Designation: D2846/D2846M – 09b$^{\varepsilon 1}$

An American National Standard

Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems[1]

This standard is issued under the fixed designation D2846/D2846M; 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.

This standard has been approved for use by agencies of the Department of Defense.

ε^1 NOTE—6.2.1 was editorially revised in March 2011.

1. Scope*

1.1 This specification covers requirements, test methods, and methods of marking for chlorinated poly(vinyl chloride) plastic hot- and cold-water distribution system components made in one standard dimension ratio and intended for water service up to and including 180°F (82°C). These components comprise pipe and tubing, socket-type fittings, street fittings, plastic-to-metal transition fittings, solvent cements, and adhesives. Requirements and methods of test are included for materials, workmanship, dimensions and tolerances, hydrostatic sustained pressure strength, and thermocycling resistance. The components covered by this specification are intended for use in residential and commercial, hot and cold, potable water distribution systems.

1.2 The products covered by this specification are intended for use with the distribution of pressurized liquids only, which are chemically compatible with the piping materials. Due to inherent hazards associated with testing components and systems with compressed air or other compressed gases some manufacturers do not allow pneumatic testing of their products. Consult with specific product/component manufacturers for their specific testing procedures prior to pneumatic testing.

NOTE 1—Pressurized (compressed) air or other compressed gases contain large amounts of stored energy which present serious saftey hazards should a system fail for any reason.

1.3 The text of this specification references notes, footnotes, and appendixes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the specification.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

NOTE 2—Suggested hydrostatic design stresses and hydrostatic pressure ratings for pipe, tubing, and fittings are listed in Appendix X1. Design, assembly, and installation considerations are discussed in Appendix X2. An optional performance qualification and an in-plant quality control program are recommended in Appendix X3.

1.5 The following safety hazards caveat pertains only to the test method portion, Sections 9 and 10, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

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

D1784 Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

D1898 Practice for Sampling of Plastics[3]

D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

D2444 Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)

D2837 Test Method for Obtaining Hydrostatic Design Basis

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

Current edition approved Feb. 28, 2011. Published August 2009. Originally approved in 1969. Last previous edition approved in 2009 as D2846/D 2846 – 09a. DOI: 10.1520/D2846_D2846M-09B.

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

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

for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
F402 Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
F412 Terminology Relating to Plastic Piping Systems
F493 Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
F1498 Specification for Taper Pipe Threads 60° for Thermoplastic Pipe and Fittings
F1960 Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing
F1961 Specification for Metal Mechanical Cold Flare Compression Fittings with Disc Spring for Crosslinked Polyethylene (PEX) Tubing
F1807 Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing
F2080 Specification for Cold-Expansion Fittings With Metal Compression-Sleeves for Cross-Linked Polyethylene (PEX) Pipe
F2098 Specification for Stainless Steel Clamps for Securing SDR9 Cross-linked Polyethylene (PEX) Tubing to Metal Insert and Plastic Insert Fittings
F2159 Specification for Plastic Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing
F2434 Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Cross-linked Polyethylene/Aluminum/Cross-linked Polyethylene (PEX-AL-PEX) Tubing
F2735 Specification for Plastic Insert Fittings For SDR9 Cross-linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing

2.2 *ANSI Standards:*
ANSI Z17.1-1958 Preferred Numbers[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 *NSF Standards:*
Standard No. 14 for Plastic Piping Components and Related Materials[6]
Standard No. 61 for Drinking Water Systems Components—Health Effects[6]

3. Terminology

3.1 *Definitions:*

3.1.1 *General*—Definitions used in this specification are in accordance with Terminology F412, unless otherwise specified. The abbreviation for chlorinated poly(vinyl chlo-ride) is CPVC. Plastic tubing denotes a particular diameter schedule of plastic pipe in which the outside diameter of the tubing is equal to the nominal size plus ⅛ in. (3.18 mm).

3.1.2 *relation between standard dimension ratio, stress, and internal pressure*—the following expression is used to relate standard dimension ratio, stress, and internal pressure for pipe and tubing:

$$2S/P = R - 1 \quad (1)$$

or

$$2\,S/P = (D_0/t\,) - 1 \quad (2)$$

where:
S = stress in circumferential or hoop direction, psi (MPa),
P = internal pressure, psi (MPa),
D_0 = average outside diameter, in. (mm),
t = minimum wall thickness, in. (mm), and
R = standard dimension ratio, SDR

3.1.3 *standard dimension ratio (SDR)*—a selected series of numbers in which the average outside diameter to minimum wall thickness dimension ratios are constant for all sizes of pipe and tubing in each standard dimension ratio, and which are the ANSI Z17.1 Preferred Number Series 10 modified by +1. SDR fittings shall by definition be equivalent in minimum socket wall thickness to the minimum wall thickness of the corresponding SDR and size of pipe or tubing, and the minimum body wall thickness shall be 125 % of that value.

3.1.4 *standard material designation code*—the chlorinated poly(vinyl chloride) material designation code shall consist of the abbreviation CPVC followed by two digits indicating the ASTM type and grade in Arabic numerals. Where necessary, a third and fourth digit shall be added to indicate the hydrostatic design stress for water at 73°F [23°C] in units of 100 psi [0.69 MPa].

4. Classification

4.1 *Pipe, Tubing, and Fittings*—This specification classifies CPVC 4120 pipe, tubing, and fittings by a single standard dimension ratio which shall be SDR 11, by a maximum continuous use temperature which shall be 180°F [82°C] and by nominal pipe or tubing diameters from ¼ in. [9.5 mm] through 2 in. [50 mm].

4.2 *Transition Fittings*—This specification classifies transition fittings intended for use up to and including 180°F [82°C] as CPVC-180°F on the basis of resistance to failure by thermocycling.

4.3 *Solvent Cements and Adhesives*— This specification classifies solvent cements and adhesives meeting the requirements contained herein as CPVC Solvent Cement or CPVC Adhesive.

NOTE 3—This specification does not include requirements for pipe fittings intended to be used to vent combustion gases.

5. Materials

5.1 *Basic Materials Description*—Chlorinated poly(vinyl chloride) plastics used to make pipe, tubing, and fittings

[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.
[5] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://www.dodssp.daps.mil.
[6] Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140, http://www.nsf.org.

