georgia

Petition to Oppose PEX AL PEX for Fuel Gas Lines

Attention: Georgia Department of Community Affairs

Petition Reference: Response to IFGC-2022 - Items 7, 8, 9, 10; Articles 403.6, 404.3, 404.17.1

Action of Petition: We, the undersigned, are opposed to using the PEX piping products, specifically the PEX AL PEX product, to supply fuel gas to residential and commercial buildings. It is our opinion that this PEX product is not proven enough to deliver fuel gas safely at this time. We do not believe this product has been fully tested with confidence at this time.

Printed Name	Signature	Location	Comments	Date
STEVE Blakovich	[illegible]	ACWORTH		3/19/21
Brian Spencer	[illegible]	Norcross		3/19/21
Jason Nikkel	[illegible]	Bowersville		3/19/21
Lamar Bradley	[illegible]	Cartersville		3/19/21
Robert Hawkins	[illegible]	ATL.		3/22/21
[illegible]	[illegible]	[illegible]		3/20/21

Petition to Oppose PEX AL PEX for Fuel Gas Lines

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Printed Name	Signature	Location	Comments	Date
Cherri Powers	Cherri Powers	Fayetteville, GA		3/19/21
JACK SCROGGS	Jack Scroggs	Athens, GA.		3/19/21
Steve Blakeney	[illegible]	Kennesaw GA		3/19/21
[illegible]	[illegible]	Snellville GA		3/19/21
Bennie Wingate	Bennie Wingate	East Point GA		3/19/21
R Pat Rogers	R Pat Rogers	ATL.		3/19
Jimmy Green	[illegible]	Canton Ga		3/19/21
Elaine Powers	Elaine Powers	Fayette GA		3/19/21
RANDY Conley	Randy Conley	Waycross GA.		3/19/21
Cindy Conley	C Conley	"		"
[illegible] Baxter	[illegible]	Alpharetta		3/19/21
Matthew Holtkamp	[illegible]	Buford		3-19-21
Stephanie Elliott	Stephanie Elliott	Kennesaw, GA		3/19/21

Petition to Oppose PEX AL PEX for Fuel Gas Lines

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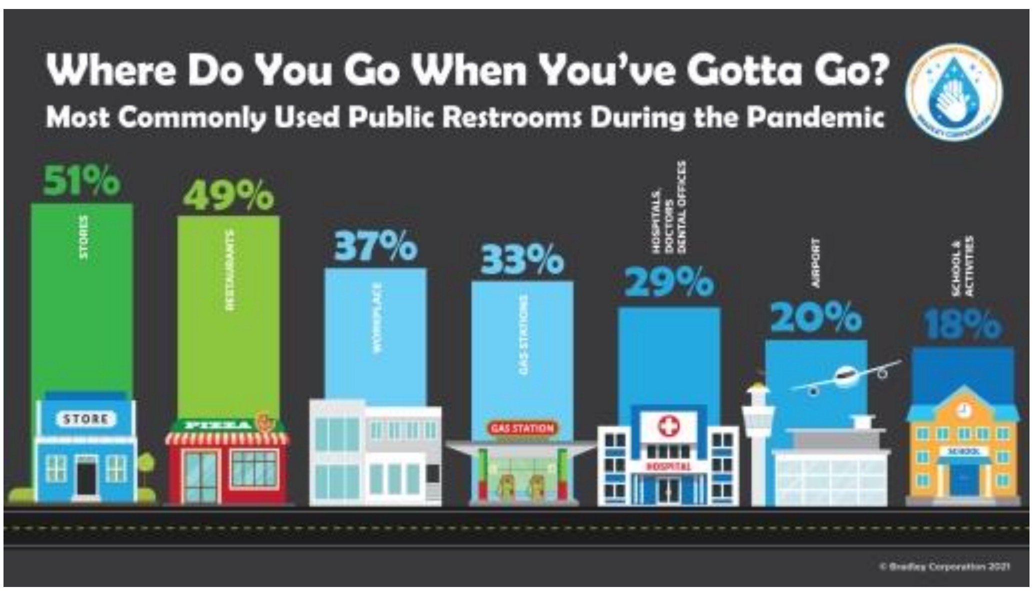
Printed Name	Signature	Location	Comments	Date
David Hammond	[signature]	Griffin, GA		3/19/21
Lavien Broxton	[signature]	ALPHARETTA		3-19-21
Nathan Oker	[signature]	Athens GA		3-19-21
Bart Heckman	[signature]	AUGUSTA		3-19-21
Ray Owechovski	[signature]	Augusta		3-19-21
ED NEWSOME	[signature]	ALBANY		3-19-21
Kenneth Horton	[signature]	Acworth		3/19/21
Steve Nail	[signature]	Hampton		3-19-21
Josh Harris	[signature]	Macon		3-19-21
Mike Littlejohn	[signature]	Rome		3-19-21
Michael Brown	[signature]	Covington		3/19/21
B.J. Littlejohn	[signature]	Rome		3-19-21
Tom Lucas	[signature]	Acworth		3-19-21
Michael Crowder	[signature]	Acworth		3-19-21
JOE SAVAGE	[signature]	AUGUSTA, GA		3-19-21
FRANK J. VERSEKETT	[signature]	MIDWAY GA		3/19/21

