Designation: F 1335 – 04

An American National Standard

Standard Specification for Pressure-Rated Composite Pipe and Fittings for Elevated Temperature Service[1]

This standard is issued under the fixed designation F 1335; 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 pressure-rated composite pipe and fittings for the transport of hot or cold liquids, beverages, or gases that are compatible with the composite pipe and fittings.

1.2 Composite pipe is produced using a butt welded aluminum pipe as a core, with an extruded inside layer of crosslinked polyethylene (PEX) or polyethylene (PE). An adhesive layer is used to bond the inside layer to the wall of the aluminum pipe. An outer layer of polyethylene (PE) and an adhesive layer are extruded to the outer wall of the aluminum pipe.

1.3 Composite pipe is produced in four configurations and referenced in Fig. 1, as Classes 1, 2, 3, and 4 composite pipe.

1.4 This specification includes compression fittings and compression joints, which are referenced in Fig. 2. Compression fittings as described in this specification are not compatible for gas transportation. Threaded fittings are referenced in Fig. 3.

1.5 The following precautionary caveat pertains only to the test method portion of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.6 The values stated in acceptable SI units are to be regarded as the standard. The values given in parentheses are provided for information only. The values stated in each system are not exact equivalents, therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

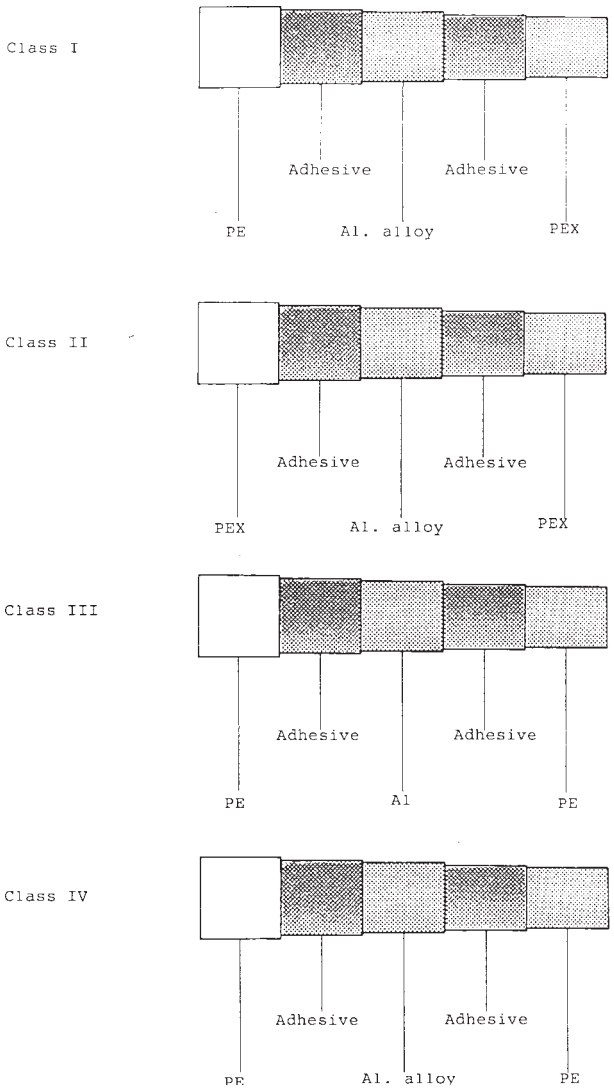


FIG. 1 Composite Pipe Composition

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

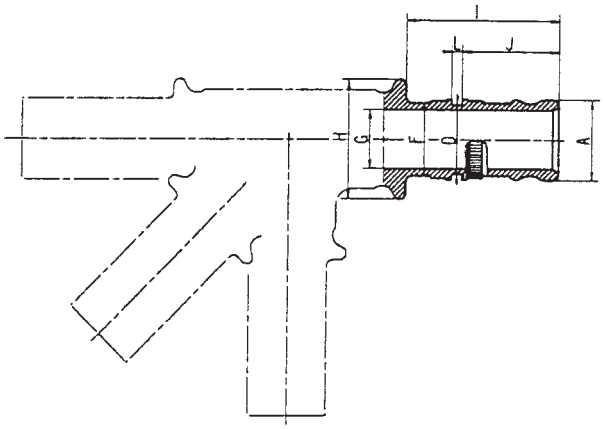
B 313/B 313M Specification for Aluminum and Aluminum-Alloy Round Welded Tubes

B 547/B 547M Specification for Aluminum and Aluminum-Alloy Formed and Arc-Welded Round Tube

[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 Jan. 1, 2004. Published January 2004. Originally approved in 1991. Last previous edition approved in 1998 as F 1335 – 98ε1.

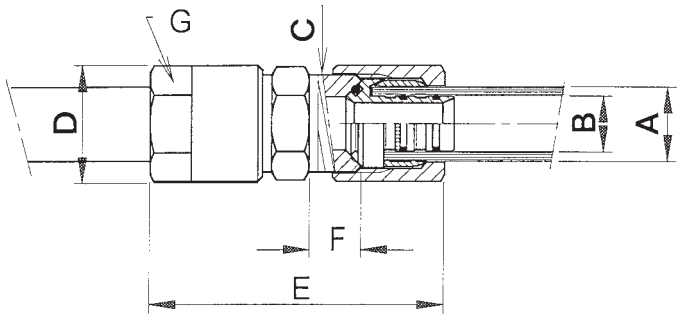
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.



