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AnAmerican National Standard

Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR–PR)[1]

This standard is issued under the fixed designation F442/F442M; 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.

1. Scope*

1.1 This specification covers chlorinated poly(vinyl chloride) (CPVC) pipe made in standard thermoplastic pipe dimension ratios and pressure rated for water (see Appendix). Included are criteria for classifying CPVC plastic pipe materials and 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 D2241.

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 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.Within the text, the SI units are shown in brackets.

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:*[2]

D618 Practice for Conditioning Plastics for Testing

D1598 Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure

D1599 Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings

D1600 Terminology for Abbreviated Terms Relating to Plastics

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

D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

D2241 Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

D2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products

F412 Terminology Relating to Plastic Piping Systems

2.2 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)[3]

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

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[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] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://www.dodssp.daps.mil.

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

2.3 *Military Standard:*

MIL-STD-129 Marking for Shipment and Storage[3]

2.4 *NSF Standards:*

Standard No. 14 for Plastic Piping Components and Related Materials[4]

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

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology F412, and abbreviations are in accordance with Terminology D1600, unless otherwise specified. The abbreviation for chlorinated poly(vinyl chloride) plastic 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 standard dimension ratio, hydrostatic design stress, and pressure rating*—the following expression, commonly known as the ISO equation,[5] is used in this specification to relate standard dimension ratio, hydrostatic design stress, and pressure rating:

$$2\,S/P = R - 1 \text{ or } 2\,S/P = (D_o/t) - 1$$

where:

S = hydrostatic design stress, psi [MPa],
P = pressure rating, psi [kPa],
D_o = average outside diameter, in. [mm]
t = minimum wall thickness, in. [mm], and
R = standard thermoplastic pipe dimension ratio (D_o/t for CPVC pipe), also known as SDR.

3.2.4 *standard thermoplastic pipe dimension ratio (SDR)*—the standard thermoplastic pipe dimension ratio (SDR) is the ratio of pipe diameter to wall thickness. For CPVC pipe it is calculated by dividing the average outside diameter of the pipe in millimetres or in inches by the minimum wall thickness in millimetres or in inches. If the wall thickness calculated by this formula is less than 0.060 in. [1.52 mm], it shall be arbitrarily increased to 0.060 in. [1.52 mm]. The SDR values shall be rounded to the nearest 0.5.

3.2.5 *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 [690 kPa] 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 and X1.2.1).

4. Classification

4.1 *General*—This specification covers CPVC pipe made from one CPVC plastic pipe material in six standard dimension ratios and water pressure ratings for nonthreaded pipe.

4.2 *Standard Thermoplastic Pipe Dimension Ratios (SDR)*—This specification covers CPVC pipe in six standard dimension ratios, namely, 11, 13.5, 17, 21, 26, and 32.5, which are uniform for all nominal pipe sizes for each material and pressure rating. These are referred to as SDR11, SDR13.5, SDR21, SDR17, SDR26, and SDR32.5, respectively. The pressure rating is uniform for all nominal pipe sizes for a given CPVC pipe material and SDR (see Table X1.1).

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

NOTE 4—This standard specification does not include requirements for pipe and fittings intended to be used to vent combustion gases.

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 D1784. The materials shall have an established HDS (Hydrostatic Design Stress) 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 D2837.

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 *Dimension and Tolerances:*

6.1.1 *Outside Diameters*—The outside diameters and tolerances shall be as shown in Table 1 when measured in accordance with Test Method D2122. The tolerances on out-of-roundness shall apply only to pipe prior to shipment.

6.1.2 *Wall Thickness*—The wall thicknesses and tolerances shall be as shown in Table 2 when measured in accordance with Test Method D2122.

6.1.3 *Wall Thickness Range*—The wall thickness range shall be within 12 % when measured in accordance with Test Method D2122.

6.2 *Sustained Pressure*—The pipe shall not fail, balloon, burst, or weep as defined in Test Method D1598 at the test pressures given in Table 3 when tested in accordance with 8.4.