TABLE 1 Outside Diameters, Wall Thicknesses, and Tolerances for CPVC 41, SDR 11, Plastic Pipe and Tubing[A]

Nominal Tube or Pipe Size		Outside Diameter, in. [mm]			Wall Thickness, in. [mm][B]	
		Average	Tolerance on Average	Max Out-of-Round[C]	SDR 11	
					Min	Tolerance
¼ Tubing		0.375 [9.5]	±0.003 [±0.08]	±0.003 [±0.08]	0.055 [1.40][D]	+0.020 [+0.51]
⅜ Tube	[10]	0.500 [12.7]	±0.003 [±0.08]	±0.003 [±0.08]	0.060 [1.52][D]	+0.020 [+0.51]
½ Tube	[15]	0.625 [15.9]	±0.003 [±0.08]	±0.004 [±0.10]	0.060 [1.52][D]	+0.020 [+0.51]
¾ Tube	[20]	0.875 [22.2]	±0.003 [±0.08]	±0.005 [±0.13]	0.080 [2.03]	+0.020 [+0.51]
1 Tube	[25]	1.125 [28.6]	±0.003 [±0.08]	±0.006 [±0.15]	0.102 [2.59]	+0.020 [+0.51]
1¼ Tube	[32]	1.375 [34.9]	±0.003 [±0.08]	±0.007 [±0.18]	0.125 [3.18]	+0.020 [+0.51]
1½ Tube	[40]	1.625 [41.3]	±0.004 [±0.10]	±0.008 [±0.20]	0.148 [3.76]	+0.020 [+0.51]
2 Tube	[50]	2.125 [54.0]	±0.004 [±0.10]	±0.010 [±0.25]	0.193 [4.90]	+0.023 [+0.58]
1½ Pipe	[40]	1.900 [48.6]	+0.006, –0.002 [+0.15, –0.05]	±0.008 [±0.20]	0.173 [4.39]	+0.021 [+0.53]
2 Pipe	[50]	2.375 [60.7]	+0.006, –0.002 [+0.15, –0.05]	±0.010 [±0.25]	0.216 [5.49]	+0.026 [+0.66]

[A] All dimensions are in inches and millimetres. (1 in. = 25.4 mm.)
[B] The minimum is the lowest wall thickness at any cross section. The maximum permitted wall thickness, at any cross section, is the minimum wall thickness plus the stated tolerance. All wall tolerances are on the plus side of the minimum requirement.
[C] The maximum out-of-roundness applies to the average measured outside diameter.
[D] For tubing sizes of ½ in. and below, wall thickness minimums are not a function of SDR.

meeting the requirements of this specification are categorized by two criteria; namely, basic short-term properties, and long-term hydrostatic strength. Sections 5.1.1 and 5.1.2 respectively define these categories.

5.1.1 *Basic Short-Term Properties*—This specification covers CPVC 41 pipe, tubing, and fittings made from plastic materials meeting the mechanical strength, heat resistance, flammability, and chemical resistance requirements for CPVC 23447 in Specification D1784.

NOTE 4—CPVC 23447 was formerly designated as CPVC Type IV Grade 1, and is herein designated as CPVC 41. This is also used in marking pipe, tubing, or fittings.

5.1.2 *Long-Term Hydrostatic Strength*— This specification covers CPVC 41 pipe, tubing, and fittings which are further defined by hydrostatic design stress as CPVC 4120. Pipe and tubing are so defined on the basis of long-term hydrostatic strength tests and are made from compounds having an established 180°F [82°C] hydrostatic design stress of 500 psi [3.45 MPa] or greater in accordance with Test Method D2837. Fittings are so defined by hydrostatic sustained pressure tests on fitting assemblies, required by this specification (see 6.2), based on the hydrostatic strength of the corresponding pipe or tubing.

NOTE 5—No hydrostatic design stress, as such, exists for fittings until such time as long-term hydrostatic strength test methods for fittings are developed.

5.2 The PEX fitting ends of CPVC to PEX transition fittings shall meet the material and dimensional requirements of the corresponding PEX fitting standard.

5.3 The PERT fitting ends of CPVC to PERT transition fittings shall meet the material and dimensional requirements of the corresponding PERT fitting standard.

5.4 *Rework Material*—Clean rework plastic material generated from the manufacturer's own plastic tube or fitting production may be used by the same manufacturer provided the pipe, tubing, or fittings meet all the requirements of this specification.

6. Requirements for Pipe, Tubing and Fittings

6.1 *Dimensions and Tolerances*:

6.1.1 *General*:

6.1.1.1 *Wall Minimums*—Table 1 and Table 2 show wall thickness minimums. Calculated SDR 11 fitting wall thicknesses that fall below 0.102 in. [2.59 mm] for the fitting socket bottom, or 0.128 in. [3.25 mm] for the fitting body, shall be arbitrarily increased to these values.

6.1.1.2 *Interference Fit*—The diameters and tolerances in Table 1 and Table 2 provide for socket-type joints having an interference fit based on the major diameter of pipe and tubing having a degree of out-of-roundness.

6.1.1.3 *Out-of-Roundness*—The maximum out-of-roundness requirements shown in Table 1 and Table 2 for pipe, tubing, and fittings apply to the average measured diameter.

NOTE 6—*Example*: In the 1-in. [25 mm] tubing size, if the measured average tubing diameter was 1.123 in. [28.52 mm], then the extreme measured diameters due to ovality could be 1.129 in. [28.68 mm] maximum and 1.117 in. [28.37 mm] minimum.

6.1.2 *Pipe and Tubing*:

6.1.2.1 *Outside Diameter and Wall Thickness*—The outside diameters and wall thicknesses for pipe and tubing shall meet the requirements for dimension and tolerance given in Table 1 when measured in accordance with Test Method D2122.

6.1.2.2 *Wall Thickness Range*—The wall thickness range for pipe and tubing shall be within 12 % when measured in accordance with Test Method D2122.

6.1.2.3 *Flattening*—There shall be no evidence of splitting, cracking, or breaking when the pipe is tested in accordance with 9.2.

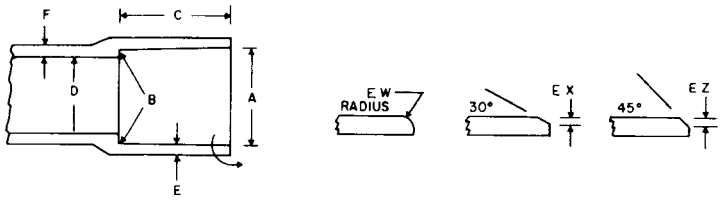
6.1.2.4 *Length*—Pipe and tubing supplied in straight lengths shall have a tolerance on any specified length of +½ , –0 in. [+12.5, –0 mm].

6.1.3 *Socket-Type Fittings*:

6.1.3.1 *Dimensions*—Fitting sockets, inside diameters (waterways), wall thicknesses, laying lengths, and reducing bushing minimums shall meet the requirements for dimension and tolerance given in Table 2, Table 3, and Table 4 when measured in accordance with Test Method D2122. The spigot ends of street fittings shall meet the outside diameter and minimum wall requirements of Table 1.