Ø Pipes, mm (in.)	16 (0.630)	20 (0.787)	26 (1.024)	32 (1.260)	X[A]	40 (1.575)	X[A]	50 (1.969)	X[A]
Ø A	11.3 (0.445)	14.8 (0.583)	19.8 (0.780)	25.8 (1.016)		32.8 (1.291)		41.8 (1.646)	
Ø D	9.2 (0.362)	12.7 (0.500)	17.3 (0.681)	23.3 (0.917)		30.3 (1.193)		38.2 (1.504)	
Ø F	10 (0.394)	13.4 (0.528)	18 (0.709)	24 (0.945)		30.6 (1.205)		39.2 (1.543)	
Ø G	7.4 (0.291)	10.7 (0.421)	15 (0.591)	20.5 (0.807)		26.6 (1.047)		33 (1.299)	
Ø H	17.9 (0.705)	21.9 (0.862)	28.5 (1.122)	34.7 (1.366)		43.5 (1.713)		54 (2.126)	
I	26 (1.024)	28.5 (1.122)	33 (1.299)	29.5 (1.161)	38 (1.496)	35 (1.378)	44 (1.732)	39 (1.535)	5 (0.197)
J	16.7 (0.657)	18 (0.709)	20.5 (0.807)	15.2 (0.598)	23.7 (0.933)	18.3 (0.720)	27.3 (1.075)	19.3 (0.760)	30.3 (1.193)
L	2 (0.079)	2 (0.079)	2.4 (0.094)	2.4 (0.094)		2.4 (0.094)		3.5 (0.138)	

[A] X = Plastic fittings.

FIG. 2 Compression Fittings and Dimensions for Composite Pipes



Reference	Pipe dimension mm (in.)		
A[A]	16 (0.630)	20 (0.787)	26 (1.024)
B[B]	11.5 (0.453)	15 (0.591)	20 (0.787)
C[C]	½ in.	¾ in.	1 in.
D[D]	25 (0.984)	30 (1.181)	38 (1.496)
E[E]	62 (2.441)	68 (2.677)	68 (2.677)
F[F]	11 (0.433)	11 (0.433)	13 (0.512)
G[G]	22 (0.866)	27 (1.063)	34 (1.339)

[A] Outside diameter.
[B] Inside diameter.
[C] Thread.
[D] Outside diameter of nut.
[E] Total length.
[F] Length of thread.
[G] Tool aperture.

FIG. 3 Threaded Fitting for Composite Pipe

B 584 Specification for Copper Alloy Sand Castings for General Applications
D 618 Practice for Conditioning Plastics for Testing
D 638 Test Method for Tensile Properties of Plastics
D 1248 Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
D 1505 Test Method for Density of Plastics by the Density-Gradient Technique
D 1598 Test Methods for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
D 1600 Terminology for Abbreviated Terms Relating to Plastics
D 1898 Practice for Sampling of Plastics[3]

[3] Withdrawn.

D 2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
D 2765 Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics
D 3222 Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials
D 3350 Specification for Polyethylene Plastics Pipe and Fittings Materials
D 3418 Test Method for Transition Temperature of Polymers by Differential Scanning Calorimetry
F 412 Terminology Relating to Plastic Piping Systems

2.2 *National Sanitation Foundation (NSF) Standards:*[4]

Standard No. 14 for Plastic Piping Components and Related Materials
Standard No. 61 for Drinking Water System Components—Health Effects

2.3 *ISO Standards:*[5]

ISO 31 - 0 General principles
ISO 32 3 Mechanics
ISO 10508 Thermoplastics Pipe and Fittings for Hot and Cold Water Systems

2.4 *DVGW Standard:*[6]

W 534 Technical Rules for Connecting Pipe Elements and Pipe Connections for Pipe in Drinking Water Installations; Requirements and Testing

2.5 *Federal Standard:*[7]

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)

2.6 *Military Standard:*[7]

MIL-STD-129 Marking for Shipment and Storage

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology F 412, and abbreviations are in accordance with Terminology D 1600, unless otherwise specified.

3.1.1 *composite pipe*—pipe consisting of two or more different materials arranged with specific functional purpose to serve as pipe.

3.1.2 *crosslinked polyethylene plastic*—plastic prepared by crosslinking (curing) polyethylene compounds.

3.1.3 *pressure ratings (PR)*—the estimated maximum pressure that water in the pipe can exert continuously with a high degree of certainty that failure of the pipe will not occur.

3.1.4 The abbreviation for polyethylene is PE, and the abbreviation for crosslinked polyethylene is PEX.

3.1.5 *Fittings for Composite Pipe*:

3.1.5.1 *compression fittings, compression joints*—fittings and joints specially developed for composite pipe in which the aluminum core is used as a compression sleeve to develop sufficient mechanical strength for the connection.

3.1.5.2 *threaded fittings, threaded joints*—fittings and joints specially designed for composite pipe to avoid the possible galvanic current between the aluminum of the composite pipe and any metallic part of the fitting.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *adhesive*—a low-molecular weight polyethylene that functions as an adhesive layer and bonds the crosslinked polyethylene or the polyethylene to the aluminum pipe.

3.2.2 *Class 1 composite pipe*—composite pipe for elevated temperature and pressure ratings.

