



Standard Specification for Oriented Poly(Vinyl Chloride), PVC0, Pressure Pipe¹

This standard is issued under the fixed designation F1483; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope*

1.1 This specification covers requirements for materials, dimensions, sustained pressure, accelerated regression testing, burst pressure, flattening, impact resistance, workmanship, solvent cement joint testing, and methods of marking for oriented poly(vinyl chloride) (PVC0) pipe for pressure applications.

1.2 The PVC0 pipe shall be joined using either elastomeric seals (gaskets) or solvent cement with primer. The gasketed joint shall meet the requirements of Specification D3139 and the elastomeric seal shall meet the requirements of Specification F477. The solvent cemented joint shall meet the requirements of 5.3.3.

1.3 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.

1.4 The following safety hazards caveat pertains only to the test method portion, Section 7 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

D618 Practice for Conditioning Plastics for Testing

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.

- D883 Terminology Relating to Plastics
- 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 Classification System and Basis for 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
- D2241 Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
- D2444 Practice for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
- D2564 Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
- D2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
- D2855 Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets
- D3139 Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- F412 Terminology Relating to Plastic Piping Systems
- F477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F656 Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
- 2.2 *Federal Standard*:³
 - Fed. Std. No. 123 Marking for Shipment (Civil Agencies)
- 2.3 *Military Standard*:³
 - MIL-STD-129 Marking for Shipment and Storage

³ Available from DLA Document Services Building 4/D 700 Robbins Avenue Philadelphia, PA 19111-5094 <http://quicksearch.dla.mil/>

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

2.4 Other Standards:

NSF Standard No. 14 for Plastic Piping Components and Related Materials⁴

ANSI/NSF Standard No. 61 for Drinking Water System Components—Health Effects⁴

2.5 PPI Publications:⁵

PPI-TR 2 PPI PVC Range Composition Listing of Qualified Ingredients

PPI-TR 3 Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe

3. Terminology

3.1 *General*—Definitions are in accordance with Terminologies D883 and F412 and abbreviations are in accordance with Terminology D1600, unless otherwise indicated. The abbreviation for poly(vinyl chloride) plastics is PVC.

3.2 Definitions:

3.2.1 *PVCO pipe, n*—abbreviation for oriented poly(vinyl chloride) plastics. PVCO pipe is PVC pressure pipe which attains a relatively high strength by reorienting the molecules. Conventionally extruded PVC pipe is expanded circumferentially (for example, 2-in. diameter is expanded to 4-in. diameter) through the application of pressure and temperature. The expansion reorients the PVC molecular structure in the hoop direction, thereby increasing the material strength.

3.2.2 *IPS, adj*—Iron Pipe Size, a set of standard outside diameters.

3.2.3 *CIOD, adj*—Cast Iron Outside Diameter—a set of standard outside diameters.

3.3 Definitions of Terms Specific to This Standard:

3.3.1 *expansion ratio (ER), n*—the ratio of the finished PVCO pipe outside diameter to the outside diameter of the original starting stock.

3.3.2 *standard thermoplastic pipe material designation code, n*—the molecularly oriented poly(vinyl chloride) materials designation code shall consist of the abbreviation PVCO for the type of plastics, followed by the ASTM type and grade in arabic numerals and the hydrostatic design stress in units of 100 psi (0.69 MPa) with any decimal figures dropped. The ASTM type and grade shall be that of the starting stock material. The hydrostatic design stress shall be that of the finished PVCO pipe.

3.3.2.1 *Discussion*—A complete material designation code shall consist of four letters and four figures (for example; a PVCO pipe manufactured from 12454 (Type 1, Grade 1) material starting stock and having an HDB of 7100 psi (48.92 MPa) [HDS of 3550 psi] (24.46 MPa)] will have a material designation code of PVCO 1135) as per Specification D2241.

3.3.3 *starting stock, n*—the conventionally extruded PVC pipe of uniform wall thickness which will be expanded to a larger diameter, molecularly oriented pipe.

3.3.4 *wall-thickness-ratio (WTR), n*—the ratio of the finished product wall thickness to the wall thickness of the starting stock.

4. Materials

4.1 *General*—Poly(vinyl chloride) plastics used to make PVCO 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.