Americans Continued to Use Public Restrooms During Pandemic but Want Touchless Fixtures

Menomonee Falls, WI (April 7, 2021) – According to a national survey by [Bradley Corp.](), half of the population continued to use public restrooms throughout the pandemic. Just 13% of Americans said they completely avoided using a public restroom while 50% visited restrooms just as they always had. Another 37% said they were uncomfortable but had, at times, utilized a public restroom when necessary.

The most common places where Americans used a public restroom were stores, restaurants and their workplace. The majority who visited public restrooms took precautions to reduce their likelihood of coming in contact with germs. 63% had ahold of a paper towel as a protective barrier when they operated the toilet flusher and faucet handles or reached for door handles. Alternately, another group employed their foot to flush the toilet or opened and closed doors with their butt.



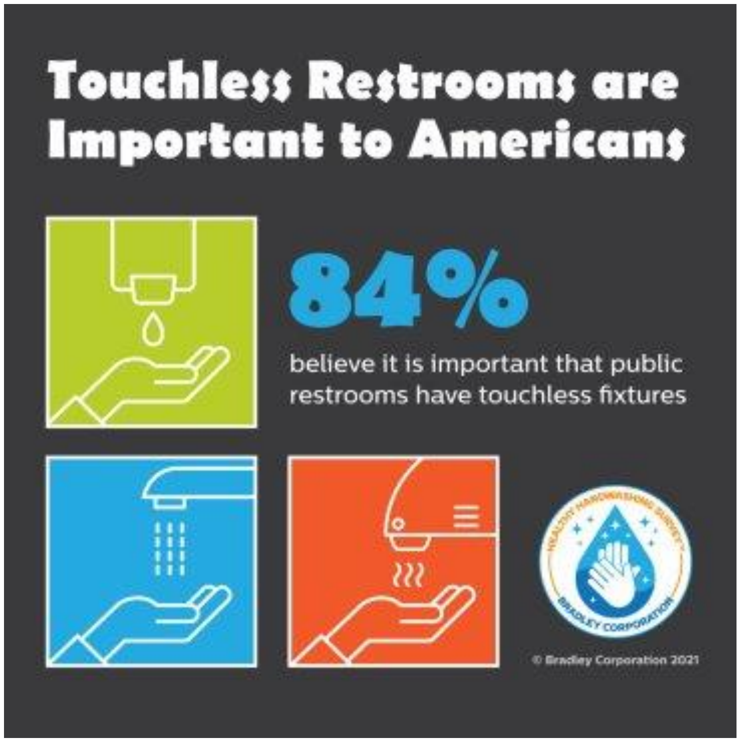
The annual Healthy Handwashing Survey from Bradley Corp. queried 1,050 American adults regarding their public restroom usage, handwashing habits and concerns about the coronavirus and flu. Participants were from around the country and were evenly split between men and women.

Strong Preference for Touchless

Since Americans have relied on evasive measures to avoid germs in public restrooms, it's not surprising that 84% believe it's important to have touchless fixtures. In fact, nearly 70% say they're more likely to return to a business that has touchless restroom features. On the other hand, 56% have a negative impression of a business that doesn't have touchless fixtures.

