



# Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120<sup>1</sup>

This standard is issued under the fixed designation D1785; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

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

## 1. Scope\*

1.1 This specification covers poly(vinyl chloride) (PVC) pipe made in Schedule 40, 80, and 120 sizes and pressure-rated for water (see [Appendix X1](#)). Included are criteria for classifying PVC plastic pipe materials and PVC plastic pipe, a system of nomenclature for PVC 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.

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 safety hazards should a system fail for any reason.

NOTE 2—This standard specifies dimensional, performance and test requirements for plumbing and fluid handling applications only. It does not include provisions for the use of these products for venting of combustion gases. UL 1738 is a standard that does include specific testing and marking requirements for flue gas venting products, including PVC.

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 inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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 9](#).*

NOTE 3—CPVC plastic pipes, Schedules 40 and 80, which were formerly included in this specification, are now covered by Specification [F441/F441M](#).

NOTE 4—The sustained and burst pressure test requirements, and the pressure ratings in the [Appendix X1](#), are calculated from stress values obtained from tests made on pipe 4 in. (100 mm) and smaller. However, tests conducted on pipe as large as 24-in. (600-mm) diameter have shown these stress values to be valid for larger diameter PVC pipe.

NOTE 5—PVC pipe made to this specification is often belled for use as line pipe. For details of the solvent cement bell, see Specification [D2672](#) and for details of belled elastomeric joints, see Specifications [D3139](#) and [D3212](#).

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

- [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](#)
- [D2152 Test Method for Adequacy of Fusion of Extruded Poly\(Vinyl Chloride\) \(PVC\) Pipe and Molded Fittings by Acetone Immersion](#)
- [D2672 Specification for Joints for IPS PVC Pipe Using Solvent Cement](#)

<sup>1</sup> 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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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

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

**D3139** Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

**D3212** Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

**F412** Terminology Relating to Plastic Piping Systems

**F441/F441M** Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

2.2 *Federal Standard:*

**Fed. Std. No. 123** Marking for Shipment (Civil Agencies)<sup>3</sup>

2.3 *Military Standard:*

**MIL-STD-129** Marking for Shipment and Storage<sup>3</sup>

2.4 *NSF/ANSI Standards:*<sup>4</sup>

**Standard No. 14** for Plastic Piping System Components and Related Materials

**Standard No. 61** for Drinking Water System Components—Health Effects

2.5 *UL Standard:*<sup>5</sup>

**UL 1738** Standard for Venting Systems for Gas-Burning Appliances, Categories II, III, and IV

$D_o$  = average outside diameter, in. (or mm), and

$t$  = minimum wall thickness, in. (or mm).

3.2.4 *standard thermoplastic pipe materials designation code*—the pipe materials designation code shall consist of the abbreviation PVC 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 three letters and four figures for PVC plastic pipe materials (see Section 5).

## 4. Classification

4.1 *General*—This specification covers PVC pipe made to and marked with one of six type/grade/design stress designations (see **X1.2**) in Schedule 40, 80, and 120 wall sizes.

4.2 *Hydrostatic Design Stresses*—This specification covers pipe made from PVC plastics as defined by four hydrostatic design stresses which have been developed on the basis of long-term tests (**Appendix X1**).

## 5. Materials and Manufacture

5.1 *General*—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 strength tests.

NOTE 6—The PVC pipe intended for use in the transport of potable water should be evaluated and certified as safe for this purpose by a testing agency acceptable to the local health authority. The evaluation should be in accordance with requirements for chemical extraction, taste, and odors that are no less restrictive than those included in NSF/ANSI Standard No. 14. The seal or mark of the laboratory making the evaluation should be included on the pipe. See pipe marking requirement for reclaimed water systems.

5.2 *Basic Materials*—This specification covers pipe made from PVC plastics having certain physical and chemical properties as described in Specification **D1784**.

5.3 *Compound*—The PVC compounds used for this pipe shall equal or exceed the following classes described in Specification **D1784**; PVC 12454, or 14333.

5.4 *Rework Material*—The manufacturer shall use only his 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 **D2122**. The tolerances for out-of-roundness shall apply only to pipe prior to shipment.

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 **Tables 3-5** when tested in accordance with **8.4**.

## 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 poly(vinyl chloride) plastic is PVC.

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,<sup>6</sup> is used in this specification to relate dimensions, hydrostatic design stress, and pressure rating:

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

where:

$S$  = hydrostatic design stress, psi (or MPa),

$P$  = pressure rating, psi (or MPa),

<sup>3</sup> Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://dodssp.daps.dla.mil>.

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

<sup>5</sup> Available from Underwriters Laboratories (UL), 2600 N.W. Lake Rd., Camas, WA 98607-8542, <http://www.ul.com>.