3.2.3 *Class 2 composite pipe*—composite pipe for elevated temperature and pressure ratings and better outside resistance.

3.2.4 *Class 3 composite pipe*—composite pipe for use at lower temperature and pressure ratings.

3.2.5 *Class 4 composite pipe*—composite pipe for low temperature, more specific for gas transportation.

3.2.6 *compression fittings for composite pipe,* (Fig. 2)—fittings specially developed for composite pipe in which the aluminum core is used as a compression sleeve to develop sufficient mechanical strength for the connection.

3.2.7 *threaded fittings* (Fig. 3)—specially developed for composite pipe for the transport of liquids and gases.

3.2.8 *lot*—a lot shall consist of all pipe of the same size produced from one extrusion line during one designated period.

4. Classification

4.1 Pipe and threaded fittings produced under this specification will provide suitable network for the transport of hot and cold liquids and compatible gases at specified pressure ratings and temperatures.

4.2 Pipe and compression fittings produced under this specification will provide suitable network for hot and cold compatible liquids at specified pressure rating and temperatures.

5. Ordering Information

5.1 Orders for composite pipe under this specification shall include the following:

5.1.1 This specification number and year of issue,
5.1.2 Name of product,
5.1.3 Class of product,
5.1.4 Quantity (roll, length),
5.1.5 Dimensions (diameter, wall thickness),
5.1.6 Pressure rating,
5.1.7 Temperature use,
5.1.8 Product code number, and
5.1.9 Whether certification of the material by the producer is required.

5.2 Orders for compression and threaded fittings for composite pipe according to this specification shall include the following information:

5.2.1 Name of product,
5.2.2 Quantity,
5.2.3 Dimensions (diameter), and
5.2.4 Product code number.

6. Materials and Manufacture

6.1 *Material Specification for Composite Pipe—Virgin plastic materials* (*adj*.), for use in composite pipe shall equal or

[4] Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140.

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

[6] Available from DVGW Deutsche Vereinigung des Gas-u. Wasserfaches, Postfach 140362, Josef-Wirmerstr. 1–3, D-53123 Bonn.

[7] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098.

exceed a minimum cell classification for each material and shall conform to the requirements prescribed in the material specification.

6.1.1 *Material Specification*—Polyethylene (PE) shall meet the requirements prescribed in Specification D 3350 and shall equal or exceed a minimum cell classification of 234233C. The color and form of the material shall be by agreement between the purchaser and supplier under Specification D 3350.

6.1.2 *Material Specification*—Crosslinked Polyethylene (PEX) shall meet the requirements prescribed in Specification D 3350 and shall equal or exceed a minimum cell classification of 354400C. The color and form of the material shall be by agreement between the purchaser and supplier under Specification D 3350.

6.1.3 *Material Specification*—Polyethylene (PE) and crosslinked polyethylene (PEX) under Specification D 1248 are referenced as Type I, II, III, and IV, and their normal density. The four normal densities, divided into three Classes, A, B, C, based on composition and use. Divide the three classes into five categories based on a broad range of flow rates, when necessary. Definitions by grade are acceptable. Specification D 1248 references pipe materials that are identified by type and grades. For example, P 23 is a Type 2, Grade 3, with class and category added when needed. Polyethylene (PE) Grade P 23, Class C, Category 5, and Grade P 24, Class C, Category 5, are acceptable for composite pipe. Crosslinked polyethylene (PEX) under Specification D 1248 as P 23 / P 24, Class A, B, or C, Category 5, are acceptable.

6.1.4 *Material Specification*—Adhesive polymers are modified low molecular weight polyethylene (PE) with a minimum density of 0.915 g/cm^3 and different levels of comonomer for adhesion to aluminum and other polar substrates. The melting point will not be less than 120°C (248°F) for composite pipe Classes 1 and 2, and 100°C (212°F) for composite pipe Classes 3 and 4. Density is determined under Test Method D 1505 and melting point under Test Method D 3418.

6.1.5 *Material Specification for Aluminum Pipe—Mechanical Properties:*

For Composite Pipe Classes 1, 2, and 4:

Tensile strength shall be at least 80 N/mm^2.

Elongation shall be at least 22 % when measured in accordance with Test Method D 638.

For Composite Pipe Class 3:

Tensile strength shall be at least 60 N/mm^2.

Elongation shall be at least 35 % when measured in accordance with Test Method D 638.

Aluminum Thickness—Shall follow Table 1.

6.1.6 *Reworkable Material*—Only reworkable material issued from the composite pipe manufacturer should be used for the outside coating of the composite pipe.

6.2 *Material and Manufacture of Fittings for Composite Pipe*:

6.2.1 *Material Specification*—Compression fittings in bronze, material 2.1096.01, following Specification B 584 and manufactured by casting.

6.2.2 *Material Specification*—Compression fittings in brass, material CuZn40Pb1, material 2.04401, following Specification B 283 and manufactured by forging.

6.2.3 *Compression Fittings in Plastic Material—Virgin material* (*adj.*) for use in compression fittings shall equal or exceed a minimum cell classification for each material and shall conform to the requirements provided in the materials specification. Material will be in accordance with Specification D 3222, Type 2. Compression fittings will be manufactured by injection molding.

7. Requirements

7.1 *Requirements for Composite Pipe*:

7.1.1 *Dimensions and Tolerances*:

7.1.2 *Outside Diameter*—The outside diameter and tolerance shall meet the requirements of Table 1 when measured in accordance with Test Method D 2122.