When it comes to which fixtures Americans prefer to be touchless, the toilet flusher, faucets and entrance doors top the list.

"Touchless restroom fixtures add a significant level of comfort for Americans when they're out and about and need to use a public restroom," says Jon Dommisse, director of strategy and corporate development for Bradley Corp. "We've all become more cognizant of potentially germy touch points so eliminating an area of concern is another way we can help resume our normal lives again."



Germ Concerns Significant

The Healthy Handwashing Survey, which was conducted in January 2021, found that 86% of Americans are more conscious about coming in contact with germs as a result of the Coronavirus.

That concern has led to a spike in handwashing and hand drying. The survey revealed that nearly 90% are washing their hands more frequently or more thoroughly as a result of the Coronavirus. In terms of frequency, 57% are sudsing up between six to 15 or more times a day. And, 73% are drying their hands more frequently or more thoroughly.

That's significant because hand drying is an important step in the handwashing process. The Centers for Disease Control and Prevention (CDC) explains that, "Germs can be transferred more easily to and from wet hands; therefore, hands should be dried after washing."

Overall, Americans correctly believe handwashing is a better germ-fighter than hand sanitizer. 61% understand their hands are less germy after washing with soap and water than after using hand sanitizer – a fact supported by the CDC. For times when soap and water are not available, the CDC says that using hand sanitizer is a good, second option for hand hygiene.

“Handwashing remains one of the easiest and most effective ways to stay healthy and reduce the likelihood of spreading germs or viruses to others,” says Dommisse. “When you pair soap and water with vigorous and thorough scrubbing, you’re literally removing and sending bacteria and germs down the drain.”

For more information, visit bradleycorp.com/handwashing.

April 20, 2021

Mr. Ted Miltiades, Director
Construction Codes and Industrialized Buildings Georgia
Dept. of Community Affairs
60 Executive Park South
NE Atlanta, GA 30329

Subject: Proposed Amendments to the 2020 Georgia State Minimum Standard Mechanical Code and the 2020 Georgia State Minimum Standard One- and Two-Family Dwelling Code

Dear Mr. Miltiades,

On behalf of the Air-Conditioning, Heating, and Refrigeration Institute (AHRI), we support proposed amendments to the 2020 Georgia State Minimum Standard Mechanical Code (IMC-2022-1 through IMC-2022-6) and the 2020 Georgia State Minimum Standard One- and Two-Family Dwelling Code (IRC-2022-4 through IRC-2022-9).

AHRI represents more than 90% of the equipment, component and refrigerant manufacturers in the Heating, Ventilation, Air Conditioning and Refrigeration or HVACR industry. . In America, the annual economic activity resulting from the HVACR industry is approximately $256 billion. In the United States alone, AHRI member companies, along with distributors, contractors, and technicians, employ more than 1.3 million people. So, I can assure you that AHRI members take this transition very seriously.

The *American Innovation and Manufacturing Act (AIM Act)* signed into law by President Trump on December 27, 2020, as a part of the omnibus/COVID-19 relief package, mandates that the U.S. Environmental Protection Agency phase down the consumption and production of hydrofluorocarbons, or HFCs, including currently-used refrigerants

Together with the U.S. Department of Energy, AHRI and other stakeholders have invested over $7 million in research carefully analyzing next generation refrigerant and equipment behavior related to this transition. In fact, we have just completed a project with UL and representatives from the fire service for the development of training for fire fighters to assure that they have the information needed for this transition. We believe that the careful consideration for safe use of next generation compliance has been completed and we now need to start preparing for the transition.

This transition, which we believe will have a deadline of January 1, 2025, requires a timely update to state building codes to enable the use of the new refrigerants that will replace the HFCs being phased down for all stakeholders to prepare for a safe transition. Since Georgia is on a 6-year building code cycle, it is imperative for these proposals to be addressed through the amendment process as soon as possible as equipment is already being certified to the UL/CSA

60335-2-40-2019 standard and next generation products will be introduced into the market to comply with EPA requirements.

The 2020 Georgia State Minimum Standard One- and Two-Family Dwelling Code includes equivalent references to UL/CSA 60335-2-40 for UL 1995. The same should be done in the 2020 Georgia State Minimum Standard Mechanical Code.

