



Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80¹

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

1. Scope

1.1 This specification covers chlorinated poly(vinyl chloride) (CPVC) pipe made in Schedule 40 and 80 sizes and pressure-rated for water (see appendix). Included are criteria for classifying CPVC plastic pipe materials and CPVC plastic pipe, a system of nomenclature for CPVC plastic pipe, and requirements and test methods for materials, workmanship, dimensions, sustained pressure, burst pressure, flattening, and extrusion quality. Methods of marking are also given.

NOTE 1—The CPVC pipe covered by this specification was covered previously in Specification D 1785.

NOTE 2—The sustained and burst pressure test requirements, and the pressure ratings in the appendix, are calculated from stress values obtained from tests made on pipe 2 in. [50 mm] and smaller. However, tests on larger pipe have shown these stress values to be valid.

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 3—Pressurized (compressed) air or other compressed gases contain large amounts of stored energy which present serious safety 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 inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. 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.

1.5 The following safety hazards caveat pertains only to the test methods portion, Section 8, 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.* A specific precautionary statement is given in Note 6.

2. Referenced Documents

2.1 ASTM Standards:

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing²

D 1598 Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure³

D 1599 Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings³

D 1600 Terminology for Abbreviated Terms Relating to Plastics²

D 1784 Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds²

D 1785 Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120³

D 2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings³

D 2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials³

F 412 Terminology Relating to Plastic Piping Systems³

2.2 Federal Standard:

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)⁴

2.3 Military Standard:

MIL-STD-129 Marking for Shipment and Storage⁴

2.4 NSF Standards:

Standard No. 14 for Plastic Piping Components and Related Materials⁵

Standard No. 61 for Drinking Water Systems

¹ This specification is under the jurisdiction of ASTM Committee F-17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.25 on Vinyl Based Pipe.

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² Annual Book of ASTM Standards, Vol 08.01.

³ Annual Book of ASTM Standards, Vol 08.04.

⁴ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

⁵ Available from the National Sanitation Foundation, P.O. Box 1468, Ann Arbor, MI 48106.

Components—Health Effects⁵

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. The abbreviation for chlorinated poly(vinyl chloride) is CPVC.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *hydrostatic design stress*—the estimated maximum tensile stress the material is capable of withstanding continuously with a high degree of certainty that failure of the pipe will not occur. This stress is circumferential when internal hydrostatic water pressure is applied.

3.2.2 *pressure rating (PR)*—the estimated maximum water pressure the pipe is capable of withstanding continuously with a high degree of certainty that failure of the pipe will not occur.

3.2.3 *relation between dimensions, design stress, and pressure rating*—The following expression, commonly known as the ISO equation,⁶ is used in this specification to relate dimensions, hydrostatic design stress, and pressure rating:

$$2 S/P = (D_o/t) - 1$$

where:

S = hydrostatic design stress, psi [MPa],

P = pressure rating, psi [MPa],

D_o = average outside diameter, in. [mm], and

t = minimum wall thickness, in. [mm].

3.2.4 *standard thermoplastic pipe materials designation code*—The pipe materials designation code shall consist of the abbreviation CPVC for the type of plastic, followed by the ASTM type and grade in Arabic numerals and the design stress in units of 100 psi (0.7 MPa) with any decimal figures dropped. When the design stress code contains less than two figures, a

cipher shall be used before the number. Thus a complete material code shall consist of four letters and four figures for CPVC plastic pipe materials (see Section 5).

4. Classification

4.1 *General*—This specification covers CPVC pipe made from one (see X1.2) CPVC plastic pipe material in Schedule 40 and 80 sizes.

4.2 *Hydrostatic Design Stresses*—This specification covers CPVC pipe made from CPVC plastic as defined by hydrostatic design stresses which have been developed on the basis of long-term tests (see appendix).

5. Materials

5.1 *General*—Chlorinated poly(vinyl chloride) plastics used to make pipe meeting the requirements of this specification are categorized by means of two criteria, namely, (1) short-term strength tests and (2) long-term hydrostatic strength tests at both 73 and 180°F [23 and 82°C].

5.2 *Basic Materials*—This specification covers CPVC pipe made from compounds meeting the requirements of Class 23447 as defined in Specification D 1784. The materials shall have Hydrostatic Design Stress (HDS) listings equal to or greater than 2000 psi [13.80 MPa] at 73°F [23°C] and 500 psi [3.45 MPa] at 180°F [82°C] when evaluated in accordance with Test Method D 2837.

NOTE 4—Mechanical strength, heat resistance, flammability, and chemical resistance properties are covered in Specification D 1784.

5.3 *Rework Material*—The manufacturers shall use only their own clean rework pipe material and the pipe produced shall meet all the requirements of this specification.