7.1.3 *Wall Thickness*—The wall thickness and tolerance of composite pipe shall meet the requirements of Table 1 when measured in accordance with Test Method D 2122. The wall thickness and outside diameter of aluminum pipe shall be determined prior to use.

7.1.4 *Average Thickness of Inner and Outer Layers*—The average thickness of the inner and outer layer of composite pipe shall be determined by determining the outside diameter of the aluminum pipe from the average outside diameter of the composite pipe, this equals the average thickness of the outer layer. Determine the average thickness of the inside layer by adding the aluminum pipe wall thickness plus the average outside layer thickness, as previously determined and subtract this total from the average total wall thickness of the composite pipe, this difference equals the average inside wall thickness.

TABLE 1 Composite Pipe Dimensions

	Nominal Pipe Size	Outside Diameter, mm (in.)	Wall Thickness, mm (in.)	Minimum Aluminum Thickness, mm (in.)	Maximum Thickness of Inside Polymeric Coating, mm (in.)
Tolerances		±0.20 (0.008)	±0.10 (0.004)	±0.04 (0.002)	±0.10 (0.004)
Composite pipe, Classes 1, 2, and 4 dimensions	16	16 (0.630)	2.25 (0.089)	0.28 (0.011)	1.37 (0.054)
	20	20 (0.787)	2.5 (0.098)	0.36 (0.014)	1.49 (0.059)
	26	26 (1.024)	3.0 (0.118)	0.44 (0.017)	1.66 (0.065)
	32	32 (1.260)	3.0 (0.118)	0.6 (0.024)	1.60 (0.063)
	40	40 (1.575)	3.5 (0.138)	0.75 (0.030)	1.85 (0.073)
	50	50 (1.969)	4.0 (0.157)	1 (0.039)	2.0 (0.079)
Composite pipe, Class 3 dimensions	16	16 (0.630)	2.25 (0.089)	0.28 (0.011)	1.37 (0.054)
	20	20 (0.787)	2.50 (0.098)	0.36 (0.014)	1.49 (0.059)

7.1.5 *Length*—The pipe shall be supplied coiled or in straight lengths in accordance with the agreement between purchaser and seller. The tolerance on coiled length shall be +100 − 0.00 mm (3.94 in.) and +10 − 0.00 mm (0.40 in.) when supplied in straight lengths.

7.2 *Requirements for Compression Fittings*:

7.2.1 Dimensions of compression fittings shall meet the requirements of Fig. 2 when measured in accordance with Test Method D 2122.

7.3 *Requirement for Threaded Fittings*:

7.3.1 Dimensions of threaded fittings shall meet the requirement of Fig. 3 when measured in accordance with Test Method D 2122.

8. Workmanship, Finish, and Appearance

8.1 *Workmanship for Composite Pipe*— Composite pipe shall be free of voids, inclusions, pin holes, cracks, or other imperfections that would cause problems. There shall be no evidence of delamination during testing or assembling of composite pipe and the selected fittings.

8.2 *Workmanship for Compression and Threaded Fittings*—The compression and threaded fitting shall be suitable for the intended application. The selected fitting shall be smooth and free of defects and all sharp edges which would damage the pipe.

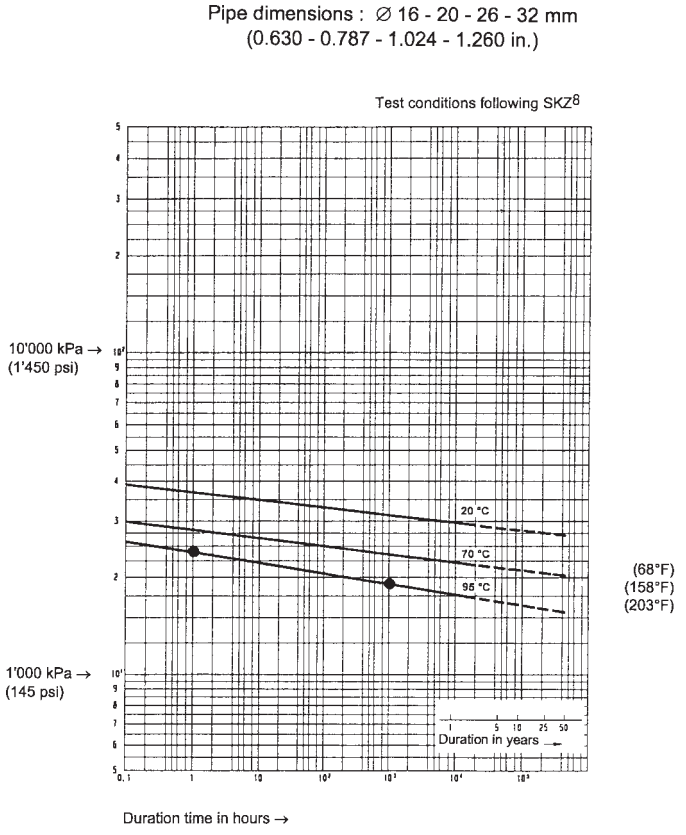
9. Qualification

9.1 *Composite Pipe and Fittings Qualification*—Qualification tests are valid for the whole range of diameters. Each size of pipe with the corresponding fitting must be qualified in accordance with these requirements.