4.1.1 *Supplementary Requirement*—This applies whenever a regulatory authority or user calls for the product to be used to convey or to be in contact with potable water. Potable water applications products intended for contact with potable water shall be evaluated, tested, and certified for conformance with ANSI/NSF Standard 61 or the health effects portion of NSF Standard No. 14 by an acceptable certifying organization when required by the regulatory authority having jurisdiction.

4.2 The PVC compound used for the starting stock of this pipe shall equal or exceed the following cell classification described in Specification D1784: PVC 12454 (Type 1, Grade 1).

4.3 Long Term Hydrostatic Strength—this specification covers PVCO pipe, made from PVC plastic pipe starting stock:

4.3.1 The PVC compound used to make the pipe starting stock shall have a minimum Hydrostatic Design Basis of 4000 psi (27.58 MPa) at 73 °F (23 °C), determined in accordance with Test Method D2837.

4.3.2 Finished PVCO pipe shall have a minimum Hydrostatic Design Basis of 7100 psi (48.92 MPa) at 73 °F (23 °C), determined by testing in accordance with Test Method D1598, with data evaluated in accordance with Test Method D2837, as provided in 5.3.2.

4.4 *Rework Materials*—Clean, rework material, generated from the manufacturer's own starting stock pipe production, shall be permitted to be used by the same manufacturer, as long as the pipe produced meets all the requirements of this specification. Recycled materials shall not be used in the compound

4.5 *Solvent Cement*—the solvent cement shall meet the requirements of Specification D2564 and be marked for use with PVCO pipe.

4.6 *Primer*—The primer shall meet the requirements of Specification F656 and be marked for use with PVCO pipe.

5. Requirements

5.1 *General*—These requirements are for finished PVCO pipe, unless otherwise noted.

5.2 Dimensions and Tolerances:

5.2.1 *Outside Diameters*—The outside diameters and tolerances shall be shown in Table 1 and Table 2 when measured in accordance with Test Method D2122. The tolerances for out-of-roundness shall apply only on pipe prior to shipment.

5.2.2 *Wall Thicknesses*—The wall thicknesses and tolerances shall be as shown in Table 3 and Table 4 when measured in accordance with Test Method D2122.

⁴ Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48105, <http://www.nsf.org>.

⁵ Available from Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, <http://www.plasticpipe.org>.

TABLE 1 IPS PVC Pipe—Outside Diameters and Tolerances

Nominal Pipe Size	Average Outside Diameter, in. (mm)	Tolerance, ±in. (mm)
4	4.500 (114.30)	0.009 (0.23)
6	6.625 (168.28)	0.011 (0.28)
8	8.625 (219.08)	0.015 (0.38)
10	10.750 (273.05)	0.016 (0.41)
12	12.750 (323.85)	0.017 (0.43)
14	14.000 (355.60)	0.018 (0.46)
16	16.000 (406.40)	0.019 (0.48)

TABLE 2 CIOD PVC Pipe—Outside Diameters and Tolerances

Nominal Pipe Size	Average Outside Diameter, in. (mm)	Tolerance, ±in. (mm)
4	4.800 (121.92)	0.009 (0.23)
6	6.900 (175.26)	0.010 (0.25)
8	9.050 (229.87)	0.015 (0.38)
10	11.100 (281.94)	0.016 (0.41)
12	13.200 (335.28)	0.017 (0.43)
14	15.300 (388.62)	0.018 (0.46)
16	17.400 (441.96)	0.019 (0.48)

5.2.3 *Solvent Cement Bell Dimensions*—The bell dimensions and tolerances shall be as shown in [Table 5](#) and [Table 6](#) when measured in accordance with Test Method [D2122](#).

5.3 *Qualification Tests*—These tests are for qualification of the compound and extrusion process, not for quality control.

5.3.1 *Sustained Pressure*—The sustained pressure test shall be completed for each diameter at initial start-up. Thereafter, it shall be completed whenever there is a change in the ER ([3.3.1](#)), or the WTR ([3.3.4](#)), or whenever a change is made to the compound which is outside the allowable limits of the Plastics Pipe Institute PVC Range Composition (see PPI TR-2). The pipe shall not fail, balloon, burst, or weep as defined in Test Method [D1598](#) at the test pressures given in [Table 7](#) when tested in accordance with [6.4](#).