UL 60335-2-40

UL will withdraw UL 1995 as a national standard effective January 1, 2024. The newest 3rd edition of UL 60335-2-40, published November 2019, has new requirements for electrical and refrigerant safety including requirements for UV-C germicidal lamp systems, CO_2 systems, photovoltaic systems, new marking requirements, water ingress rating system as well as allowances for next generation Group A2L refrigerants.

ASHRAE-34 and ASHRAE 15

ASHRAE 34-2019 includes next generation refrigerants that do not appear in previous editions of the standard. ASHRAE 15-2019 incorporates among other things specific requirements for the use of next generation A2L refrigerants (Addenda d and h), alignment with Standard 34 (Addendum c), clarifications on requirements when changing the refrigerant (Addendum e), clarification and new detail of discharge line piping (Addendum f), as well as some minor changes (Addendum b). Hence, both ASHRAE 34-2019 and ASHRAE 15-2019 standard references need to be updated. It should be noted that the 2021 ICC International Mechanical Code references ASHRAE 15-2019 and ASHRAE 34-2019.

With the change to next generation refrigerants, the 2020 Georgia State Minimum Standard Mechanical Code needs to be updated to address the use of Group A2L refrigerants in high probability (direct) systems. The safety requirements in ASHRAE 15-2019 address the concerns regarding the use of a Group A2L refrigerants; listing of equipment; installation of refrigerant detectors; and ventilation to mitigate any leak of refrigerant. By referencing ASHRAE 15-2019 directly, the requirements become an enforceable part of the code. ASHRAE 15-2019 requires an A2L appliance or equipment to be listed to UL/CSA 60335-2-40-2019.

We ask that members of the committee support the proposed amendments to the 2020 Georgia State Minimum Standard Mechanical Code (IMC-2022-1 through IMC-2022-6) and the 2020 Georgia State Minimum Standard One- and Two-Family Dwelling Code (IRC-2022-4 through IRC-2022-9) in this code cycle which will provide a safe transition for the entire supply chain.

Sincerely,

Helen Walter-Terrinoni

Helen Walter-Terrinoni
Vice President of Regulatory Affairs
Air-Conditioning, Heating and Refrigeration Institute (AHRI)

LENNOX INTERNATIONAL

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Sr. Engineering Manager
Regulatory Affairs
Telephone: 803-738-4085

April 21, 2021

Mr. Ted Miltiades, Director
Construction Codes and Industrialized Buildings
Georgia Dept. of Community Affairs
60 Executive Park South
NE Atlanta, GA 30329

Submitted via: e-mail

Re: Lennox Comments regarding the Proposed Amendments to the 2020 Georgia State Minimum Standard Mechanical Code and the 2020 Georgia State Minimum Standard One- and Two-Family Dwelling Code.

Lennox International Inc. (Lennox) hereby submits comments in support of proposed amendments to the 2020 Georgia State Minimum Standard Mechanical Code (IMC-2022-1 through IMC-2022-6) and the 2020 Georgia State Minimum Standard One- and Two-Family Dwelling Code (IRC-2022-4 through IRC-2022-9) and recommends timely adoption into the Georgia code.

Lennox is a leading provider, based in the United States, of climate control solutions for heating, air-conditioning and refrigeration equipment (HVACR). Lennox is a publicly-traded company, has thousands of employees, and offers a broad range of HVACR products to the marketplace. This industry is an important source of American jobs and provides equipment that is vital to the health and wellbeing of consumers and the preservation of food. In America, the annual economic activity resulting from the HVACR industry is approximately $256 billion. In the United States alone, the HVACR industry, along with distributors, contractors, and technicians, employ more than 1.3 million people

The *American Innovation and Manufacturing Act (AIM Act)* signed into law by President Trump on December 27, 2020, as a part of the omnibus/COVID-19 relief package, mandates that the U.S. Environmental Protection Agency phase down the consumption and production of hydrofluorocarbons, or HFCs, including currently-used refrigerants. Lennox strongly supported this legislation.