<sup>6</sup> 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 PVC Plastic Pipe Schedules 40, 80, and 120, in. (mm)**

Nominal Pipe Size	Outside Diameter	Average	Tolerances	
			Maximum Out-of-Roundness (maximum minus minimum diameter)	
			Schedule 40 sizes 3½ in. and over; Schedule 80 sizes 8 in. and over	Schedule 40 sizes 3 in. and less;
				Schedule 80 sizes 6 in. and less;
Schedule 120 sizes all				
⅛	0.405 (10.29)	±0.004 (±0.10)	...	0.016 (0.41)
¼	0.540 (13.72)	±0.004 (±0.10)	...	0.016 (0.41)
⅜	0.675 (17.14)	±0.004 (±0.10)	...	0.016 (0.41)
½	0.840 (21.34)	±0.004 (±0.10)	...	0.016 (0.41)
¾	1.050 (26.67)	±0.004 (±0.10)	...	0.020 (0.51)
1	1.315 (33.40)	±0.005 (±0.13)	...	0.020 (0.51)
1¼	1.660 (42.16)	±0.005 (±0.13)	...	0.024 (0.61)
1½	1.900 (48.26)	±0.006 (±0.15)	...	0.024 (0.61)
2	2.375 (60.32)	±0.006 (±0.15)	...	0.024 (0.61)
2½	2.875 (73.02)	±0.007 (±0.18)	...	0.030 (0.76)
3	3.500 (88.90)	±0.008 (±0.20)	...	0.030 (0.76)
3½	4.000 (101.60)	±0.008 (±0.20)	0.100 (2.54)	0.030 (0.76)
4	4.500 (114.30)	±0.009 (±0.23)	0.100 (2.54)	0.030 (0.76)
5	5.563 (141.30)	±0.010 (±0.25)	0.100 (2.54)	0.060 (1.52)
6	6.625 (168.28)	±0.011 (±0.28)	0.100 (2.54)	0.070 (1.78)
8	8.625 (219.08)	±0.015 (±0.38)	0.150 (3.81)	0.090 (2.29)
10	10.750 (273.05)	±0.015 (±0.38)	0.150 (3.81)	0.100 (2.54)
12	12.750 (323.85)	±0.015 (±0.38)	0.150 (3.81)	0.120 (3.05)
14	14.000 (355.60)	±0.015 (±0.38)	0.200 (5.08)	...
16	16.000 (406.40)	±0.019 (±0.48)	0.320 (8.13)	...
18	18.000 (457.20)	±0.019 (±0.48)	0.360 (9.14)	...
20	20.000 (508.00)	±0.023 (±0.58)	0.400 (10.2)	...
24	24.000 (609.60)	±0.031 (±0.79)	0.480 (12.2)	...

**TABLE 2 Wall Thicknesses and Tolerances for PVC Plastic Pipe, Schedules 40, 80, and 120,<sup>A,B</sup> in. (mm)**

Nominal Pipe Size	Wall Thickness <sup>A</sup>					
	Schedule 40		Schedule 80		Schedule 120	
	Minimum	Tolerance	Minimum	Tolerance	Minimum	Tolerance
⅛	0.068 (1.73)	+0.020 (+0.51)	0.095 (2.41)	+0.020 (+0.51)	...	...
¼	0.088 (2.24)	+0.020 (+0.51)	0.119 (3.02)	+0.020 (+0.51)	...	...
⅜	0.091 (2.31)	+0.020 (+0.51)	0.126 (3.20)	+0.020 (+0.51)	...	...
½	0.109 (2.77)	+0.020 (+0.51)	0.147 (3.73)	+0.020 (+0.51)	0.170 (4.32)	+0.020 (+0.51)
¾	0.113 (2.87)	+0.020 (+0.51)	0.154 (3.91)	+0.020 (+0.51)	0.170 (4.32)	+0.020 (+0.51)
1	0.133 (3.38)	+0.020 (+0.51)	0.179 (4.55)	+0.021 (+0.53)	0.200 (5.08)	+0.024 (+0.61)
1¼	0.140 (3.56)	+0.020 (+0.51)	0.191 (4.85)	+0.023 (+0.58)	0.215 (5.46)	+0.026 (+0.66)
1½	0.145 (3.68)	+0.020 (+0.51)	0.200 (5.08)	+0.024 (+0.61)	0.225 (5.72)	+0.027 (+0.68)
2	0.154 (3.91)	+0.020 (+0.51)	0.218 (5.54)	+0.026 (+0.66)	0.250 (6.35)	+0.030 (+0.76)
2½	0.203 (5.16)	+0.024 (+0.61)	0.276 (7.01)	+0.033 (+0.84)	0.300 (7.62)	+0.036 (+0.91)
3	0.216 (5.49)	+0.026 (+0.66)	0.300 (7.62)	+0.036 (+0.91)	0.350 (8.89)	+0.042 (+1.07)
3½	0.226 (5.74)	+0.027 (+0.68)	0.318 (8.08)	+0.038 (+0.96)	0.350 (8.89)	+0.042 (+1.07)
4	0.237 (6.02)	+0.028 (+0.71)	0.337 (8.56)	+0.040 (+1.02)	0.437 (11.10)	+0.052 (+1.32)
5	0.258 (6.55)	+0.031 (+0.79)	0.375 (9.52)	+0.045 (+1.14)	0.500 (12.70)	+0.060 (+1.52)
6	0.280 (7.11)	+0.034 (+0.86)	0.432 (10.97)	+0.052 (+1.32)	0.562 (14.27)	+0.067 (+1.70)
8	0.322 (8.18)	+0.039 (+0.99)	0.500 (12.70)	+0.060 (+1.52)	0.718 (18.24)	+0.086 (+2.18)
10	0.365 (9.27)	+0.044 (+1.12)	0.593 (15.06)	+0.071 (+1.80)	0.843 (21.41)	+0.101 (+2.56)
12	0.406 (10.31)	+0.049 (+1.24)	0.687 (17.45)	+0.082 (+2.08)	1.000 (25.40)	+0.120 (+3.05)
14	0.437 (11.10)	+0.053 (+1.35)	0.750 (19.05)	+0.090 (+2.29)	...	...
16	0.500 (12.70)	+0.060 (+1.52)	0.843 (21.41)	+0.101 (+2.57)	...	...
18	0.562 (14.27)	+0.067 (+1.70)	0.937 (23.80)	+0.112 (+2.84)	...	...
20	0.593 (15.06)	+0.071 (+1.80)	1.031 (26.19)	+0.124 (+3.15)	...	...
24	0.687 (17.45)	+0.082 (+2.08)	1.218 (30.94)	+0.146 (+3.71)	...	...