5.3.2 *Regression Test*—This test shall be completed on a representative diameter at initial start-up. A representative diameter is one which has an ER, a WTR, and a compound which is the same as the other diameters manufactured. Thereafter, it shall be completed on a representative diameter whenever there is a change in the ER or the WTR, or whenever a change is made to the compound which is outside the allowable limits of the Plastics Pipe Institute PVC compound range formula (see PPI TR-3). The test shall be conducted in accordance with [6.5](#).

5.3.2.1 The pipe shall demonstrate a minimum hydrostatic design basis projection, at the 100 000-h intercept, of 6810 psi (46.92 MPa) (for Hydrostatic Design Basis Categories, see Table 1 of Test Method [D2837](#)).

5.3.3 *Long-Term Hydrostatic Strength Test for Solvent Cemented Joints*—Solvent cemented joints of pipe shall be assembled in accordance with Specification [D2855](#) instructions for joining of PVC pipe and fittings, and tested for long-term hydrostatic strength for each diameter at initial start-up. Thereafter, it shall be completed whenever there is a change in the ER ([3.3.1](#)), or the WTR ([3.3.4](#)), or whenever a change is made to the compound which is outside the allowable limits of the Plastics Pipe Institute PVC compound range formula (see PPI TR-3). The joint shall not fail, balloon, burst, weep, leak or

pull apart while subjected to a sustained pressure of 2 times the pressure rating of the pipe for continuous service for 1000 hours at $73\text{ °F} \pm 4\text{ °F}$ ($23\text{ °C} \pm 2\text{ °C}$).

5.4 *Quality Control Tests*—These tests are intended to ensure the quality of the finished pipe product.

5.4.1 *Burst Pressure*—The minimum burst pressure for PVC pipe shall be as given in [Table 8](#), when determined in accordance with [6.6](#).

5.4.2 *Flattening*—There shall be no evidence of splitting, cracking, or breaking when the pipe is tested in accordance with [6.7](#).

5.4.3 *Extrusion Quality*—The starting stock pipe shall not flake, crack, or disintegrate when tested in accordance with Test Method [D2152](#).

5.4.4 *Impact Resistance*—The minimum impact resistance for PVC pipe shall be as given in [Table 9](#), when determined in accordance with [6.8](#).

NOTE 1—The impact resistance test is intended for use only as a quality-control test, not as a simulated service test. This test has been found to have no quality-control significance in sizes over 12 in. (300 mm).

5.4.5 *Workmanship, Finish, and Appearance*—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 2—Color and transparency or opacity should be specified in the contract or purchase order.

6. Test Methods

6.1 *Conditioning*—Condition the test specimen at $73\text{ °F} \pm 4\text{ °F}$ ($23\text{ °C} \pm 2\text{ °C}$) and $50\% \pm 5\%$ 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.

6.2 *Test Conditions*—Conduct the tests in the standard laboratory atmosphere of $73\text{ °F} \pm 4\text{ °F}$ ($23\text{ °C} \pm 2\text{ °C}$) and $50\% \pm 5\%$ relative humidity, unless otherwise specified in the test methods or in this specification.

6.3 *Sampling*—The selection of the sample or samples of pipe shall be as agreed upon between the purchaser and the seller. In case of no prior agreement, the sample selection of the manufacturer shall be deemed adequate.

6.3.1 *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.

6.4 *Sustained Pressure Test*—Select the test specimens at random. Test individually with water at the internal pressure given in [Table 7](#), six specimens of pipe, each specimen shall be 3 ft long (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 $\pm 10\text{ psi}$ ($\pm 70\text{ kPa}$). Condition the specimens at the test temperature of $73\text{ °F} \pm 4\text{ °F}$ ($23\text{ °C} \pm 2\text{ °C}$).