6. Requirements

6.1 *Dimensions and Tolerances:*

6.1.1 Dimensions and tolerances shall be as shown in Table 1 and Table 2 when measured in accordance with Test Method

⁶ ISO R 161-1960, Pipes of Plastics Materials for the Transport of Fluids (Outside Diameters and Nominal Pressures) Part 1, Metric Series.

TABLE 1 Outside Diameters and Tolerances for CPVC Plastic Pipe, Schedules 40 and 80, in. [mm]

Nominal Pipe Size	Outside Diameter	Tolerances	Tolerances	
			Maximum Out-of-Roundness (maximum minus minimum diameter)	
			Schedule 40 sizes 3 1/2 in. and over; Schedule 80 sizes 8 in. and over	Schedule 40 sizes 3 in. and less; Schedule 80 sizes 6 in. and less
1/4 [8]	0.540 [13.7]	±0.004 [0.10]	...	0.016 (0.41)
3/8 [10]	0.675 [17.1]	±0.004 [0.10]	...	0.016 (0.41)
1/2 [15]	0.840 [21.3]	±0.004 [0.10]	...	0.016 (0.41)
3/4 [20]	1.050 [26.7]	±0.004 [0.10]	...	0.020 (0.51)
1 [25]	1.315 [33.4]	±0.005 [0.13]	...	0.020 (0.51)
1 1/4 [32]	1.660 [42.2]	±0.005 [0.13]	...	0.024 (0.61)
1 1/2 [40]	1.900 [48.3]	±0.006 [0.15]	...	0.024 (0.61)
2 [50]	2.375 [60.3]	±0.006 [0.15]	...	0.024 (0.61)
2 1/2 [65]	2.875 [73.0]	±0.007 [0.18]	...	0.030 (0.76)
3 [80]	3.500 [88.9]	±0.008 [0.20]	...	0.030 (0.76)
3 1/2 [90]	4.000 [101.6]	±0.008 [0.20]	0.100 (2.54)	0.030 (0.76)
4 [100]	4.500 [114.3]	±0.009 [0.23]	0.100 (2.54)	0.030 (0.76)
5 [125]	5.563 [141.3]	±0.010 [0.25]	0.100 (2.54)	0.060 (1.52)
6 [150]	6.625 [168.3]	±0.011 [0.28]	0.100 (2.54)	0.070 (1.78)
8 [200]	8.625 [219.1]	±0.015 [0.38]	0.150 (3.81)	0.090 (2.29)
10 [250]	10.750 [273.1]	±0.015 [0.38]	0.150 (3.81)	0.100 (2.54)
12 [300]	12.750 [323.9]	±0.015 [0.38]	0.150 (3.81)	0.120 (3.05)

F 441/F 441M

TABLE 2 Wall Thicknesses and Tolerances for CPVC Plastic Pipe, Schedules 40 and 80, in.^{A,B} [mm]

Nominal Pipe Size	Wall Thickness ^A			
	Schedule 40		Schedule 80	
	Min	Tolerance	Min	Tolerance
1/4 [8]	0.088 [2.24]	+0.020 [0.51]	0.119 [3.02]	+0.020 [0.51]
3/8 [10]	0.091 [2.31]	+0.020 [0.51]	0.126 [3.20]	+0.020 [0.51]
1/2 [15]	0.109 [2.77]	+0.020 [0.51]	0.147 [3.73]	+0.020 [0.51]
3/4 [20]	0.113 [2.87]	+0.020 [0.51]	0.154 [3.91]	+0.020 [0.51]
1 [25]	0.133 [3.38]	+0.020 [0.51]	0.179 [4.55]	+0.021 [0.53]
1 1/4 [32]	0.140 [3.56]	+0.020 [0.51]	0.191 [4.85]	+0.023 [0.58]
1 1/2 [40]	0.145 [3.68]	+0.020 [0.51]	0.200 [5.08]	+0.024 [0.61]
2 [50]	0.154 [3.91]	+0.020 [0.51]	0.218 [5.54]	+0.026 [0.66]
2 1/2 [65]	0.203 [5.16]	+0.024 [0.61]	0.276 [7.01]	+0.033 [0.84]
3 [80]	0.216 [5.49]	+0.026 [0.66]	0.300 [7.62]	+0.036 [0.91]
3 1/2 [90]	0.226 [5.74]	+0.027 [0.68]	0.318 [8.08]	+0.038 [0.96]
4 [100]	0.237 [6.02]	+0.028 [0.71]	0.337 [8.56]	+0.040 [1.02]
5 [125]	0.258 [6.55]	+0.031 [0.79]	0.375 [9.52]	+0.045 [1.14]
6 [150]	0.280 [7.11]	+0.034 [0.86]	0.432 [10.97]	+0.052 [1.32]
8 [200]	0.322 [8.18]	+0.039 [0.99]	0.500 [12.70]	+0.060 [1.52]
10 [250]	0.365 [9.27]	+0.044 [1.12]	0.593 [15.06]	+0.071 [1.80]
12 [300]	0.406 [10.31]	+0.049 [1.24]	0.687 [17.45]	+0.082 [2.08]

^A The minimum is the lowest wall thickness of the pipe at any cross section. All tolerances are on the plus side of the minimum requirement.