<sup>A</sup> The minimum is the lowest wall thickness of the pipe at any cross section. The maximum permitted wall thickness, at any cross section, is the minimum wall thickness plus the stated tolerance. All tolerances are on the plus side of the minimum requirement.

<sup>B</sup> These dimensions conform to nominal IPS dimensions, with the exception that Schedule 120 wall thickness for pipe sizes ½ to 3½ in. (12.5 to 87.5 mm), inclusive, are special PVC plastic pipe sizes.

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 Tables 3-5 and Test Method D2837) for the PVC material used in its manufacture. (Example: PVC 1120 pipe must have a minimum 100 000-h projection of 3830 psi (26.40 MPa) and 85 % lower confidence limit (LCL).

**TABLE 3 Sustained Pressure Test Conditions for Water at 73°F (23°C) for PVC Plastic Pipe, Schedule 40**

Nominal Pipe Size	Pressure Required for Test <sup>A</sup>			
	PVC1120 PVC1220 PVC2120	PVC2116	PVC2112	PVC2110
in.	psi			
1/8	1690	1360	1130	930
1/4	1640	1310	1090	900
3/8	1310	1050	870	720
1/2	1250	1000	840	690
3/4	1010	810	680	550
1	950	760	630	520
1 1/4	770	620	520	420
1 1/2	690	560	460	380
2	580	470	390	320
2 1/2	640	510	430	350
3	590	440	370	300
3 1/2	500	400	340	280
4	470	370	310	260
5	410	330	270	220
6	370	300	250	200
8	330	260	220	180
10	300	240	200	160
12	280	220	180	150
14	270	220	180	150
16	270	220	180	150
18	270	220	180	150
20	260	210	170	140
24	250	200	170	140
in.	MPa			
1/8	11.65	9.38	7.79	6.41
1/4	11.31	9.03	7.52	6.21
3/8	9.03	7.24	6.00	4.96
1/2	8.62	6.89	5.79	4.76
3/4	6.96	5.58	4.69	3.79
1	6.55	5.24	4.34	3.59
1 1/4	5.31	4.27	3.59	2.90
1 1/2	4.76	3.86	3.17	2.62
2	4.00	3.24	2.69	2.21
2 1/2	4.41	3.52	2.96	2.41
3	4.07	3.03	2.55	2.07
3 1/2	3.45	2.76	2.34	1.93
4	3.24	2.55	2.14	1.79
5	2.83	2.28	1.86	1.52
6	2.55	2.07	1.72	1.38
8	2.28	1.79	1.52	1.24
10	2.07	1.65	1.38	1.10
12	1.93	1.52	1.24	1.03
14	1.89	1.54	1.26	1.05
16	1.89	1.54	1.26	1.05
18	1.89	1.54	1.26	1.05
20	1.82	1.47	1.19	0.98
24	1.75	1.40	1.19	0.98