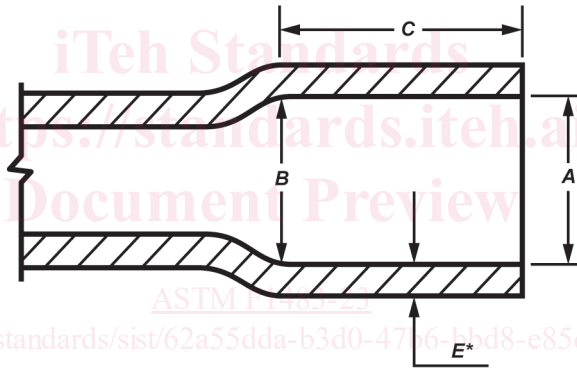
TABLE 3 Minimum Wall Thickness for PVC-O Plastic Pipes with IPS Outside Diameter

Nominal Pipe Size	Wall Thickness, in. (mm)		
	PVC-O 1135		
	Pressure Rated, 160 psi, min	Pressure Rated, 200 psi, min	Pressure Rated, 250 psi, min
4	0.099 (2.52)	0.123 (3.12)	0.153 (3.89)
6	0.146 (3.71)	0.182 (4.62)	0.225 (5.72)
8	0.190 (4.83)	0.236 (5.99)	0.293 (7.44)
10	0.237 (6.02)	0.295 (7.49)	0.366 (9.30)
12	0.281 (7.14)	0.349 (8.86)	0.434 (11.02)
14	0.309 (7.85)	0.384 (9.75)	0.476 (12.09)
16	0.353 (8.97)	0.438 (11.13)	0.544 (13.82)

TABLE 4 Minimum Wall Thickness for PVC-O Plastic Pipes with Cast Iron Outside Diameter (CIOD)

Nominal Pipe Size	Wall Thickness, in. (mm)		
	PVC-O 1135		
	Pressure Rated, 150 psi, min	Pressure Rated, 200 psi, min	Pressure Rated, 250 psi, min
4	0.099 (2.51)	0.132 (3.35)	0.163 (4.14)
6	0.143 (3.63)	0.189 (4.80)	0.235 (5.97)
8	0.187 (4.75)	0.248 (6.30)	0.308 (7.82)
10	0.229 (5.82)	0.304 (7.72)	0.378 (9.60)
12	0.273 (6.93)	0.362 (9.19)	0.449 (11.40)
14	0.317 (8.05)	0.419 (10.64)	0.520 (13.21)
16	0.360 (9.14)	0.477 (12.12)	0.592 (15.04)

TABLE 5 IPS PVC-O Pipe—Solvent Weld Bell Dimensions^A



Nominal Pipe Size	A Socket Entrance Diameter		B Socket Bottom Diameter		C Socket Length Min.
	Diameter	Tolerance ±	Diameter	Tolerance ±	Tolerance + 0.25 in.
	4	4.527 (114.99)	0.006 (0.15)	4.473 (113.61)	0.006 (0.15)
6	6.658 (169.11)	0.008 (0.20)	6.592 (167.44)	0.008 (0.20)	6.00 (152.40)
8	8.670 (220.22)	0.010 (0.25)	8.580 (217.93)	0.010 (0.25)	6.00 (152.40)
10	10.798 (274.27)	0.011 (0.28)	10.702 (271.83)	0.011 (0.28)	7.50 (190.50)
12	12.801 (325.15)	0.012 (0.30)	12.699 (322.55)	0.012 (0.30)	8.50 (215.90)
14	14.054 (356.97)	0.013 (0.33)	13.946 (354.23)	0.013 (0.33)	9.00 (228.60)
16	16.057 (407.85)	0.014 (0.36)	15.943 (404.95)	0.014 (0.36)	10.00 (245.00)

^AThe minimum wall thickness of the bell, E, shall be not less than 90% of the minimum wall thickness of the pipe specified in Table 5.

6.4.1 Maintain the test temperature at 73 °F ± 4 °F (23 °C ± 2 °C). Test in accordance with Test Methods D2837, except maintain the pressure at the values given in Table 7 for 1000 h. Failure of two of 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.

6.5 Regression Test—Test in accordance with procedures in Test Method D1598, except that restrained end fittings shall be permitted to be employed. **Warning**—Since rupture of the test specimen is expected in quick-burst and high-strength regression testing, well-shielded test equipment and protective personal equipment should be used when conducting the tests.

NOTE 3—Since the test time is changing for a 100 h to 10 000 h, an implementation period to meet the new requirement is needed.