Now, equipment, component and refrigerant manufacturers in the Heating, Ventilation, Air Conditioning and Refrigeration or HVACR industry are focused on the pending industry transition to phasedown HFC's. To ensure a safe transition the U.S. Department of Energy, the HVACR industry and other stakeholders have invested over $7 million in research carefully analyzing next generation refrigerant and equipment behavior related to this transition. In fact, industry has just completed a project with UL and representatives from the fire service for the development of training for fire fighters to assure that they have the information needed for this transition. We believe that the careful consideration for safe use of next generation compliance has been completed and we now need to start preparing for the transition.

This transition, which we believe will become effective in January 1, 2025, requires a timely update to state building codes to enable the use of the new refrigerants that will replace the HFCs being phased down for all stakeholders to prepare for a safe transition. Since Georgia is on a 6-year building code cycle, it is imperative for these proposals to be addressed through the amendment process in a timely manner to allow compliance with EPA requirements.

The 2020 Georgia State Minimum Standard One- and Two-Family Dwelling Code includes equivalent references to UL/CSA 60335-2-40 and UL 1995. The same should be done in the 2020 Georgia State Minimum Standard Mechanical Code.

UL 60335-2-40

UL will withdraw UL 1995 as a national standard effective January 1, 2024. The newest 3rd edition of UL 60335-2-40, published November 2019, has new requirements for electrical and refrigerant safety-including requirements for UV-C germicidal lamp systems, CO_2 systems, photovoltaic systems, new marking requirements, water ingress rating system as well as allowances for next generation Group A2L refrigerants.

ASHRAE-34 and ASHRAE 15

ASHRAE 34-2019 includes next generation refrigerants that do not appear in previous editions of the standard. ASHRAE 15-2019 incorporates among other things specific requirements for the use of next generation A2L refrigerants (Addenda d and h), alignment with Standard 34 (Addendum c), clarifications on requirements when changing the refrigerant (Addendum e), clarification and new detail of discharge line piping (Addendum f), as well as some minor changes (Addendum b). Hence, both ASHRAE 34-2019 and ASHRAE 15-2019 standard references need to be updated. It should be noted that the 2021 ICC International Mechanical Code references ASHRAE 15-2019 and ASHRAE 34-2019.

With the change to next generation refrigerants, the 2020 Georgia State Minimum Standard Mechanical Code needs to be updated to address the use of Group A2L refrigerants in high probability (direct) systems. The safety requirements in ASHRAE 15-2019 address the concerns regarding the use of a Group A2L refrigerants including; listing of equipment; installation of refrigerant detectors; and ventilation to mitigate a potential leak of refrigerant.

In summary, Lennox ask members of the committee to support the proposed amendments to the 2020 Georgia State Minimum Standard Mechanical Code (IMC-2022-1 through IMC-2022-6) and the 2020 Georgia State Minimum Standard One- and Two-Family Dwelling Code (IRC-2022-4 through IRC-2022-9) in this code cycle which will provide a safe transition for the entire supply chain.

Sincerely,

Dave Winningham,
Sr. Engineering Manager, Regulatory Affairs

The following example was copied from the U S Department of Energy Web site

[Sizing a New Water Heater | Department of Energy]

FHR based off peak demand of hot water in 1 hour.

To estimate your peak hour demand:

- Determine what time of day (morning, noon, evening) you use the most hot water in your home. Keep in mind the number of people living in your home.
- Use the worksheet below to estimate your maximum usage of hot water during this one hour of the day—this is your peak hour demand. Note: the worksheet does not estimate total daily hot water usage.

The worksheet example shows a total peak hour demand of 36 gallons. Therefore, this household would need a water heater model with a first hour rating of 34 to 38 gallons.

Worksheet for Estimating Peak Hour Demand/First Hour Rating *

USE	AVERAGE GALLONS OF HOT WATER PER USAGE		TIMES USED DURING 1 HOUR		GALLONS USED IN 1 HOUR
Shower	10	×		=	
Shaving (.05 gallon per minute)	2	×		=	
Hand dishwashing or food prep (2 gallons per minute)	4	×		=	
Automatic dishwasher	6	×		=	
Clothes washer	7	×		=	
			Total Peak Hour Demand	=	

Using these numbers the FHR would be 36 Gallons regardless of energy source.