6.1.3.2 *Alignment*—The maximum angular variation of any socket opening shall not exceed ½ ° off the true centerline axis.

TABLE 2 Tapered Socket Dimensions for CPVC 41, SDR 11, Plastic Pipe and Tubing Fittings[A,B]

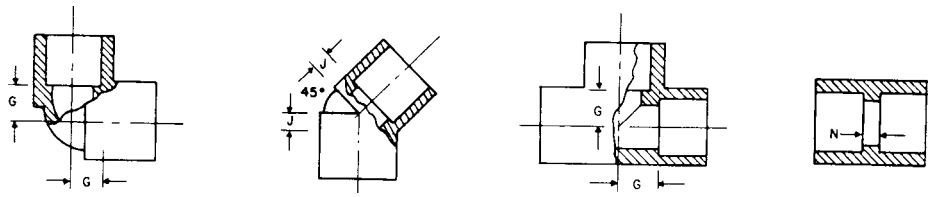


Nominal Tube or Pipe Size		*A* Socket Entrance Diameter, in. [mm]			*B* Socket Bottom Diameter, in. [mm]		
		Average	Tolerance on Average	Max Out-of-Round[C]	Average	Tolerance on Average	Max Out-of-Round[C]
⅜ Tube	[10]	0.508 [12.90]	±0.003 [±0.08]	±0.003 [±0.08]	0.494 [12.55]	±0.003 [±0.08]	±0.003 [±0.08]
½ Tube	[15]	0.633 [16.08]	±0.003 [±0.08]	±0.004 [±0.10]	0.619 [15.72]	±0.003 [±0.08]	±0.004 [±0.10]
¾ Tube	[20]	0.884 [22.45]	±0.003 [±0.08]	±0.005 [±0.13]	0.870 [22.10]	±0.003 [±0.08]	±0.005 [±0.13]
1 Tube	[25]	1.135 [28.83]	±0.003 [±0.08]	±0.006 [±0.15]	1.121 [28.47]	±0.003 [±0.08]	±0.006 [±0.15]
1¼ Tube	[32]	1.386 [35.20]	±0.003 [±0.08]	±0.007 [±0.18]	1.372 [34.85]	±0.003 [±0.08]	±0.007 [±0.18]
1½ Tube	[40]	1.640 [41.66]	±0.004 [±0.10]	±0.008 [±0.20]	1.622 [41.20]	±0.004 [±0.10]	±0.008 [±0.20]
2 Tube	[50]	2.141 [54.38]	±0.004 [±0.10]	±0.010 [±0.25]	2.123 [53.92]	±0.004 [±0.10]	±0.010 [±0.25]
1½ Pipe	[40]	1.918 [48.72]	±0.004 [±0.10]	±0.008 [±0.20]	1.900 [48.26]	±0.004 [±0.10]	±0.008 [±0.20]
2 Pipe	[50]	2.393 [60.78]	±0.004 [±0.10]	±0.010 [±0.25]	2.375 [60.33]	±0.004 [±0.10]	±0.010 [±0.25]

C Socket Length, min, in. [mm]	*D* Inside Diameter, min, in. [mm]	Wall Thickness, min,[D] in. [mm]			Entrance; min *EW EX EZ*, in. [mm]
		(E_a) Socket Entrance	(E_b) Socket Bottom	*F*	
0.500 [12.70]	0.364 [9.25]	0.068 [1.73]	0.102 [2.59]	0.128 [3.25]	0.034 [0.86]
0.500 [12.70]	0.489 [12.42]	0.068 [1.73]	0.102 [2.59]	0.128 [3.25]	0.034 [0.86]
0.700 [17.78]	0.715 [18.16]	0.080 [2.03]	0.102 [2.59]	0.128 [3.25]	0.034 [0.86]
0.900 [22.86]	0.921 [23.39]	0.102 [2.59]	0.102 [2.59]	0.128 [3.25]	0.034 [0.86]
1.100 [27.94]	1.125 [28.58]	0.125 [3.18]	0.125 [3.18]	0.156 [3.96]	0.042 [1.07]
1.300 [33.02]	1.329 [33.76]	0.148 [3.76]	0.148 [3.76]	0.185 [4.70]	0.049 [1.24]
1.700 [43.18]	1.739 [44.17]	0.193 [4.90]	0.193 [4.90]	0.241 [6.12]	0.064 [1.63]
1.375 [34.92]	1.494 [37.95]	0.173 [4.39]	0.173 [4.39]	0.216 [5.49]	0.058 [1.47]
1.500 [38.10]	1.933 [49.10]	0.216 [5.49]	0.216 [5.49]	0.270 [6.86]	0.072 [1.83]

[A] All dimensions are in inches and millimetres. (1 in. = 25.4 mm.)
[B] All sketches and designs of fittings are illustrative only.
[C] Maximum out-of-roundness applies to the average measured inside diameter.
[D] The minimum is the lowest wall thickness at any cross section.

TABLE 3 Minimum Dimensions from Center to End of Socket (Laying Length) for CPVC 41, SDR 11 Plastic Pipe and Tubing Fittings[A,B,C]

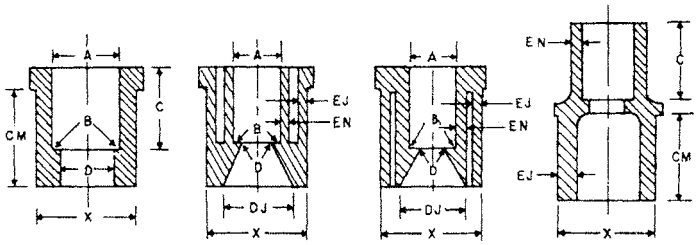


Nominal Tube or Pipe Size		*G* Min[D], in. [mm]	*J* Min[D], in. [mm]	*N* Min[D], in. [mm]
⅜ Tube	[10]	0.359 [9.12]	0.174 [4.42]	0.102 [2.59]
½ Tube	[15]	0.382 [9.70]	0.183 [4.65]	0.102 [2.59]
¾ Tube	[20]	0.507 [12.88]	0.235 [5.97]	0.102 [2.59]
1 Tube	[25]	0.633 [16.08]	0.287 [7.29]	0.102 [2.59]
1¼ Tube	[32]	0.758 [19.25]	0.339 [8.61]	0.102 [2.59]
1½ Tube	[40]	0.884 [22.45]	0.391 [9.93]	0.102 [2.59]
2 Tube	[50]	1.134 [28.83]	0.495 [12.57]	0.102 [2.59]
1½ Pipe	[40]	1.022 [25.96]	0.448 [11.38]	0.102 [2.59]
2 Pipe	[50]	1.260 [32.00]	0.547 [13.89]	0.102 [2.59]

[A] All dimensions are in inches and millimetres. (1 in. = 25.4 mm.)
[B] All dimensions not shown shall be in accordance with those in Table 2.
[C] The sketches and designs of fittings are illustrative only.
[D] Minimum dimensions have zero negative tolerance.