9.1.1 *Hydrostatic Sustained Pressure Test*—Test the composite pipe and fittings in accordance with Test Method D 1598. Perform tests of 1 h and 1000 h in accordance with Fig. 4 for composite pipe Classes 1 and 2, dimension 16, 20, 26 and 32 mm, in accordance with Fig. 5 for composite pipe dimension 40 and 50 mm and in accordance with Fig. 6 for composite pipe Classes 3 and 4. No burst shall occur for the duration of the tests.

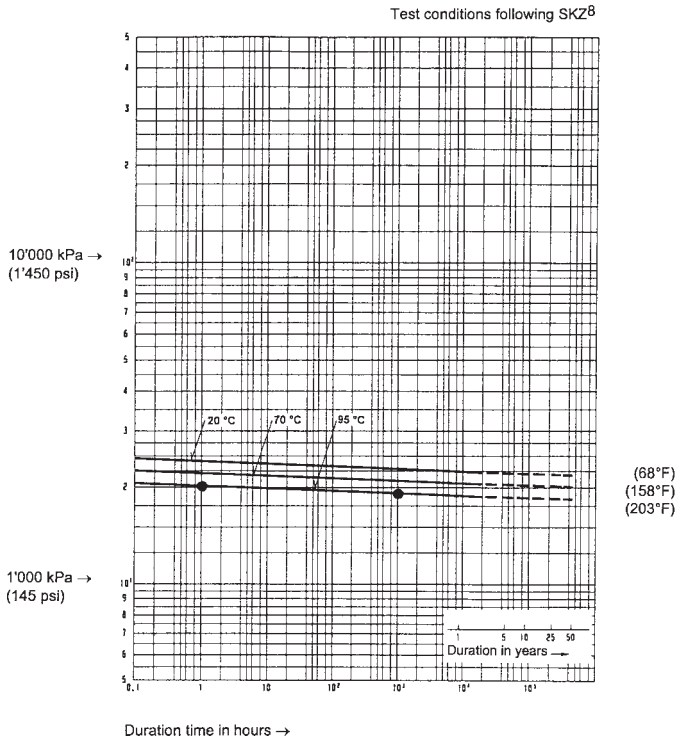
9.1.2 *Vacuum Depression Test DVG W 534*—Test the composite pipe under test method DVGW W 534, (see Fig. 7). The result shall meet the minimum vacuum depression requirement.

9.1.3 *Hot and Cold Pressure Cycling*—Pressure cycle composite pipe and fittings under hot and cold test conditions for 5000 cycles using the type of equipment as described in Fig. 8. The pressure cycle shall be 1000 kPa (145 psi) at a temperature of 93 ± 5°C (199.4 ± 15°F) and 20 ± 5°C (68 ± 15°F), alternating continuously between the hot and the cold every 15 ± 2 min.



NOTE—The reading of the graph indicates the pressure rating applicable to the two classes of pipe. This takes into account the temperature of utilization and the desired duration of use.

FIG. 4 Graph for Pressure Rating for Composite Pipe Classes 1 and 2, Compression Fittings and Compression Joints



NOTE—The reading of the graph indicates the pressure rating applicable to the two classes of pipe. This takes into account the temperature of utilization and the desired duration of use.

FIG. 5 Graph for Pressure Rating for Composite Pipe Classes 1and 2, Compression Fittings and Compression Joints

9.1.4 *Water Hammer Test*—Test Method following ISO 10508. Composite pipe and fittings shall not fail when subjected to 10 000 cycles. The test equipment will deliver room temperature pressure cycles of 100 ± 50 kPa (14.5 ± 7.25 psi) and 2500 ± 50 kPa (362 ± 7.25 psi), alternating continuously between 100 kPa (14.5 psi) and 2500 kPa (362 psi) every 30 ± 5 min. Equipment according to Fig. 9.

9.1.5 *Delamination*—Composite pipe shall not delaminate when tested with the adapter tool described in Fig. 10. The adapter tool is inserted inside the composite pipe to the marked depth. No delamination of bond shall occur.

9.1.6 *Fusion Line Test*—The adapter tool, as described in Fig. 10, is inserted inside the composite pipe to Depth C. No visible damage shall appear on the fusion line or any place of the aluminum section.

9.1.7 *Gel Content (when relevant)*—Determine the gel content of crosslinked polyethylene (PEX) by Test Method D 2765.

10. Quality Control

10.1 Quality control tests are valid for the whole range of diameters. Only test methods specified are used. Quality control program shall include tests described under Section 9 qualification testing, 9.1.1, 9.1.5, 9.1.6, and 9.1.7 (when relevant).

11. Sampling and Conditioning

11.1 Sampling and conditioning are both valid for qualification and quality control.

11.2 *Sampling*—The number of specimen for each test is taken from pipe selected at random from each lot under the random sampling plan of Practice D 1898.

11.3 *Conditioning*—Condition the specimen at the room temperature and relative humidity of the manufacturer's facility for not less than 1 h, or until the temperature of the specimen is at room temperature.