EXAMPLE

3 showers	10	×	3	=	30
1 shave	2	×	1	=	2
1 hand dishwashing	4	×	1	=	4
Peak Hour Demand				=	36

Adapted from information from the Federal Energy Management Program Energy Cost Calculator.
*The above worksheet is based on standard usage with no water conservation measures.

Appendix E to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Water Heaters

Subpart B—Test Procedures

5.3.3 First-Hour Rating Test.

5.3.3.1 *General.* During hot water draws for water heaters with rated storage volumes greater than or equal to 20 gallons, remove water at a rate of 3.0 ±0.25 gallons per minute (11.4 ±0.95 liters per minute). During hot water draws for storage-type water heaters with rated storage volumes below 20 gallons, remove water at a rate of 1.0 ±0.25 gallon per minute (3.8 ±0.95 liters per minute). Collect the water in a container that is large enough to hold the volume removed during an individual draw and is suitable for weighing at the termination of each draw to determine the total volume of water withdrawn. As an alternative to collecting the water, a water meter may be used to directly measure the water volume(s) withdrawn.

5.3.3.2 *Draw Initiation Criteria.* Begin the first-hour rating test by starting a draw on the storage-type water heater. After completion of this first draw, initiate successive draws based on the following criteria. For gas-fired and oil-fired water heaters, initiate successive draws when the temperature controller acts to reduce the supply of fuel to the main burner. For electric water heaters having a single element or multiple elements that all operate simultaneously, initiate successive draws when the temperature controller acts to reduce the electrical input supplied to the element(s). For electric water heaters having two or more elements that do not operate simultaneously, initiate successive draws when the applicable temperature controller acts to reduce the electrical input to the energized element located vertically highest in the storage tank. For heat pump water heaters that do not use supplemental, resistive heating, initiate successive draws immediately after the electrical input to the compressor is reduced by the action of the water heater's temperature controller. For heat pump water heaters that use supplemental resistive heating, initiate successive draws immediately after the electrical input to the first of either the compressor or the vertically highest resistive element is reduced by the action of the applicable water heater temperature controller. This draw initiation criterion for heat pump water heaters that use supplemental resistive heating, however, shall only apply when the water located above the thermostat at cut-out is heated to 125 °F ±5 °F (51.7 °C ±2.8 °C). If this criterion is not met, then the next draw should be initiated once the heat pump compressor cuts out.

5.3.3.3 *Test Sequence.* Establish normal water heater operation. If the water heater is not presently operating, initiate a draw. The draw may be terminated any time after cut-in occurs. After cut-out occurs (*i.e.,* all temperature controllers are satisfied), record the internal storage tank temperature at each sensor described in section 4.5 of this appendix every one minute, and determine the mean tank temperature by averaging the values from these sensors.

Initiate a draw after a maximum mean tank temperature (the maximum of the mean temperatures of the individual sensors) has been observed following a cut-out. Record the time when the draw is initiated and designate it as an elapsed time of zero ($\tau^* = 0$). (The superscript * is used to denote variables pertaining to the first-hour rating test). Record the outlet water temperature beginning 15 seconds after the draw is initiated and at 5-second intervals thereafter until the draw is terminated. Determine the maximum outlet temperature that occurs during this first draw and record it as $T^*_{max,1}$. For the duration of this first draw and all successive draws, in addition, monitor the inlet temperature to the water heater to ensure that the required 58 °F ±2 °F (14.4 °C ±1.1 °C) test condition is met. Terminate the hot water draw when the outlet temperature decreases to $T^*_{max,1}$ − 15 °F ($T^*_{max,1}$ − 8.3 °C). (Note, if the outlet temperature does not decrease to $T^*_{max,1}$ − 15 °F ($T^*_{max,1}$ − 8.3 °C) during the draw, then hot water would be drawn continuously for the duration of the test. In this instance, the test would end when the temperature decreases to $T^*_{max,1}$− 15 °F ($T^*_{max,1}$ − 8.3 °C) after the electrical power and/or fuel supplied to the water heater is shut off, as described in the following paragraphs.) Record this temperature as $T^*_{min,1}$. Following draw termination, determine the average outlet water temperature and the mass or volume removed during this first draw and record them as $\overline{T}^*_{del,i}$ and M^*_1 or V^*_1, respectively.