6.1.4 *Plastic-to-Metal Transition Fittings*:

TABLE 4 Dimensions of Reducer Bushings for CPVC 41, SDR 11, Socket-Type, Plastic Pipe and Tubing Fittings[A,B,C,D]



[A] Tubing socket dimensions, *A*, *B*, and *C*, and tolerances on these dimensions shall be the same as in Table 2. The minimum length of the male end of the bushing or coupling, *CM*, shall be the same as *C* in Table 2, but in any case the male end shall bottom in the mating fitting. Minimum waterway dimensions, *D* and *DJ*, shall be the same as *D* in Table 2. Minimum wall dimensions, *EJ* and *EN*, apply to the larger and smaller sizes joined respectively, and shall be the same as the corresponding values for E_a in Table 2.

[B] The minimum socket wall thickness for reducing bushings shall be 102 in. [2.59 mm]. If the socket wall thickness exceeds the total of *EJ* and *EN* calculated from the appropriate E_b values in Table 2 and the reducer bushing is cored, the inner socket shall be reinforced from the outer wall by a minimum of three ribs extending the full depth of the coring.

[C] The transition from *D* to *DM* shall be straight, tapered as shown, or radiused, at the discretion of the manufacturer.

[D] A taper on the male end of a bushing is optional. If a taper is used, it shall be a positive taper in the same direction as the taper in the socket. Whether a taper is used or not, all diameters *X* shall conform to the diameter and tolerance for the corresponding size of tubing shown in Table 1.

6.1.4.1 *Basic Dimensions*—Plastic parts of plastic-to-metal transition fittings shall meet the dimensional requirements of Table 1 and Table 2, where applicable, with the following exceptions. Such parts shall be exempted from the requirements for inside diameter (waterway) and wall thickness tolerance.

6.1.4.2 *Threads*—For all fittings having taper pipe threads, threads shall conform to Specification F1498 and be gaged in accordance with 9.5.

6.1.5 *CPVC to PEX and CPVC to PERT Transition Fittings:*

6.1.5.1 Basic Dimensions:

(1) CPVC spigot-ends of CPVC to PEX and CPVC to PERT fittings shall meet the dimensional requirements of Table 1, where applicable, with the following exceptions. Such parts shall be exempted from the requirements for inside diameter (waterway) and wall thickness tolerance and,

(2) CPVC tapered socket-ends of CPVC to PEX and CPVC to PERT transition fittings shall meet the dimensional requirements of Table 2 where applicable.

(3) The PEX fitting end of CPVC to PEX and CPVC to PERT transition fittings shall meet the applicable requirements of the corresponding ASTM fitting standard. See the following specifications for these requirements: F1960, F1961, F1807, F2080, F2098, F2159, F2434 and F2735.

6.2 *Hydrostatic Sustained Pressure*:

6.2.1 *General*—Pipe, tubing, and fittings (tested as assemblies) shall meet the minimum hydrostatic sustained pressure requirements of both test conditions shown in Table 5 when tested in accordance with 9.3.

6.2.2 *Pipe and Tubing Quality*—Test Condition B shall be termed the primary sustained pressure test for pipe and tubing and shall be used for quality control (see Appendix X3). Test Condition A shall be termed the secondary sustained pressure test for pipe and tubing and shall be used for periodic performance qualification. Failure to pass either test is cause for rejection.

6.2.3 *Fitting Quality*—Test Condition A shall be termed the primary sustained pressure test for fittings and shall be used for quality control (see Appendix X3). Test Condition B shall be termed the secondary sustained pressure test for fittings and shall be used for periodic performance qualification. Failure to pass either test is cause for rejection.

TABLE 5 Minimum Hydrostatic Sustained Pressure Requirements for CPVC 4120, SDR 11, Pipe, Tubing, and Fitting Assemblies Tested in Either Water or Air Bath External Environment at 180°F [82°C][A]

Test Condition	Test Duration	Hydrostatic Test Pressure	
		Water Bath	Air Bath
A	6 min	521 psi [3 590 kPa]	551 psi [3 800 kPa]
B	4 h	364 psi (2 510 kPa)	403 psi [2 780 kPa]

[A] Test conditions were calculated from the following experimentally derived, 95 % confidence, rupture pressure versus time relationships for CPVC 41, SDR 11, pipe and tubing at 180°F [82°C]. Pressure, *P*, and time, *t*, are in psi and h respectively. The 50 % confidence relationships are given for information only.

$\log P = -0.085155 \log t + 2.726805$ (50 % confidence in air)

$\log P = -0.085155 \log t + 2.656225$ (95 % confidence in air)

$\log P = -0.097269 \log t + 2.690464$ (50 % confidence in water)

$\log P = -0.097269 \log t + 2.619884$ (95 % confidence in water)

NOTE 7—Drop weight impact resistance is correlatable with hydrostatic sustained pressure resistance for CPVC 41 components, and may be useful for predicting compliance with the sustained pressure requirements of Table 5. Such correlations will necessarily differ with the size, wall thickness, and geometry of individual components. Test Method D2444 using Tup A and Holder A is suggested for nominal diameters of 1 in. [25 mm] and above. For smaller components, a guided mandrel type of impacter such as the Gardner Impacter[7] equipped with a ½ in. [12.7 mm] radius mandrel is suggested. Drop impact is not included in this specification directly as a quality requirement because of the wide test scatter normally associated with this test, and also because of the wide differences in value over the range of sizes and components covered in this specification.

6.3 *Thermocycling*—Transition fittings (other than metal socket-type transitions for use with adhesives), assembled

[7] Available from Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, http://www.plasticpipe.org.