6.2.1 *Accelerated Regression Test*—At the option of the manufacturer, the accelerated regression test may be used as a substitute for both pressure tests—sustained and burst. The test

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

[5] See ISO R161-1960: 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

Nominal Pipe Size	Average Outside Diameter, in. [mm]	Tolerances, in. [mm]		
			Maximum Out-of-Roundness (maximum minus minimum diameter)	
		For Average	SDR32.5 SDR26 SDR21	SDR17 SDR13.5 SDR11
¼ [8]	0.540 [13.7]	±0.004 [0.10]	0.030 (0.76)	0.016 (0.41)
⅜ [10]	0.675 [17.1]	±0.004 [0.10]	0.030 (0.76)	0.016 (0.41)
½ [15]	0.840 [21.3]	±0.004 [0.10]	0.030 (0.76)	0.016 (0.41)
¾ [20]	1.050 [26.7]	±0.004 [0.10]	0.030 (0.76)	0.020 (0.51)
1 [25]	1.315 [33.4]	±0.005 [0.13]	0.030 (0.76)	0.020 (0.51)
1¼ [32]	1.660 [42.2]	±0.005 [0.13]	0.030 (0.76)	0.024 (0.61)
1½ [40]	1.900 [48.2]	±0.006 [0.15]	0.060 (1.52)	0.024 (0.61)
2 [50]	2.375 [60.3]	±0.006 [0.15]	0.060 (1.52)	0.024 (0.61)
2½ [65]	2.875 [73.0]	±0.007 [0.18]	0.060 (1.52)	0.030 (0.76)
3 [80]	3.500 [88.9]	±0.008 [0.20]	0.060 (1.52)	0.030 (0.76)
3½ [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)

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 D2837) 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 D2837) is zero or negative; or *b* in the equation $h = a + bf$ in Appendix X1 (Test Method D2837) 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 8.5.

6.4 *Flattening*—There shall be no evidence of splitting, cracking, or breaking when the pipe is tested in accordance with 8.6.

7. Workmanship, Finish, and Appearance

7.1 The pipe shall be homogeneous throughout and free from 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.

NOTE 5—Color and transparency or opacity should be specified in the contract or purchase order.

8. Test Methods

8.1 *Conditioning*—Condition the test specimens at 73.4 ± 3.6°F [23 ± 2°C] and 50 ± 5 % relative humidity for not less than 40 h prior to test in accordance with Procedure A of Practice D618 for those tests where conditioning is required.

8.2 *Test Conditions*—Conduct the tests in the standard laboratory atmosphere of 73 ± 3.6°F [23 ± 2°C] and 50 ± 5 % relative humidity, unless otherwise specified in the test methods or in this specification.

8.3 *Sampling*—The selection of the sample or samples of pipe shall be as agreed upon by the purchaser and the seller. In case of no prior agreement, any sample selected by the testing laboratory shall be deemed adequate.

8.3.1 *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.

8.4 *Sustained Pressure Test*—Select the test specimens at random. Test individually with water at the internal pressures given in Table 3, six specimens of pipe, each specimen at least ten times the nominal diameter in length, but not less than 10 in. [250 mm] or more than 3 ft [1000 mm] between end closures and bearing the permanent marking on the pipe. Maintain the specimens at the pressure indicated for a period of 1000 h. Hold the pressure as closely as possible, but within ±10 psi [±70 kPa]. Condition the specimens at the test temperature of 73± 3.6°F [23 ± 2°C]. Maintain the test temperature at 73 ± 3.6°F [23 ± 2°C]. Test in accordance with Test Method D1598, except maintain the pressure at the values given in Table 3 for 1000 h. Failure of two of the six specimens tested shall constitute failure in the test. Failure of one of the six specimens tested is cause for retest of six additional specimens. Failure of one of the six specimens tested in retest shall constitute failure in the test. Evidence of failure of the pipe shall be as defined in Test Method D1598.

8.4.1 *Accelerated Regression Test*—Test in accordance with procedures in Test Method D1598, using either free end or restrained end fittings. A minimum of six specimens shall be tested. Test three specimens at a single pressure that will result