Initiate a second and, if applicable, successive draw(s) each time the applicable draw initiation criteria described in section 5.3.3.2 are satisfied. As required for the first draw, record the outlet water temperature 15 seconds after initiating each draw and at 5-second intervals thereafter until the draw is terminated. Determine the maximum outlet temperature that occurs during each draw and record it as $T^*_{max,i}$, where the subscript i refers to the draw number. Terminate each hot water draw when the outlet temperature decreases to $T^*_{max,i}$ − 15 °F ($T^*_{max,i}$ − 8.3 °C). Record this temperature as $T^*_{min,i}$. Calculate and record the average outlet temperature and the mass or volume removed during each draw ($\overline{T}^*_{del,i}$ and M^*_i or V^*_i, respectively). Continue this sequence of draw and recovery until one hour after the start of the test, then shut off the electrical power and/or fuel supplied to the water heater.

If a draw is occurring at one hour from the start of the test, continue this draw until the outlet temperature decreases to $T^*_{max,n}$ − 15 °F ($T^*_{max,n}$ − 8.3 °C), at which time the draw shall be immediately terminated. (The subscript n shall be used to denote measurements associated with the final draw.) If a draw is not occurring one hour after the start of the test, initiate a final draw at one hour, regardless of whether the criteria described in section 5.3.3.2 of this appendix are satisfied. This draw shall proceed for a minimum of 30 seconds and shall terminate when the outlet temperature first indicates a value less than or equal to the cut-off temperature used for the previous draw ($T^*_{min,n-1}$). If an outlet temperature greater than $T^*_{min,n-1}$ is not measured within 30 seconds of initiation of the draw, zero additional credit shall be given towards first-hour rating (*i.e.,* $M^*_n = 0$ or $V^*_n = 0$) based on the final draw. After the final draw is terminated, calculate and record the average outlet temperature and the mass or volume removed during the final draw ($\overline{T}^*_{del,n}$ and M^*_n or V^*_n, respectively).

Georgia Plumbers Trade Association Inc.
P O Box 1698
Stockbridge Georgia 30281
Phone: (770) 573 – 4815
Web: GPTA.net
Email: Admnasst@gpta.net

April 28, 2021

To: Members of the PMG Sub-committee

Amendment # Table 506.1 Water Heater Sizing

Table 506.1 of the Georgia amendments uses the number of bedroom and bathrooms in the dwelling to determine the minimum FHR for the water heater to be installed. The amendment I submitted is to replace the current table with an updated version that was developed by Bradford White Cooperation in response to the new testing criteria developed by the U S Department of Energy. A number of the FHR of certain size water heaters were revised on the new table. The new table I submitted reflects these changes. If we continue include the water heater sizing table in our plumbing code, I want to make sure we include the correct first hour ratings as to be able to support this table and requirements if needed.

At the request of Windell Peters I have asked the people at Bradford White to rework the table and make it simpler to use. They have agreed with the changes and promised to have the new table with changes to me by Friday. I will send it out as soon as I receive it.

I have included some documents that provide information from the U S Department of Energy (DOE) for standards and procedures used for determining the First Hour Rating of a water heater. The second document from the DOE shows an example for the method of determining the FHR needed for a home based on water usage.

Anyone who would like to discuss this issue or that might have questions can contact me at 770-595-9887 or email at randerson@gpta.net.

Ron Anderson, President
GPTA Inc.

TABLE 506 MINIMUM CAPACITIES FOR RESIDENTIAL WATER HEATERS [1, 2, 3]

Number of Bathrooms	1 to 1.5			2 to 2.5				3 to 3.5			
Number of Bedrooms	1	2	3	2	3	4	5	3	4	5	6
First Hour Rating, Gallons	38	49	49	49	62	62	74	62	74	74	74

FHR= First Hour Rating, 1 gal=3.7854 L, 1 gph=1.5 mL/s

1. Tankless Water Heaters shall be sized and installed per manufacturer's recommendations
2. Water heaters for single family dwellings having more than six bedrooms and/or 3 1/2 baths shall be sized per manufacturer's recommendations.
3. Table 506 reflects the minimum requirements for one or multiple water heating units.