TABLE 6 Minimum Hydrostatic Burst Strength Requirements for Nominal 2-in. [50-mm] CPVC Solvent Cemented Joints after 2 h Drying at Test Temperature

Temperature	Burst Pressure
73.4°F [23°C]	400 psi [2 760 kPa]
180°F [82°C]	200 psi [1 380 kPa]

TABLE 7 Minimum Hydrostatic Sustained Pressure Requirements for CPVC Socket-Type Adhesive Joint Assemblies Tested Either in Water Bath or Air Bath External Environment at 180°F [82°C][A]

Test Duration, h	Test Pressure	
	Water Bath	Air Bath
10 000	170 psi [1 170 kPa)	207 psi (1 430 kPa)

[A] Test conditions were calculated from the experimentally derived, 95 % confidence limit, rupture pressure versus time relationships for CPVC 41, SDR 11, pipe and tubing noted in Table 5. It is implied that CPVC adhesive joints meeting the sustained pressure requirements of 7.2.2 would necessarily pass the less rigorous requirements of 6.2.1.

according to the manufacturer's instructions, shall not separate or leak when thermocycled 1000 times between the temperatures of 60°F and 180°F [16°C and 82°C] in accordance with 9.3.[8]

7. Requirements for Solvent Cement and Adhesive Joints

7.1 *CPVC Solvent Cements*:

NOTE 8—CPVC solvent cements may exist which meet the requirements of the specification when used in accordance with the manufacturer's recommendations, without a primer or cleaner. It is recommended that those CPVC solvent cements which may be used without a primer or cleaner be clear or yellow in color. Otherwise, it is recommended that CPVC solvent cement requiring the use of a primer or cleaner be orange in color. Color identification is recommended to facilitate cement recognition, to prevent the misuse of the cement and to minimize the unintentional use of other cements that may fail at elevated service temperatures.

7.1.1 *General*—CPVC solvent cements, for use in CPVC 41, plastic-to-plastic, socket-type joints shall meet the requirements set forth in Specification F493.

7.1.2 *Hydrostatic Burst Strength*—2-in. [50-mm] CPVC solvent cement joints shall exceed the minimum hydrostatic burst strength requirements given in Table 6 after a maximum drying interval of 2 h when tested in accordance with 10.1.1. Failure to pass the burst requirement at either temperature is cause for rejection.

7.1.3 *Hydrostatic Sustained Pressure Strength*—½-in. [15-mm] CPVC solvent cement joints shall meet the requirements of 6.2 when tested in accordance with 9.3.

7.1.4 *Safe Handling of Solvent Cement*— Refer to Practice F402.

7.2 *CPVC Adhesives*:

7.2.1 *General*—CPVC adhesives (other than CPVC solvent cement), shall qualify for use in CPVC socket-type joints by a rigorous simulated use testing program as further defined in 7.2.2 and 7.2.3. CPVC adhesives shall be tested in the largest size joint and in the exact type of joint for which they are intended; that is, 2-in. [50-mm] plastic-to-metal or 2-in. [50-mm] plastic-to-plastic.

7.2.2 *Hydrostatic Sustained Pressure Strength*—Socket-type CPVC adhesive joints, made and cured according to the adhesive manufacturer's instructions, shall not separate or leak when tested in accordance with 10.2 at the hydrostatic sustained pressure condition given in Table 7.

7.2.3 *Thermocycling*—Socket-type CPVC adhesive joints, made and cured according to the adhesive manufacturer's instructions, shall not separate or leak when thermocycled 10 000 times between the temperatures of 60°F and 180°F [16°C and 82°C] in accordance with 10.2.

8. Workmanship, Finish, and Appearance

8.1 *Workmanship*—The pipe and fittings shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, or other defects. The pipe shall be as uniform as commercially practicable in color, opacity, density, and other physical properties.

9. Test Methods for Pipe, Tubing, and Fittings

9.1 *Sampling*—A sufficient quantity of pipe, tubing, or fittings, as agreed upon between the purchaser and the seller, shall be selected from each lot or shipment and tested to determine conformance with this specification (see Practice D1898). In the case of no prior agreement, random samples selected by the testing laboratory shall be deemed adequate.

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

9.2 *Flattening*—Flatten three specimens of the pipe, 2 in. [50-mm] long, between parallel plates in a suitable press until the distance between the plates is 40 % of the outside diameter of the pipe or the walls of the pipe touch, whichever occurs first. The rate of loading shall be uniform and such that the compression is completed within 5 min. Upon removal of the load, examine the specimens for evidence of splitting, cracking, or breaking.

9.3 *Hydrostatic Sustained Pressure*:

9.3.1 *Summary of Test Method*—This test method describes a pass-fail test for CPVC 41 pipe, tubing, or fittings (tested as assemblies) subjected to a constant internal hydrostatic pressure for a predetermined period of time. Test conditions are based on known rupture pressure versus time relationships for standard CPVC 41 components (see footnote to Table 5). The external test environment shall be either water or air; however, test pressures differ depending on the environment selected (see Table 5).

9.3.2 *Apparatus*:

9.3.2.1 *Constant-Temperature Environment*—Either a water bath or an air bath capable of maintaining a constant and uniform temperature of 180 ± 1.8°F [82 ± 1°C] throughout.

[8] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:F17-1039.

TABLE 8 Minimum Suggested Drying Times for Solvent Cemented Fitting Assemblies in Air at 180°F [82°C]

Test Condition (from Table 5)	Suggested Drying Time at 180°F [82°C], h
A	4
B	16

9.3.2.2 *Pressurizing System*—A pressure source capable of rapidly and continuously applying a constant hydrostatic pressure, controlled to ±10 psi [±69 kPa] or better, to the test specimens.

9.3.2.3 *Timing Device*—Any clock capable of accuracy to within 1 % of the total test time.

9.3.2.4 *Closure Fittings*—Any suitable specimen closure that allows "free-end" mounting, is free of leaks, and will not contribute to end failures.

NOTE 9—Various types of compression and flared, metal fittings have been found to be acceptable. Socket-type CPVC 41 caps are also acceptable provided that the necessary solvent cemented or adhesive joints are suitably dried or cured (refer to 9.3.3.2).

9.3.3 *Sampling and Specimen Preparation*:

9.3.3.1 *Pipe and Tubing*—Select at random specimens of at least seven times the nominal diameter in length, but in any case not shorter than 10 in. [250 mm]. Take three specimens for quality control testing. Take six specimens for qualification or referee testing.

9.3.3.2 *Fittings*—Select specimens at random. Take three specimens for quality control testing. Take six specimens for qualification or referee testing. Assemble the fittings, individually or collectively, using suitable lengths of CPVC 41 pipe or tubing and CPVC solvent cement or CPVC adhesive. Use only pipe or tubing and solvent cement or adhesive meeting the requirements of this specification. Assemble the joints in accordance with the cement manufacturer's instructions. Allow solvent cemented fitting assemblies to dry at elevated temperature, up to 180°F [82°C] maximum, in a forced-air oven until all joints are sufficiently strong to eliminate joint failures during the test. Minimum suggested drying times are shown in Table 8. Cure assemblies prepared with CPVC adhesives according to the adhesive manufacturer's instructions until the adhesive joints are sufficiently strong to eliminate joint failures during the test. In no case, however, should adhesive joints be cured at a temperature higher than 180°F [82°C].