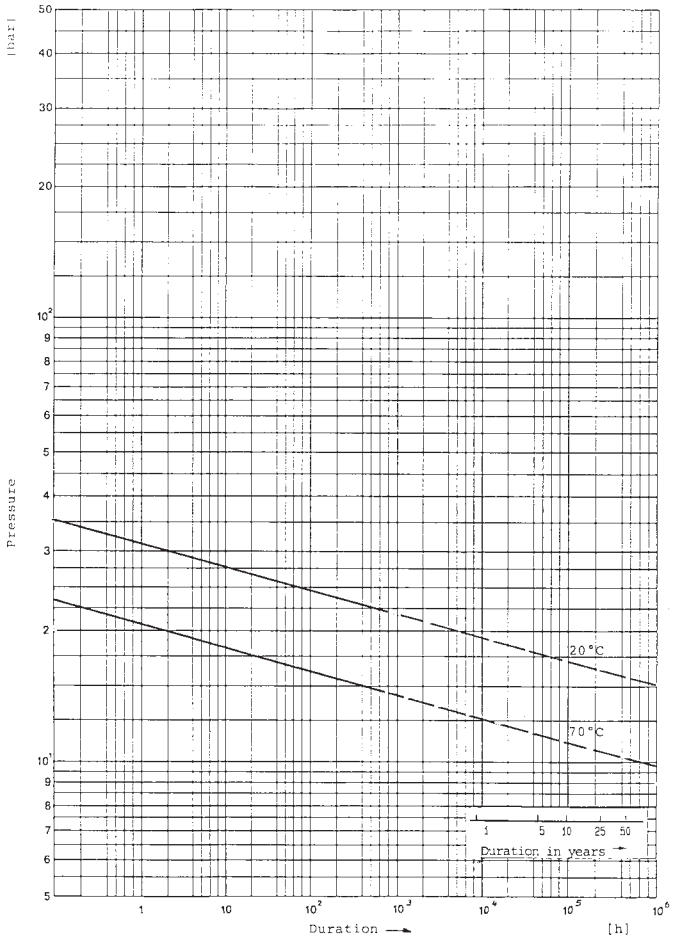
11.4 *Frequency and Number of Tests for Quality Control*—The frequency and number of test shall be under the manufacturer's established quality control program.

11.5 *Referee Testing*:

11.5.1 *Sampling*—Specimens are collected under 11.1 and the number of specimens shall be sufficient to obtain test results as required for those properties tested. Specimens are prepared under the appropriate ASTM test method, unless otherwise stated.

11.5.2 *Conditioning for Referee Testing*—Condition the specimen at 23 ± 2°C (73 ± 4°F) and 50 ± 5 % relative humidity for not less than 40 h before testing under Procedure A of Practice D 618.

11.6 *Test Conditions for Referee Testing*—Conduct tests in the Standard Laboratory Atmosphere of 23 ± 2°C (73 ± 4°F) and 50 ± 5 % relative humidity.



NOTE 1—The reading of the graphs indicates the pressure rating applicable to the different classes of pipe. This takes into account the temperature of utilization and the desired duration of use.

NOTE 2—The tolerances authorized by the standards in force in the composition of the aluminum used for such described composite pipe will entail the corresponding tolerances in the technical characteristics of the composite pipe. The graphs take into account this phenomena and, consequently, the eventual imprecisions of reading the graph are not damageable.

FIG. 6 Pressure Rating

11.7 *Test Methods*—Only test methods specified are used.

12. Rejection and Rehearing

12.1 When the results of any test(s) do not meet the requirements of this specification, the test(s) shall be conducted again under an agreement between the purchaser and the seller. There shall be no agreement to lower the minimum requirement of the specification by such means as omitting tests that are part of the specification, substituting or modifying a test method, or by changing the specification limits. In retesting, the product requirements of this specification shall be met and the test methods specified in the specification shall be used. When failure occurs on retest, the lot of product represented by the test(s) does not meet the requirements of this specification.

12.2 *Certification*—When agreed upon in writing by the purchaser and the manufacturer, a product certification shall be issued. This certification shall indicate compliance with the provisions of the specification. Each certification furnished shall be signed by an authorized agent of the manufacturer.

13. Product Marking

13.1 *Quality of Marking*—The marking is applied to the pipe for end-use application in such a manner that it remains legible after installation and inspection.

13.2 *Content of Marking for Composite Pipe*—Marking on the pipe shall include the following, spaced at intervals of not more than 2 m (6.56 ft):

13.2.1 Nominal pipe size,

13.2.2 Class of pipe,

13.2.3 ASTM designation F 1335,

13.2.4 Manufacturer's name or trademark,

13.2.5 Production code, (see Note),

13.2.6 Pipe intended for the transport of potable water shall also include the seal or mark of the laboratory making the evaluation for this purpose (spaced at intervals specified by the laboratory).