**TABLE 4 Sustained Pressure Test Conditions for Water at 73°F (23°C) for PVC Plastic Pipe, Schedule 80**

Nominal Pipe Size	Pressure Required for Test <sup>A</sup>			
	PVC1120 PVC1220 PVC2120	PVC2116	PVC2112	PVC2110
in.	psi			
1/8	2570	2060	1720	1410
1/4	2370	1900	1580	1300
3/8	1930	1540	1290	1060
1/2	1780	1430	1190	980
3/4	1440	1160	960	790
1	1320	1060	880	720
1 1/4	1090	870	730	600
1 1/2	990	790	660	540
2	850	680	570	460
2 1/2	890	710	590	490
3	790	630	520	430
3 1/2	730	580	480	400
4	680	540	450	370
5	610	490	400	330
6	590	470	390	320
8	520	410	340	280
10	490	390	330	270
12	480	380	320	260
14	470	380	320	260
16	470	370	310	260
18	460	370	310	250
20	460	370	300	250
24	450	360	300	250
in.	MPa			
1/8	17.72	14.21	11.86	9.72
1/4	16.34	13.10	10.90	8.96
3/8	13.31	10.62	8.89	7.31
1/2	12.27	9.86	8.20	6.76
3/4	9.93	8.00	6.62	5.45
1	9.10	7.31	6.07	4.96
1 1/4	7.52	6.00	5.03	4.14
1 1/2	6.83	4.96	4.55	3.72
2	5.86	4.69	3.93	3.17
2 1/2	6.14	4.90	4.07	3.38
3	5.45	4.34	3.59	2.96
3 1/2	5.03	4.00	3.31	2.76
4	4.69	3.72	3.10	2.55
5	4.21	3.38	2.76	2.28
6	4.07	3.24	2.69	2.21
8	3.59	2.83	2.34	1.93
10	3.38	2.69	2.28	1.86
12	3.31	2.62	2.21	1.79
14	3.29	2.66	2.24	1.82
16	3.29	2.59	2.17	1.82
18	3.22	2.59	2.17	1.75
20	3.22	2.59	2.10	1.75
24	3.15	2.52	2.10	1.75

<sup>A</sup> The fiber stresses used to derive these test pressures are as follows:

	psi	MPa
PVC1120	4200	29.0
PVC1220	4200	29.0
PVC2120	4200	29.0
PVC2116	3360	23.2
PVC2112	2800	19.3
PVC2110	2300	15.9

<sup>A</sup> The fiber stresses used to derive these test pressures are as follows:

	psi	MPa
PVC1120	4200	29.0
PVC1220	4200	29.0
PVC2120	4200	29.0
PVC2116	3360	23.2
PVC2112	2800	19.3
PVC2110	2300	15.9

**6.3 Burst Pressure**—The minimum burst pressures for PVC plastic pipe shall be as given in **Table 6**, when determined in accordance with Test Method **D1599**.

NOTE 7—Times greater than 60 s may be needed to bring large size

specimens to burst pressure. The test is more difficult to pass using greater pressurizing times.

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

**TABLE 5 Sustained Pressure Test Conditions for Water at 73°F (23°C) for PVC Plastic Pipe, Schedule 120**

Nominal Pipe Size	Pressure Required for Test <sup>A</sup>			
	PVC1120 PVC1220 PVC2120	PVC2116	PVC2112	PVC2110
in.				
1/2	2130	1710	1420	1170
3/4	1620	1300	1080	890
1	1510	1200	1000	830
1 1/4	1250	1000	830	680
1 1/2	1130	900	750	620
2	990	790	660	540
2 1/2	980	780	650	540
3	930	750	620	510
3 1/2	810	640	540	440
4	900	720	600	490
5	830	660	550	450
6	780	620	520	430
8	760	610	510	420
10	770	620	510	420
12	710	570	480	390
in.				
1/2	14.69	11.79	9.79	8.07
3/4	11.17	8.96	7.45	6.14
1	10.41	8.27	6.89	5.72
1 1/4	8.62	6.89	5.72	4.69
1 1/2	7.79	6.21	5.17	4.27
2	6.83	5.45	4.55	3.72
2 1/2	6.76	5.38	4.48	3.72
3	6.41	5.17	4.27	3.52
3 1/2	5.58	4.41	3.72	3.03
4	6.21	4.96	4.14	3.38
5	5.72	4.55	3.79	3.10
6	5.38	4.27	3.59	2.96
8	5.24	4.21	3.52	2.90
10	5.31	4.27	3.52	2.90
12	4.90	3.93	3.31	2.69

<sup>A</sup> The fiber stresses used to derive these test pressures are as follows:

	psi	MPa
PVC1120	4200	29.0
PVC1220	4200	29.0
PVC2120	4200	29.0
PVC2116	3360	23.2
PVC2112	2800	19.3
PVC2110	2300	15.9

6.5 *Extrusion Quality*—The pipe shall not flake or disintegrate when tested in accordance with Test Method **D2152**.