9.3.4 *Procedure*—After curing all cemented or adhesive joints used, attach suitable end closures where necessary. Fill the specimen with water, making certain to avoid entrapment of air. Condition the test specimen at 180 ± 1.8°F [82 ± 1°C] for a minimum of 30 min if using a water bath, or 4 h if using an air bath. Attach the specimen to the pressure source, and place it on test at 180 ± 1.8°F [82± 1°C] under the proper hydrostatic pressure selected from Table 5. Start the timer immediately. Hold the test pressure and temperature as close as possible to the specified values, but in any case to within ± 10 psi [±69 kPa] and 1.8°F [1°C] respectively. At the end of the specified minimum time interval, isolate the specimen from the pressure source and check for any continuous loss of pressure resulting from transmission of water through the specimen. Any such continuous loss of pressure, resulting from bursting or weeping of the test specimens as defined in Test Method D1598, shall constitute failure. If joint leakage or joint separation has occurred, the test shall be repeated using a longer joint drying or curing cycle.

9.3.5 *Interpretation of Results*:

9.3.5.1 *For Quality Control*—Failure of any one of three specimens tested shall constitute failure in this test.

9.3.5.2 *For Performance Qualification*— Failure of any one of six specimens tested shall constitute failure in this test.

9.4 *Thermocycling*:

9.4.1 *Summary of Method*—This method describes a pass-fail test for thermally cycling CPVC plastic-to-metal transition fitting assemblies over a critical temperature range for a selected number of cycles while subjected to a nominal internal pressure. The test provides a measure of resistance to failure due to the combined effects of differential thermal expansion and creep for CPVC plastic-to-metal transition fittings intended for continuous use up to and including 180°F [82°C].

9.4.2 *Apparatus*—A nitrogen or air source capable of maintaining a nominal internal pressure of 100 ± 10 psi [690 ± 69 kPa) on the specimens is required. The immersion system shall consist of two water reservoirs controlled at 60 ± 3.6°F [16 ± 2°C] and 180 ± 3.6°F [82 ± 2°C]. The specimens shall be cycled from one reservoir to the other or the hot and cold water shall be alternately cycled over the test specimens automatically and returned to the proper reservoir.

NOTE 10—Automatic cycling may be accomplished by pumping from each reservoir through a delivery system having timer-actuated valves to a specimen water trough having synchronized, timer-actuated return drains. Any automatic apparatus shall provide for complete immersion of the test specimens in the trough.

9.4.3 *Sampling and Specimen Preparation*— Select at random six specimens of the type and size of CPVC plastic-to-metal transition fitting to be tested. Assemble the fittings with suitable lengths of pipe or tubing meeting the requirements of this specification, and attach to a common manifold. Assemble strictly according to the instructions of the transition fitting manufacturer. If plastic threads are to be mated to metal threads, use the thread sealant intended for use with the threaded transition. 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.

9.4.4 *Procedure*—Pressure the specimen assembly with nitrogen in air 100 ± 10 psi [690 ± 69 kPa]. Immerse in 60 ± 3.6°F [16 ± 2°C] water to determine if there are any initial leaks. All leaks shall be eliminated before the thermocycling test is started. Thermally cycle the specimen assembly either manually or automatically, and under an internal pressure of 100 ± 10 psi [690± 69 kPa] alternately between 60 ± 3.6°F [16 ± 2°C] and 180 ± 3.6°F [82 ± 2°C] by means of immersion in water using the following test cycle:

Water immersion at 180°F [82°C]	2 minutes (min)
Air immersion at ambient	2 minutes (max)
Water immersion at 60°F [16°C]	2 minutes (min)
Air immersion at ambient	2 minutes (max)

Upon the completion of 1000 thermal cycles, immerse the specimen assembly again in 60 ± 3.6°F [16 ± 2°C] water and check for any sign of gas leakage. Any evidence of leakage at

the transition fitting or separation of the transition fitting from the pipe or tubing constitutes a failure.

9.4.5 *Interpretation of Results*—Failure of any one of six specimens tested shall constitute failure in this test.

9.5 *Threads*—All taper pipe threads shall be gaged in accordance with Specification F1498.

10. Tests for Solvent Cement and Adhesive Joints

10.1 *Test for Solvent Cement Joints*:

10.1.1 *Hydrostatic Burst Strength*—Determine the minimum hydrostatic burst strength for CPVC solvent cemented joints according to Test Method D1599, except as herein specified. Test assemblies containing at least six nominal 2-in. [50-mm] solvent cemented joints prepared for CPVC 41 pipe or tubing and fittings meeting the requirements of this specification. Assemble the joints in accordance with the solvent cement manufacturer's instructions. After attaching end closures, fill the specimen assembly with water and condition in water at the test temperature for 2 h maximum. Then test immediately. Increase the internal pressure at a constant rate so as to reach the minimum burst requirement in 60 to 70 s. Leakage or separation at any of the joints tested at less than the minimum hydrostatic burst requirement specified in Table 6 shall constitute failure in this test.

10.2 *Test for Adhesive Joints*:

10.2.1 *General*—Prepare a test assembly containing at least six adhesive joints of the largest nominal diameter and the exact type (plastic-to-plastic, or plastic-to-metal) for which the adhesive is intended to qualify. Make and cure the adhesive joints in accordance with the adhesive manufacturer's instructions, but in no case above 180°F [82°C]. The CPVC 41 pipe or tubing and fittings used in the assembly shall meet the requirements of this specification.

10.2.2 *Hydrostatic Sustained Pressure for Adhesive Joints*—Test in accordance with 9.2, but at the conditions in Table 7 which require a test duration of 10 000 h. Any evidence of leaking or separation at the adhesive joint, or adhesive-related bursting, weeping, or ballooning of the CPVC 41 components adjacent to the joint, shall constitute failure. Failure of any one of six joint specimens tested shall constitute failure in this test.

10.2.3 *Thermocycling for Adhesive Joints*— Test in accordance with 9.3, but carry the test to 10 000 cycles. Any evidence of leakage or separation at the adhesive joint constitutes a failure. Failure of any one of six joint specimens tested shall constitute failure in this test.