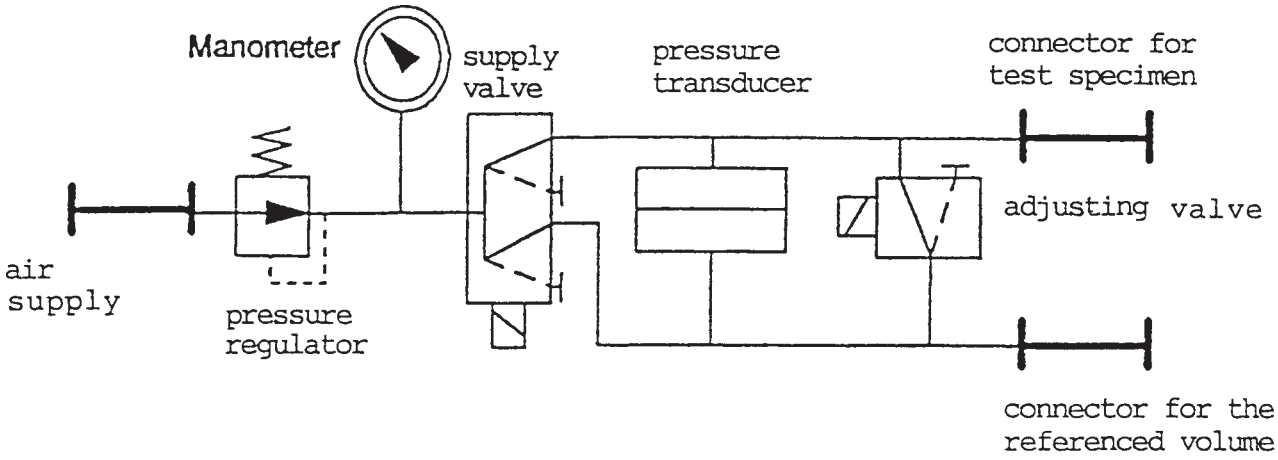
13.3 *Compression and Threaded Fittings*—Marking on the compression fittings and threaded fittings for composite pipe shall include nominal size, ASTM designation F 1335, manufacturer's name or trademark. If nominal size, ASTM designation F 1335, cannot be placed on the compression fittings or threaded fittings, it shall be placed on the packing. Marking of the fittings intended for the transport of potable water shall also follow the request of the laboratory making the evaluation for this purpose.

14. Quality Assurance

14.1 When the product is marked with this designation, F 1335, 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.

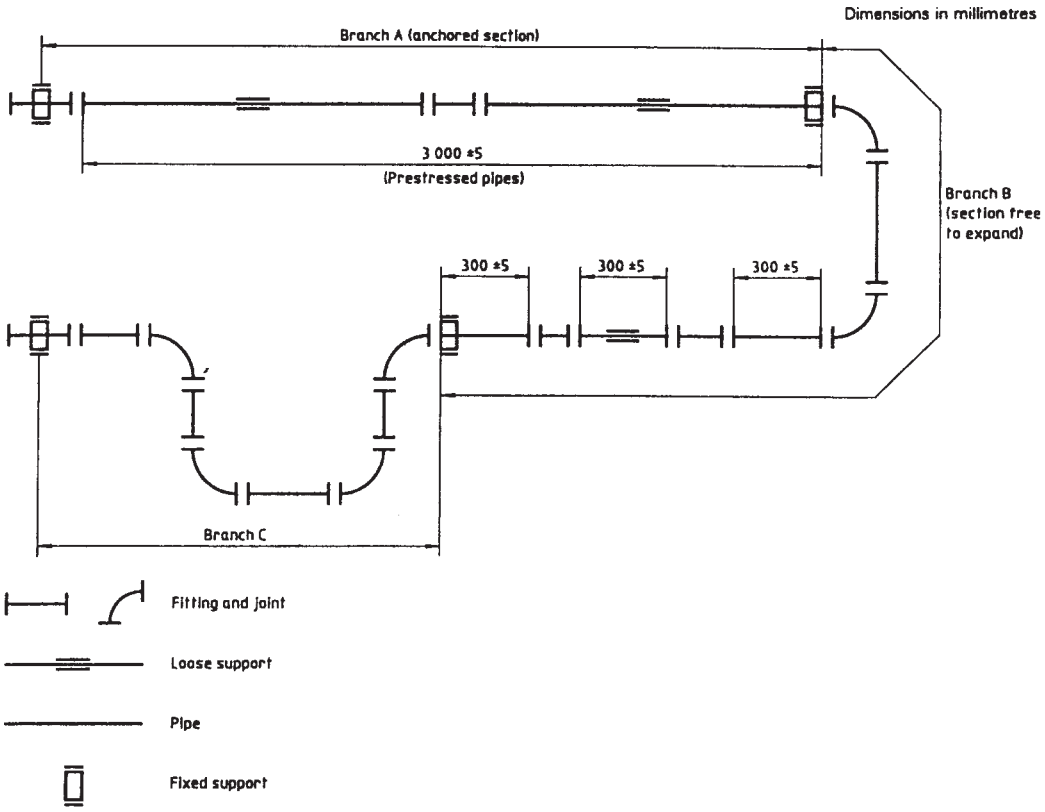
15. Keywords

15.1 butt-welded aluminum pipe; compression fittings; compression joints; composite pipe; threaded fittings; threaded joints