## 7. Workmanship, Finish, and Appearance

7.1 The pipe 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.

NOTE 8—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  $73.4 \pm 3.6^\circ\text{F}$  ( $23 \pm 2^\circ\text{C}$ ) and  $50 \pm 10\%$  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 tests in the standard laboratory atmosphere of  $73.4 \pm 3.6^\circ\text{F}$  ( $23 \pm 2^\circ\text{C}$ ) and  $50 \pm 10\%$  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 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 **Tables 3-5**, 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 (1 m) 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  $\pm 10$  psi ( $\pm 70$  kPa). Condition the specimens at the test temperature of  $73.4^\circ\text{F}$  ( $23^\circ\text{C}$ ) to within  $3.6^\circ\text{F}$  ( $\pm 2^\circ\text{C}$ ). Test in accordance with Test Method **D1598**, except maintain the pressure at the values

**TABLE 6 Burst Pressure Requirements for Water at 73°F (23°C) for PVC Plastic Pipe, Schedules 40, 80, and 120**

Nominal Pipe Size	Min Burst Pressures <sup>A</sup>						
	Schedule 40		Schedule 80		Schedule 120		
	PVC1120 PVC1220 PVC2120	PVC2112 PVC2116 PVC2110	PVC1120 PVC1220 PVC2120	PVC2112 PVC2116 PVC2110	PVC1120 PVC1220 PVC2120	PVC2112 PVC2116 PVC2110	
in.	psi						
1/8	2580	2020	3920	3060	...	...	
1/4	2490	1950	3620	2830	...	...	
3/8	1990	1560	2940	2300	...	...	
1/2	1910	1490	2720	2120	3250	2540	
3/4	1540	1210	2200	1720	2470	1930	
1	1440	1130	2020	1580	2300	1790	
1 1/4	1180	920	1660	1300	1900	1490	
1 1/2	1060	830	1510	1180	1720	1340	
2	890	690	1290	1010	1510	1180	
2 1/2	970	760	1360	1060	1490	1170	
3	840	660	1200	940	1420	1110	
3 1/2	770	600	1110	860	1230	960	
4	710	560	1040	810	1380	1080	
5	620	390	930	720	1260	990	
6	560	440	890	700	1190	930	
8	500	390	790	620	1160	910	
10	450	350	750	580	1170	920	
12	420	330	730	570	1090	850	
14	410	320	720	570	...	...	
16	410	320	710	560	...	...	
18	410	320	700	550	...	...	
20	390	310	700	540	...	...	
24	380	300	680	530	...	...	
in.	MPa						
1/8	17.79	13.93	27.03	21.10	...	...	
1/4	17.17	13.45	24.96	19.52	...	...	
3/8	13.72	10.76	20.27	15.86	...	...	
1/2	13.17	10.27	18.76	14.62	22.41	17.52	
3/4	10.62	8.34	15.17	11.86	17.03	13.31	
1	9.93	7.79	13.93	10.89	15.86	12.34	
1 1/4	8.14	6.34	11.45	8.96	13.10	10.27	
1 1/2	7.31	5.72	10.41	8.14	11.86	9.24	
2	6.14	4.76	8.89	6.96	10.41	8.14	
2 1/2	6.69	5.24	9.38	7.31	10.27	8.07	
3	5.79	4.55	8.27	6.48	9.79	7.65	
3 1/2	5.31	4.14	7.65	5.93	8.48	6.62	
4	4.90	3.86	7.17	5.58	9.51	7.45	
5	4.27	2.69	6.41	4.96	8.69	6.83	
6	3.86	3.03	6.14	4.83	8.20	6.41	
8	3.45	2.69	5.45	4.27	8.00	6.27	
10	3.10	2.41	5.17	4.00	8.07	6.34	
12	2.90	2.28	5.03	3.93	7.52	5.86	
14	2.87	2.24	5.04	3.99	...	...	
16	2.87	2.24	4.97	3.92	...	...	
18	2.87	2.24	4.90	3.85	...	...	
20	2.73	2.17	4.90	3.78	...	...	
24	2.66	2.10	4.76	3.71	...	...	

<sup>A</sup> The fiber stresses used to derive these test pressures are as follows:

	psi	MPa
PVC1120	6400	44.1
PVC1220	6400	44.1
PVC2120	6400	44.1
PVC2116	5000	34.5
PVC2112	5000	34.5
PVC2110	5000	34.5

given in **Tables 3-5** 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 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 samples shall be tested. Test three specimens at a single pressure that will result in failures at or below 0.10 h. Test an additional three

specimens at a single pressure that will result in failures at about 200 h. Generating additional data points to improve the LTHS or LCL, or both, is acceptable. No points shall be excluded unless an obvious defect is detected in the failure area of the test sample, or there was a malfunction of the equipment. Characterize the data using the least squares regression described in Test Method **D2837**.

**8.5 Burst Pressure**—Determine the minimum burst pressure with at least five specimens in accordance with Test Method **D1599**. The time of testing of each specimen shall be between 60 and 70 s.

**8.6 Flattening**—Flatten three specimens of the pipe each at least 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 2 to 5 min. On removal of the load examine the specimens for evidence of splitting, cracking, or breaking.

## 9. Retest and Rejection

9.1 If the results of any test(s) do not meet the requirements of this specification, the test(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.