^B These dimensions conform to nominal IPS dimensions.

D 2122. The tolerances for out-of-roundness shall apply only to pipe prior to shipment.

6.1.2 *Wall Thickness Range*—The wall thickness range shall not exceed 12 % when measured in accordance with Test Method D 2122.

6.2 *Sustained Pressure*—The pipe shall not fail, balloon, burst, or weep as defined in Test Method D 1598, at the test pressures given in Table 3, when tested in accordance with 8.4.

6.2.1 *Accelerated Regression Test*—The accelerated regression test shall be used in place of both the sustained and burst pressure tests at the option of the manufacturer. The test shall be conducted in accordance with 8.4.1. The pipe shall demonstrate a hydrostatic design basis projection at the 100 000 h intercept that meets the hydrostatic design basis category requirement (see Table 1, Test Method D 2837) for

the CPVC material used in its manufacture. If the lower confidence value at 100 000 h differs from the extrapolated LTHS value by more than 15 % of the latter; or *M* in Appendix X2 (Test Method D 2837) is zero or negative; or *b* in the equation $h = a + bf$ in Appendix X1 (Test Method D 2837) is positive, consider the data unsuitable.

6.3 *Burst Pressure*—The minimum burst pressures for CPVC plastic pipe shall be as given in Table 4, when determined in accordance with Test Method D 1599.

6.4 *Flattening*—There shall be no evidence of splitting, cracking, or breaking when the pipe is tested in accordance with 8.5.

7. Workmanship, Finish, and Appearance

7.1 The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other defects.

TABLE 3 Sustained Pressure Test Conditions for Water at 73°F [23°C] for CPVC 4120 Plastic Pipe, Schedules 40 and 80

Nominal Pipe Size	Pressure Required for Test ^A			
	Schedule 40		Schedule 80	
	psi	[kPa]	psi	[kPa]
1/4 [8]	1640	[11 310]	2370	[16 340]
3/8 [10]	1310	[9 030]	1930	[13 310]
1/2 [15]	1250	[8 620]	1780	[12 270]
3/4 [20]	1010	[6 960]	1440	[9 930]
1 [25]	950	[6 550]	1320	[9 100]
1 1/4 [32]	770	[5 310]	1090	[7 520]
1 1/2 [40]	690	[4 760]	990	[6 830]
2 [50]	580	[4 000]	850	[5 860]
2 1/2 [65]	640	[4 410]	890	[6 140]
3 [80]	590	[4 070]	790	[5 450]
3 1/2 [90]	500	[3 450]	730	[5 030]
4 [100]	470	[3 240]	680	[4 690]
5 [125]	410	[2 830]	610	[4 210]
6 [150]	370	[2 550]	590	[4 070]
8 [200]	330	[2 280]	520	[3 590]
10 [250]	300	[2 070]	490	[3 380]
12 [300]	280	[1 930]	480	[3 310]

^A The fiber stress used to derive these test pressures is 4200 psi [29.0 MPa].

TABLE 4 Burst Pressure Requirements for Water at 73°F [23°C] for CPVC 4120 Plastic Pipe, Schedules 40 and 80

Nominal Pipe Size	Minimum Burst Pressure ^A			
	Schedule 40		Schedule 80	
	psi	[kPa]	psi	[kPa]
1/4 [8]	2490	[17 170]	3620	[24 960]
3/8 [10]	1990	[13 720]	2940	[20 270]
1/2 [15]	1910	[13 170]	2720	[18 760]
3/4 [20]	1540	[10 620]	2200	[15 170]
1 [25]	1440	[9 930]	2020	[13 930]
1 1/4 [32]	1180	[8 140]	1660	[11 450]
1 1/2 [40]	1060	[7 310]	1510	[10 410]
2 [50]	890	[6 140]	1290	[8 890]
2 1/2 [65]	970	[6 690]	1360	[9 380]
3 [80]	840	[5 790]	1200	[8 270]
3 1/2 [90]	770	[5 310]	1110	[7 650]
4 [100]	710	[4 900]	1040	[7 170]
5 [125]	620	[4 270]	930	[6 410]
6 [150]	560	[3 860]	890	[6 140]
8 [200]	500	[3 450]	790	[5 450]
10 [250]	450	[3 100]	750	[5 170]
12 [300]	420	[2 900]	730	[5 030]

^A The fiber stress used to derive these test pressures is 6400 psi [44.1 MPa].