Test bed example for vacuum depression test

FIG. 7 Vacuum Depression Test



Test assembly for systems based on rigid pipes

FIG. 8 Hot and Cold Pressure Cycling Test

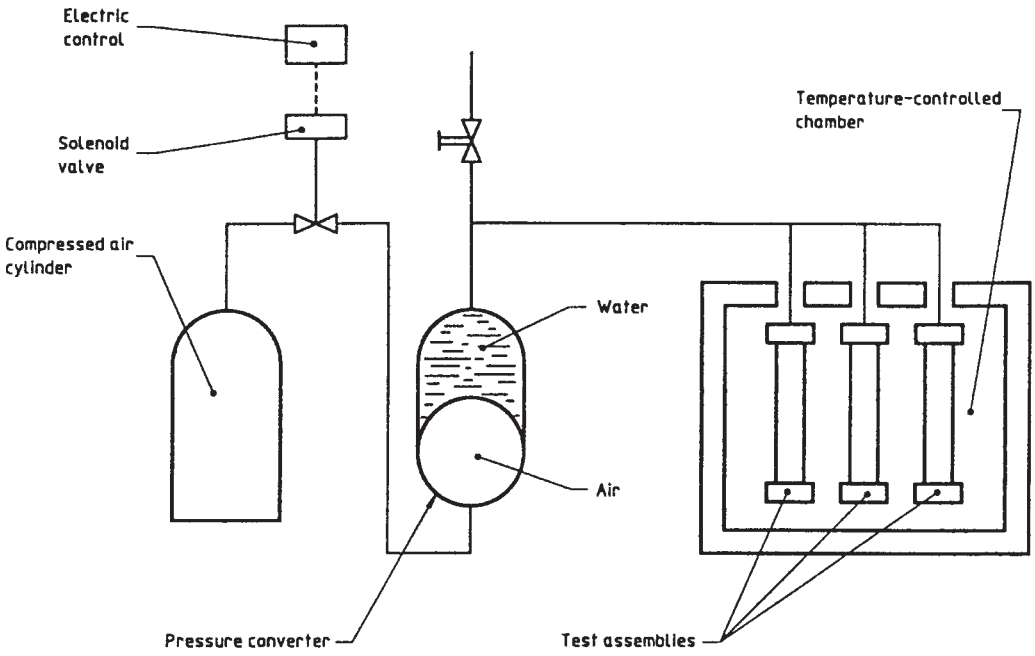
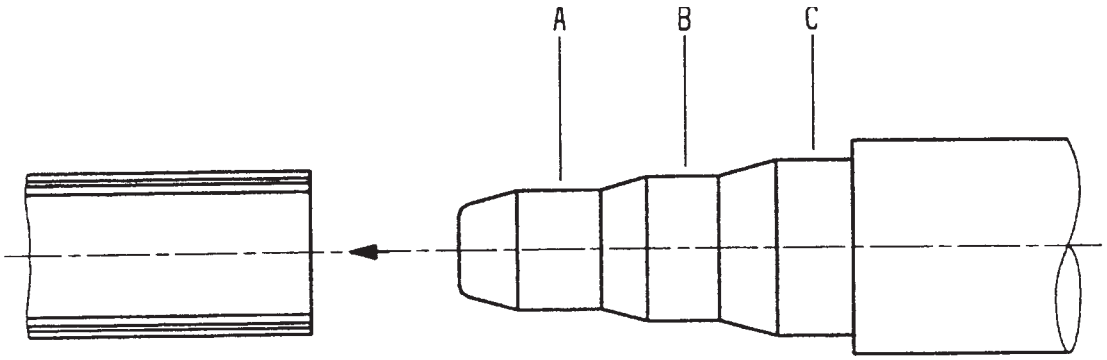


Diagram of typical equipment arrangement for cyclic pressure shock test

FIG. 9 Water Hammer Test



A = inside pipe diameter guide

B = diameter increase for bond strength test

C = diameter increase for fusion line inspection test

Nominal Pipe Size,	Tooling Measurements, mm (in.)		
mm (in.)	A ± 0.20 (0.008)	B ± 0.20 (0.008)	C ± 0.20 (0.008)
16 (0.630)	11.0 (0.433)	13.7 (0.539)	15.3 (0.602)
20 (0.787)	14.5 (0.571)	17.2 (0.677)	20.0 (0.787)
26 (1.024)	19.5 (0.768)	22.2 (0.874)	25.7 (1.012)
32 (1.260)	25.5 (1.004)	29.2 (1.150)	32.2 (1.268)
40 (1.575)	32.5 (1.280)	37.2 (1.465)	42.0 (1.654)
50 (1.969)	42.0 (1.654)	48.0 (1.890)	52.5 (2.067)

FIG. 10 Delamination and Fusion Line Test

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

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

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

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

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

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

POTABLE WATER REQUIREMENT

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

S3. *Potable Water Requirement*—Products intended for contact with potable water shall be evaluated, tested, and certified for conformance with ANSI/NSF Standard No. 61 or the health effects portion of NSF Standard No. 14 by an acceptable certifying organization when required by the regulatory authority having jurisdiction.

APPENDIXES

(Nonmandatory Information)

X1. CONSTRUCTION

X1.1 The composite pipe is made by a continuous extrusion process with five layers of three to five different materials. A solid butt welded aluminum tube with the weld laying parallel to the pipe axis is situated between two polymeric layers. Extruded adhesive coats allow adhesion between the components. A textile webbing may be incorporated in the outside adhesion coat.

X1.2 The pipe section is perfectly homogeneous in the circumference and this process allows unlimited lengths.

X2. PIPE PROPERTIES

X2.1 This composite pipe brings most of the advantages of the plastic to the metallic one and most of the advantages of the metallic one to the plastic one. The aging of such pipe works on the same principle as metallic pipe. This without most of the known inconveniences of those two components.

X2.2 The right proportion between malleable aluminum and polymeric material allows an easy bending, even by hand, the pipe keeping exactly the shape given. This kind of pipe is light although strong, corrosion resistant, and perfectly tight.

X2.3 Composite pipe has been successfully and extensively tested by official laboratories. Official labels have been delivered in several countries.