## 10. Product Marking

**10.1 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.

**10.2 Content of Marking:**

10.2.1 Marking on the pipe shall include the following, spaced at intervals of not more than 5 ft (1.5 m):

10.2.1.1 Nominal pipe size (for example, 2 in. (50 mm)),

10.2.1.2 Type of plastic pipe material in accordance with the designation code prescribed in **3.2.4**, for example, PVC1120,

10.2.1.3 Schedule (40, 80, or 120, whichever is applicable) and the pressure rating in pounds per square inch (megapascals) for water at 73°F (23°C) shown as the number followed by psi (for example, 200 psi (1.4 MPa)). When the indicated pressure rating is lower than that calculated in accordance with **3.2.3** (see **Appendix X1**), this shall be indicated by placing a star after the pressure rating,

10.2.1.4 ASTM designation D1785, with which the pipe complies,

10.2.1.5 Manufacturer's name (or trademark),

10.2.1.6 Production code with which the manufacturer can trace the year, month, day, shift, plant and extruder of manufacture for this product, and

10.2.1.7 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.

**NOTE 9**—Manufacturers using the seal or mark of a laboratory must obtain prior authorization from the laboratory concerned.

**NOTE 10**—It is common practice to dual mark Schedule 40 piping for potable water and DWV usage in which compliance with each applicable standard is met.

## 11. Quality Assurance

11.1 When the product is marked with this designation, D1785, 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.

## 12. Keywords

12.1 pressure pipe; PVC pipe; Schedule 40 pipe; Schedule 80 pipe; Schedule 120 pipe

## SUPPLEMENTARY REQUIREMENTS

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.

**S1. Potable Water Requirement**—Products intended for contact with potable water shall be evaluated, tested, and certified for conformance with NSF/ANSI Standard No. 61 or the health effects portion of NSF/ANSI Standard No. 14 by an

acceptable certifying organization when required by the regulatory authority having jurisdiction.

This requirement applies only to pipe to be used in systems that have not established other provisions for identification.

**S2. Pipe Marking Requirement for Reclaimed Water Systems**—Color identification of pipe shall be by (1) use of purple (violet) PVC material or (2) by use of continuous purple

stripes printed lengthwise on opposite sides of the pipe. The pipe shall be marked RECLAIMED WATER at intervals of 5 ft. or less.

## GOVERNMENT/MILITARY PROCUREMENT

These requirements apply *only* to federal/military procurement, not domestic sales or transfers.

S1. *Pipe for Reclaimed-Water System*—Pipe used in these systems shall be purple (violet) in color and it shall be marked **Reclaimed Water**.

S2. *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 S2.1—In U.S. Federal contracts, the contractor is responsible for inspection.

S3. *Packaging and Marking for U.S. Government Procurement*:

S3.1 *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.

S3.2 *Marking*—Marking for shipment shall be in accordance with Fed. Std. No. 123 for civil agencies and MIL-STD-129 for military agencies.

NOTE S3.1—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 specification.

## APPENDIX

### (Nonmandatory Information)

#### X1. SOURCE OF HYDROSTATIC DESIGN STRESSES

X1.1 The hydrostatic design stresses recommended by the Plastics Pipe Institute are used to pressure rate PVC plastic pipe. These hydrostatic design stresses are 2000 psi (14 MPa), 1600 psi (11 MPa), 1250 psi (9 MPa), and 1000 psi (7 MPa) for water at 73°F (23°C). These hydrostatic design stresses apply only to pipe meeting all the requirements of this specification.

X1.2 Six PVC pipe materials are included based on the requirements of Specification **D1784** and the PPI-recommended hydrostatic design stresses as follows:

X1.2.1 Type I, Grade 1 (12454-B), with a hydrostatic design stress of 2000 psi (14 MPa), designated as PVC1120.

X1.2.2 Type I, Grade 2 (12454-C), with a hydrostatic design stress of 2000 psi (14 MPa), designated as PVC1220.

X1.2.3 Type II, Grade 1 (14333-D), with a hydrostatic design stress of 2000 psi (14 MPa), designated as PVC2120.

X1.2.4 Type II, Grade 1 (14333-D), with a hydrostatic design stress of 1600 psi (11.2 MPa), designated as PVC2116.

X1.2.5 Type II, Grade 1 (14333-D), with a hydrostatic design stress of 1250 psi (8.7 MPa), designated as PVC2112.

X1.2.6 Type II, Grade 1 (14333-D), with a hydrostatic design stress of 1000 psi (7.0 MPa), designated as PVC2110.

X1.3 The standard method for obtaining hydrostatic basis for thermoplastic pipe materials is Test Method **D2837**. Addi-

tional information regarding the test method and other criteria used in developing these hydrostatic design stresses may be obtained from the Plastics Pipe Institute, a division of The Society of the Plastics Industry, 355 Lexington Ave., New York, NY 10017. These hydrostatic design stresses may not be suitable for materials that show a wide departure from a straight-line plot of log stress versus log time to failure. All the data available to date on PVC pipe materials made in the United States exhibit a straight-line plot under these plotting conditions.