11. Retest and Rejection

11.1 If the results of any test(s) do not meet the requirements of this specification, the tests(s) shall be conducted again only by agreement between the purchaser and seller. Under such agreement, minimum requirements shall not be lowered, changed, or modified, nor shall specification limits be changed. If upon retest, failure occurs, the quantity of product represented by the test(s) does not meet the requirements of this specification.

NOTE 11—Manufacturers using the seal or mark of a laboratory must obtain prior authorization from the laboratory concerned.

12. Product Marking

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

12.2 *Content of Marking*:

12.2.1 Manufacturer's name (or trademark), and production code,

12.2.2 Components 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,

12.2.3 This designation: "ASTM D2846, or /D 2846M, or D2846/D2846M,"

12.2.4 Material designation in accordance with 5.1.2 (CPVC 4120),

12.2.5 Pressure rating (see Appendix X1) at 180°F [82°C].

12.2.6 Nominal size,

12.2.7 Standard dimension ratio (SDR 11), and

12.2.8 A code number identifying the compound and the date of manufacture.

12.3 *Pipe and Tubing*—Markings 12.2.1 through 12.2.7 shall be required on pipe and tubing at intervals of not more than 5 ft [1.5 m]. Marking shall be applied without indentation in some permanent manner so as to remain legible under normal handling and installation practice.

12.4 *Socket-Type Fittings*—Markings 12.2.1 through 12.2.4 shall be required on socket-type fittings, except where size makes such marking impractical. Where markings are omitted, fittings shall be identified by some symbol which is defined in the manufacturer's trade literature. Marking on fittings shall be molded, hot stamped, or applied in some other permanent manner so as to remain legible under normal handling and installation practice. Where recessed marking is used, care shall be taken to see that wall thicknesses are not reduced below the specified minimums.

12.5 *Transition Fittings*—Markings 12.2.1 through 12.2.3 shall be required on CPVC plastic-to-metal transition fittings in addition to the designation CPVC.

12.6 *CPVC to PEX and CPVC to PERT Transition Fittings*—Markings 12.1 through 12.2.3 shall be required to be marked on the transition fittings in addition to the standard number to which the PEX or PERT fitting end portion of the transition is manufactured.

12.7 *Solvent Cements and Adhesives*— Solvent cements and adhesives shall be labeled in accordance with 12.2.1 through 12.2.3 in addition to the designation CPVC Solvent Cement or CPVC Adhesive.

NOTE 12—Certain regional air quality districts have established criteria regarding limits on volatile organic content levels for certain products, including CPVC solvent cement. Both the cement producer and user should ensure that the product complies with the specific air quality district requirements as determined by the test methods specified by that air quality district. It is recommended that the air quality district and the air quality district's regulation to which the cement conforms be indicated on the label.

13. Safe Handling of Solvent Cement

13.1 Refer to Practice F402 for information on safe handling of solvent cements.

14. Quality Assurance

14.1 When the product is marked with this designation, D2846/D2846M, 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 cold-water pipe; CPVC piping; hot-water pipe; water distribution piping

SUPPLEMENTARY REQUIREMENTS

GOVERNMENT/MILITARY PROCUREMENT

These requirements apply *only* to Federal/Military procurement, not domestic sales of 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 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 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 document.

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. HYDROSTATIC DESIGN STRESS

X1.1 Hydrostatic design stresses recommended by the Plastics Pipe Institute are used to pressure rate CPVC plastic pipe and tubing. These design stresses are based on the 100 000-h hydrostatic strength of the pipe and tubing obtained in accordance with Test Method D2837. Additional information regarding the method of test and other criteria used in developing these hydrostatic design stresses may be obtained from the Plastics Pipe Institute, Division of the Society of the Plastics Industry, 355 Lexington Ave., New York, NY 10017.

X1.2 Independent methods for determining the hydrostatic design stress of fittings have yet to be developed due to the complicating effects of fitting geometry. Instead, fittings and assembled systems carry an implied pressure rating equivalent to that of the corresponding pipe or tubing on the basis of

actual equivalent hydrostatic performance of assembled systems for periods exceeding 10 000 h. The sustained pressure requirements of 6.2 for fittings, tested as assembled systems, are derived from the rupture pressure-time relationship for pipe and tubing (see footnote to Table 5).

X1.3 The hydrostatic design stresses and pressure ratings in Table X1.1 apply to systems assembled from CPVC 4120, SDR 11, components meeting the requirements of this specification.

X1.4 These hydrostatic design stresses are not suitable for materials that show a negative departure from a straight-line plot of log stress versus log time-to-failure. All of the data available to date on CPVC materials made in the United States and tested in the form of pipe, tubing, or cured fitting assemblies meet this requirement. Experience of the industry indicates that CPVC hot- and cold-water distribution systems made from components meeting the requirements of this specification give satisfactory service under normal conditions at this temperature-pressure rating.

TABLE X1.1 Hydrostatic Design Stresses and Pressure Ratings for CPVC 4120, SDR 11, Hot-Water Distribution Systems

Rated Temperature	Hydrostatic Design Stress	Pressure Rating for Water
73.4°F [23°C]	2000 psi [13.8 MPa]	400 psi [2.8 MPa]
180°F [82°C]	500 psi [3.5 MPa]	100 psi [0.7 MPa]

X2. DESIGN, ASSEMBLY, AND INSTALLATION CONSIDERATIONS

X2.1 Design

X2.1.1 *Thermal Expansion*—The linear thermal expansion rate for CPVC is approximately ½ in. for each 10°F temperature change for each 100 ft [8 mm for each 10°C temperature change for each 10 m] of pipe or tubing. When installing long runs of pipe allow 1/16 to 3/32 in. longitudinal clearance per foot [5 to 7 mm per metre] of run to accommodate thermal expansion. Proper design includes offsets of 12 in. [300 mm] or more every 10 ft [3 m] on vertical risers if they are restrained by horizontal branches at each floor level. Pipe should not be anchored rigidly to a support but rather be secured with broad, smooth hangers providing for a degree of movement.

X2.1.2 *Support Spacing*—The maximum recommended spacing between supports is 3 ft [1 m] for sizes 1 in. or smaller and 4 ft [1.2 m] for larger sizes.

X2.1.3 *Water Heaters*—Components covered by this specification are not intended for use at temperatures above 180°F [82.2°C]. Hence, they may not be suitable for use with the instantaneous type (coil or immersion) water heater. They are suitable for use with storage type water heaters with connections made in an approved manner.

X2.1.4 *Sweating*—Even though the thermal conductivity of CPVC is several orders of magnitude lower than that of metal, sweating or condensation at a slow rate may occur under certain temperature and humidity conditions.