MITSUBISHI ELECTRIC TRANE HVAC US

May 3, 2021

Mr. Ted Miltiades, Director
Construction Codes and Industrialized Buildings
Georgia Dept. of Community Affairs
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30329

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Subject: Proposed Amendments to the 2020 Georgia State Minimum Standard Mechanical Code and the 2020 Georgia State Minimum Standard One- and Two-Family Dwelling Code

Dear Mr. Miltiades,

Mitsubishi Electric Trane HVAC US (METUS), headquartered in Suwanee, GA, is a leading provider of ductless and VRF systems in the United States and Latin America. As a 50/50 joint venture between Trane Technologies and Mitsubishi Electric US, Inc., the company provides innovative products, systems and solutions capable of cooling and heating any application from a home to a large commercial building.

METUS supports proposed amendments to the 2020 Georgia State Minimum Standard Mechanical Code (IMC-2022-1 through IMC-2022-6) and the 2020 Georgia State Minimum Standard One- and Two-Family Dwelling Code (IRC-2022-4 through IRC-2022-9).

The *American Innovation and Manufacturing Act (AIM Act)* signed into law by President Trump on December 27, 2020, as a part of the omnibus/COVID-19 relief package, mandates that the U.S. Environmental Protection Agency phase down the consumption and production of hydrofluorocarbons, or HFCs, including currently-used refrigerants.

Together the U.S. Department of Energy and other stakeholders have invested over $7 million in research carefully analyzing next generation refrigerants and equipment behavior related to this transition. In fact, industry has just completed a project with UL and representatives from the fire service for the development of training for fire fighters to assure that they have the information needed for this transition. We believe that the careful consideration for safe use of next generation refrigerants has been completed and we now need to start preparing for the transition.

This transition, which we believe will commence on January 1, 2025, requires a timely update to state building codes to enable the use of the new refrigerants that will replace the HFCs being phased down. This will ensure that all stakeholders can prepare for a safe transition. Since Georgia is on a 6-year building code cycle, it is imperative for these proposals to be addressed through the amendment process as soon as possible as equipment is already being certified to the UL/CSA 60335-2-40 product safety standard and next generation products will be introduced into the market to comply with EPA requirements.

The 2020 Georgia State Minimum Standard One- and Two-Family Dwelling Code includes equivalent references to UL/CSA 60335-2-40 for UL 1995. The same should be done in the 2020 Georgia State Minimum Standard Mechanical Code.

UL 60335-2-40

UL will withdraw UL 1995 as a national standard effective January 1, 2024. The 3rd edition of UL 60335-2-40, published November 2019, has new requirements for electrical and refrigerant safety-including requirements for UV-C germicidal lamp systems, CO_2 systems, photovoltaic systems, new marking requirements, water ingress rating system as well as allowances for next generation Group A2L refrigerants.

ASHRAE Standard 34 and ASHRAE Standard 15

ASHRAE Standard 34 and ASHRAE Standard 15 references need to be updated to the 2019 editions. It should be noted that the 2021 ICC International Mechanical Code references ASHRAE 15-2019 and ASHRAE 34-2019. ASHRAE Standard 34-2019 includes next generation refrigerants that do not appear in previous editions of the standard. ASHRAE Standard 15-2019 incorporates specific requirements for the use of next generation A2L refrigerants, alignment with Standard 34, and clarification on requirements when changing the refrigerant.

The safety requirements in ASHRAE Standard 15-2019 address the concerns regarding the use of a Group A2L refrigerants, listing of equipment, installation of refrigerant detectors, and ventilation to mitigate any leak of refrigerant. By referencing ASHRAE Standard 15-2019 directly, the requirements become an enforceable part of the code. ASHRAE 15-2019 requires an A2L appliance or equipment to be listed to UL/CSA 60335-2-40, 3rd edition.

We ask that members of the committee support the proposed amendments to the 2020 Georgia State

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Minimum Standard Mechanical Code (IMC-2022-1 through IMC-2022-6) and the 2020 Georgia State Minimum Standard One- and Two-Family Dwelling Code (IRC-2022-4 through IRC-2022-9) in this code cycle which will provide a safe transition for the entire supply chain.

Sincerely,

Steve O’Brien
Senior Vice President of Residential and Commercial Business