X1.4 The pipe is rated for use with water at 73°F (23°C) at the maximum internal pressures shown in **Tables X1.1-X1.3**. Lower pressure ratings than those calculated in accordance with **3.2.3** may be recommended, at the option of the pipe manufacturer, in which case the SDR shall be included in the marking. Experience of the industry indicates that PVC plastic pipe meeting the requirements of this specification gives satisfactory service under normal conditions for a long period at these pressure ratings. The sustained pressure requirements are related to these ratings through the slopes of the strength-time plots of these materials in pipe form.

X1.5 The hydrostatic design stresses recommended by the Plastics Pipe Institute are based on tests made on pipe ranging in size from ½ to 2½ in. (12.5 to 63.5 mm).



**TABLE X1.1 Water Pressure Ratings at 73°F (23°C) for Schedule 40 PVC Plastic Pipe**

Nominal Pipe Size	Pressure Ratings <sup>A</sup>			
	PVC1120 <sup>B</sup> PVC1220 PVC2120	PVC2116	PVC2112 <sup>B</sup>	PVC2110 <sup>B</sup>
in.				
			psi	
1/8	810	650	500	400
1/4	780	620	490	390
3/8	620	500	390	310
1/2	600	480	370	300
3/4	480	390	300	240
1	450	360	280	220
1 1/4	370	290	230	180
1 1/2	330	260	210	170
2	280	220	170	140
2 1/2	300	240	190	150
3	260	210	160	130
3 1/2	240	190	150	120
4	220	180	140	110
5	190	160	120	100
6	180	140	110	90
8	160	120	100	80
10	140	110	90	70
12	130	110	80	70
14	130	100	80	60
16	130	100	80	60
18	130	100	80	60
20	120	100	80	60
24	120	90	70	60
in.			MPa	
1/8	5.58	4.48	3.45	2.76
1/4	5.38	4.27	3.38	2.69
3/8	4.27	3.45	2.69	2.14
1/2	4.14	3.31	2.55	2.07
3/4	3.31	2.69	2.07	1.65
1	3.10	2.48	1.93	1.52
1 1/4	2.55	2.04	1.59	1.24
1 1/2	2.28	1.79	1.45	1.17
2	1.93	1.52	1.17	0.97
2 1/2	2.07	1.65	1.31	1.03
3	1.79	1.45	1.10	0.90
3 1/2	1.65	1.31	1.03	0.83
4	1.52	1.24	0.97	0.76
5	1.31	1.10	0.83	0.69
6	1.24	0.97	0.76	0.62
8	1.10	0.83	0.69	0.55
10	0.97	0.76	0.62	0.48
12	0.90	0.76	0.55	0.48
14	0.91	0.70	0.56	0.42
16	0.91	0.70	0.56	0.42
18	0.91	0.70	0.56	0.42
20	0.84	0.70	0.56	0.42
24	0.84	0.63	0.49	0.42

<sup>A</sup> These pressure ratings apply only to unthreaded pipe. The industry does not recommend threading PVC plastic pipe in Schedule 40 dimensions in nominal pipe sizes 6 in. (150 mm) and smaller.

<sup>B</sup> See [Appendix X1](#) for code designation.