X2.1.5 *Water Hammer and Surge*—A CPVC hot-water system will withstand repeated pressure surges well in excess of its rated pressure, but water hammer arrestors may be advisable when solenoid valves or other quick closing devices are used in the system. In designing for such situations it is advisable to consult the pipe or fitting manufacturer for recommended surge pressure limits. Water hammer and surge pressure calculations are reviewed in AWWA Manual M11, "Steel Pipe Design and Installation", 1964, Chapter 7, American Water Works Association Inc., 2 Park Ave., New York, NY 10016.

X2.2 Assembly

X2.2.1 *Solvent Cemented Joints*:

X2.2.1.1 *Interference Fit*—Components meeting the dimensional requirements of this specification are designed to have an interference fit. Before making a cemented joint, it is advisable to check for an interference dry-fit. A good interference dry-fit exists when the pipe or tubing makes contact with the fitting socket wall between one third and two thirds of the way into the socket.

X2.2.1.2 *Cutting*—Pipe and tubing may be cut to length with tubing cutters. Tubing cutters with thin cutting wheels designed specially for plastic are recommended. Where tubing cutters are not available, a saw and mitre box may be used. Burrs and ridges caused by handling or cutting must be removed before assembling a joint.

X2.2.1.3 *Solvent Cleaning*—When recommended by the cement manufacturer, organic liquids can be used as a cleaning solvent for CPVC 41 components. These organic liquids should have a low solvation power for CPVC, to prevent mistaken use of the cleaning solvent for a cement. Uncemented joints with a good solvent. THF for instance, will pass the usual cold water pressure check but are likely to fail later in hot water service.

X2.2.1.4 *Step-by-Step Assembly*—Correct assembly consists of the following steps: (*1*) cut the pipe square; (*2*) remove burrs; (*3*) check for interference fit; (*4*) clean both pipe end and fitting socket with a recommended CPVC cleaner or by light sanding, or both; (5) apply a liberal coat of CPVC solvent cement to the pipe and apply a light coat of cement to the fitting socket; (*6*) assemble immediately by bottoming the pipe in the socket and rotating a quarter turn as the joint is assembled; and (*7*) remove excess cement from the joint. If a joint has been properly made, a small bead of cement will always appear at the juncture between the pipe or tubing and the fitting.

X2.2.2 *Adhesive Joints*—Assemble according to the manufacturer's instructions paying particular attention to whether sanding of the pipe or tubing is recommended to eliminate the interference fit.

X2.2.3 *Plastic-to-Metal Transitions*—Assemble in accordance with the manufacturer's instructions. Union and compression type transition fittings are likely to include ferrules or

O-rings, or both, which form an essential part of the fitting assembly and should not be omitted. Plastic socket-to-male threaded adapters should be installed with a recommended thread sealant.

X2.3 Installation

X2.3.1 *Storage and Handling*—CPVC pipe, tubing, and fittings should be stored under cover to avoid unnecessary dirt accumulation and long-term exposure to sunlight. Pipe and tubing should be stored with continuous support in straight, uncrossed bundles. Care should be used in handling to ensure that unnecessary abuse such as abrasion on concrete or crushing is avoided.

X2.3.2 *Installation Temperature*—Extra care must be taken at temperatures of 40°F or lower and 110°F or higher. Always follow the manufacturer's installation instructions carefully.

X2.3.3 *Pressure Testing*—CPVC piping systems made of ½ through 2-in. sizes in accordance with this specification, and utilizing a solvent cement requiring a primer or cleaner, can be pressure tested (using cold tap water only) at line pressure (150 psi maximum) after the solvent cement joints have cured for at least the following amount of time:

Ambient Temperature	Minimum Cure Times, h	
	½ in. to 1 in.	1¼ in. to 2 in.
over 60°F	1	2
40° to 60°F	2	4

For cements not requiring a primer or cleaner, refer to the manufacturer's recommended cure times specific to that cement.

X2.3.4 *Repairs*—If a leak is discovered, that portion of the system should be drained and the joint and fitting should be cut out. The pipe should be thoroughly dried and a new fitting should be installed using couplings and short lengths of pipe.

X2.3.5 *Soldering in the Area*—Soldered metal joints should not be made closer than 18 in. (460 mm) to an installed plastic-to-metal adapter in the same water line.

X3. OPTIONAL PERFORMANCE QUALIFICATION AND IN-PLANT QUALITY CONTROL PROGRAM FOR CPVC HOT-WATER DISTRIBUTION SYSTEM COMPONENTS

X3.1 Scope

X3.1.1 The following program covers performance qualification and in-plant quality control for component design and manufacture respectively to provide reasonable assurance that CPVC hot-water distribution system components supplied under this specification shall consistently meet its requirements.

TABLE X3.1 Suggested Quality Control Program

Component	Property	Frequency	Method
Pipe and tubing	outside diameter	hourly	6.1.2.1
	wall thickness	hourly	6.1.2.1
	sustained pressure	daily	6.2
			6.1.3
Fittings	socket diameter	hourly	6.1.4.2
	external threads	hourly	6.2
	sustained pressure	daily	6.2

X3.2 Performance Qualification

X3.2.1 Performance qualification tests shall be run initially on each component design, size, and formulation according to the requirements of this specification. The test results shall be independently certified, and shall be made available to the purchaser on request.

X3.3 In-Plant Quality Control

X3.3.1 *Material*—The pipe, tubing, and fittings shall be manufactured only from CPVC 4120 materials, as defined in Section 5 of this specification. The manufacturer shall so certify.

X3.3.2 *Quality Control Testing*—Pipe, tubing, and fitting quality control tests shall be run for each extrusion line or mold cavity in accordance with the requirements of this specification at a frequency agreed upon between the purchaser and the manufacturer. The program outlined in Table X3.1 is recommended. The test results shall be recorded and filed for inspection on request. Should a component fail to meet the specification in any test, production should be sampled back to the previous acceptable test result and tested to determine which components produced in the interim do not meet the requirement. Components that do not meet the requirements of this specification shall be rejected.

X3.3.3 *Marking*—A code number shall be included on the pipe, tubing, and fittings that can be used to identify the manufacturer, the compound, and the date of manufacture.

SUMMARY OF CHANGES

Committee F17 has identified the location of selected changes to this standard since the last issue (D2846/D 2846–09a) that may impact the use of this standard. (Approved Aug. 1, 2009.)

(*1*) Note 3 was added.

Committee F17 has identified the location of selected changes to this standard since the last issue (D2846/D 2846–09) that may impact the use of this standard. (Approved May 15, 2009.)

(*1*) 5.3 was added.
(*2*) 6.1.5 was revised.
(*3*) 12.6 was revised.