**TABLE X1.2 Water Pressure Ratings at 73°F (23°C) for Schedule 80 PVC Plastic Pipe**

Nominal Pipe Size, in.	psi							
	PVC1120, PVC1220, PVC2120		PVC2116		PVC2112		PVC2110	
	Unthreaded	Threaded	Unthreaded	Threaded	Unthreaded	Threaded	Unthreaded	Threaded
1/8	1230	610	980	490	770	380	610	310
1/4	1130	570	900	450	710	350	570	280
3/8	920	460	730	370	570	290	460	230
1/2	850	420	680	340	530	260	420	210
3/4	690	340	550	280	430	210	340	170
1	630	320	500	250	390	200	320	160
1 1/4	520	260	420	210	320	160	260	130
1 1/2	470	240	380	190	290	150	240	120
2	400	200	320	160	250	130	200	100
2 1/2	420	210	340	170	260	130	210	110
3	370	190	300	150	230	120	190	90
3 1/2	350	170	280	140	220	110	170	90
4	320	160	260	130	200	100	160	80
5	290	140	230	120	180	90	140	70
6	280	140	220	110	170	90	140	70
8	250	120	200	100	150	80	120	60
10	230	120	190	90	150	70	120	60
12	230	110	180	90	140	70	110	60
14	220	...	180	...	140	...	110	...
16	220	...	180	...	140	...	110	...
18	220	...	180	...	140	...	110	...
20	220	...	170	...	140	...	110	...
24	210	...	170	...	130	...	110	...
MPa								
1/8	8.48	4.21	6.76	3.38	5.31	2.62	4.21	2.14
1/4	7.79	3.93	6.21	3.10	4.90	2.41	3.93	1.93
3/8	6.34	3.17	5.03	2.55	3.93	2.00	3.17	1.59
1/2	5.86	2.90	4.69	2.34	3.65	1.79	2.90	1.45
3/4	4.76	2.34	3.79	1.93	2.96	1.45	2.34	1.17
1	4.34	2.21	3.45	1.72	2.69	1.38	2.21	1.10
1 1/4	3.59	1.79	2.90	1.45	2.21	1.10	1.79	0.90
1 1/2	3.24	1.65	2.62	1.31	2.0	1.03	1.65	0.83
2	2.76	1.38	2.21	1.10	1.72	0.90	1.38	0.69
2 1/2	2.90	1.45	2.34	1.17	1.79	0.90	1.45	0.76
3	2.55	1.31	2.07	1.03	1.59	0.83	1.31	0.62
3 1/2	2.41	1.17	1.93	0.97	1.52	0.76	1.17	0.62
4	2.21	1.10	1.79	0.90	1.38	0.69	1.10	0.55
5	2.00	0.97	1.59	0.83	1.24	0.62	0.97	0.48
6	1.93	0.97	1.52	0.76	1.17	0.62	0.97	0.48
8	1.72	0.83	1.38	0.69	1.03	0.55	0.83	0.41
10	1.59	0.83	1.31	0.62	1.03	0.48	0.83	0.41
12	1.59	0.76	1.24	0.62	0.97	0.48	0.76	0.41
14	1.54	...	1.26	...	0.98	...	0.77	...
16	1.54	...	1.26	...	0.98	...	0.77	...
18	1.54	...	1.26	...	0.98	...	0.77	...
20	1.54	...	1.19	...	0.98	...	0.77	...
24	1.47	...	1.19	...	0.91	...	0.77	...

**TABLE X1.3 Water Pressure Ratings at 73°F (23°C) for Schedule 120 PVC Plastic Pipe**

Nominal Pipe Size, in.	psi							
	PVC1120, PVC1220, PVC2120		PVC2116		PVC2112		PVC2110	
	Unthreaded	Threaded	Unthreaded	Threaded	Unthreaded	Threaded	Unthreaded	Threaded
1/2	1010	510	810	410	630	320	510	250
3/4	770	390	620	310	480	240	390	190
1	720	360	570	290	450	220	360	180
1 1/4	600	300	480	240	370	190	300	150
1 1/2	540	270	430	210	340	170	270	130
2	470	240	380	190	290	150	240	120
2 1/2	470	230	370	190	290	150	230	120
3	440	220	360	180	280	140	220	110
3 1/2	380	190	310	150	240	120	190	100
4	430	220	340	170	270	130	220	110
5	400	200	320	160	250	120	200	100
6	370	190	300	150	230	120	190	90
8	380	180	290	140	230	110	180	90
10	370	180	290	140	230	110	180	90
12	340	170	270	140	210	110	170	80

  

Nominal Pipe Size, in.	MPa							
	PVC1120, PVC1220, PVC2120		PVC2116		PVC2112		PVC2110	
	Unthreaded	Threaded	Unthreaded	Threaded	Unthreaded	Threaded	Unthreaded	Threaded
1/2	6.96	3.52	5.58	2.83	4.34	2.21	3.52	1.72
3/4	5.31	2.69	4.27	2.14	3.31	1.65	2.69	1.31
1	4.96	2.48	3.93	2.00	3.10	1.52	2.48	1.24
1 1/4	4.14	2.07	3.31	1.65	2.55	1.31	2.07	1.03
1 1/2	3.72	1.86	2.96	1.45	2.34	1.17	1.86	0.90
2	3.24	1.65	2.62	1.31	2.00	1.03	1.65	0.83
2 1/2	3.24	1.59	2.55	1.31	2.00	1.03	1.59	0.83
3	3.03	1.52	2.48	1.24	1.93	0.97	1.52	0.76
3 1/2	2.62	1.31	2.14	1.03	1.65	0.83	1.31	0.69
4	2.96	1.52	2.34	1.17	1.86	0.90	1.52	0.76
5	2.76	1.38	2.21	1.10	1.72	0.83	1.38	0.69
6	2.55	1.31	2.07	1.03	1.59	0.83	1.31	0.62
8	2.62	1.24	2.00	0.97	1.59	0.76	1.24	0.62
10	2.55	1.24	2.00	0.97	1.59	0.76	1.24	0.62
12	2.34	1.17	1.86	0.97	1.45	0.76	1.17	0.55

### SUMMARY OF CHANGES

Committee F17 has identified the location of selected changes to this standard since the last issue (F1785–12) that may impact the use of this standard.

(1) Revised **Note 2** to include reference to UL Standard 1738.  
 Added UL 1738 to Section **2**, Referenced Documents.

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