Designation: F1483 – 15

Standard Specification for Oriented Poly(Vinyl Chloride), PVCO, Pressure Pipe[1]

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 reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

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

1.2 The PVCO pipe shall be joined using elastomeric seals (gaskets). The joint shall meet the requirements of Specification D3139 and the elastomeric seal shall meet the requirements of Specification F477. The PVCO shall not be joined by solvent cementing.

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 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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D618 Practice for Conditioning Plastics for Testing

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 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

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 for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products

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

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

2.4 *Other Standards:*

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

ANSI/NSF Standard No. 61 for Drinking Water System Components—Health Effects[4]

PPI-TR 3 Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe[5]

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.

[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 DLA Document Services Building 4/D 700 Robbins Avenue Philadelphia, PA 19111-5094 http://quicksearch.dla.mil/

[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.

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

3.2 *Definitions:*

3.2.1 *PVCO pipe*—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.

3.3 *Definitions of Terms Specific to This Standard:*

3.3.1 *expansion ratio (ER)*—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*—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).

3.3.3 *starting stock*—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)*—the ratio of the finished product wall thickness to the wall thickness of the starting stock.

4. Classification

4.1 *General*—This specification covers PVCO made from PVC plastic pipe, starting stock, having a hydrostatic design stress of 2000 psi (13.78 MPa) determined in accordance with Test Method D2837. Finished PVCO pipe shall have a hydrostatic design stress of 3550 psi (24.46 MPa) determined by testing in accordance with Test Methods D1598, with data evaluated in accordance with Test Methods D2837, as in 6.3.2.

5. Materials

5.1 *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.

5.1.1 *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.

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

5.3 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). Recycled materials shall not be used in the compound.

5.4 *Rework Materials*—Clean, rework material, generated from the manufacturer's own 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.

6. Requirements

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

6.2 *Dimensions and Tolerances:*

6.2.1 *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.

6.2.2 *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.

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

6.3.1 *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 compound range formula (see PPI TR-3). The pipe shall not fail, balloon, burst, or weep as defined in Test Method D1598 at the test pressures given in Table 5 when tested in accordance with 7.4.

6.3.2 *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 7.5.

6.3.2.1 The pipe shall demonstrate a minimum hydrostatic design basis projection, at the 100 000-h intercept, of 6810 psi

TABLE 1 IPS PVCO Pipe—Outside Diameters and Tolerances

Nominal Pipe Size, in.	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 PVCO Pipe—Outside Diameters and Tolerances

Nominal Pipe Size, in.	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)

(46.92 MPa) (for Hydrostatic Design Basis Categories, see Table 1 of Test Method D2837).

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

6.4.1 *Burst Pressure*—The minimum burst pressure for PVCO pipe shall be as given in Table 6, when determined in accordance with 7.6.

6.4.2 *Flattening*—There shall be no evidence of splitting, cracking, or breaking when the pipe is tested in accordance with 7.7.

6.4.3 *Extrusion Quality*—The starting stock pipe shall not flake, crack, or disintegrate when tested in accordance with Test Method D2152.

6.4.4 *Impact Resistance*—The minimum impact resistance for PVCO shall be as given in Table 7, when determined in accordance with 7.8.

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).

6.4.5 *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.

7. Test Methods

7.1 *Conditioning*—Condition the test specimen 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.

7.2 *Test Conditions*—Conduct the tests in the standard laboratory atmosphere of 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5 % relative humidity, unless otherwise specified in the test methods or in this specification.

7.3 *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.

7.3.1 *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.

7.4 *Sustained Pressure Test*—Select the test specimens at random. Test individually with water at the internal pressure given in Table 5, 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 ±10 psi (±70 kPa). Condition the specimens at the test temperature of 73.4 ± 3.6°F (23 ± 2°C).

7.4.1 Maintain the test temperature at 73.4 ± 3.6°F (23 ± 2°C). Test in accordance with Test Methods D2837, except maintain the pressure at the values given in Table 5 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 Methods D1598.

7.5 *Regression Test*—Test in accordance with procedures in Test Methods 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.

7.6 *Burst Pressure*—Determine the minimum burst pressure with at least five specimens in accordance with Test Method D1599, having the lengths specified in 7.4. The time of testing of each specimen shall be not less than 60 s.

NOTE 4—Times greater than 60 s may be needed to bring the larger-sized specimens to the burst pressure. The test is more difficult to pass using greater pressuring times.

7.7 *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. The rate of loading shall be uniform and such that the compression is completed within 2 to 5 min. Upon removal of the load, examine the specimens for evidence of splitting, cracking, or breaking.

7.8 *Impact Resistance*—Determine the impact resistance in accordance with the specification requirement section of Test Method D2444. Test at 73.4 ± 3.6°F (23± 2°C) using a Tup B and flat plate support. Use a 20-lb (9-kg) tup.

7.8.1 *Test Specimens*—Specimens of pipe for impact testing shall be cut to lengths required in Test Method D2444.

7.8.2 *Test Requirements*—For pipe sizes 4 through 12 in. (100 through 300 mm), test ten specimens. If nine or more pass, the lot passes. If two or more fail, the lot fails.

8. Retest and Rejection

8.1 If the results of any test(s) do not meet the requirements of this specification, the test(s) may be conducted again in accordance with an agreement between the purchaser and the seller. There shall be no agreement to lower the minimum requirements of the specification by such means as omitting tests that are a part of the specification, substituting or

TABLE 3 Minimum Wall Thickness for PVCO Plastic Pipes with IPS Outside Diameter

Nominal Pipe Size, in.	Wall Thickness, in. (mm)		
	PVCO 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 PVCO Plastic Pipes with Cast Iron Outside Diameter (CIOD)

Nominal Pipe Size, in.	Wall Thickness, in. (mm)		
	PVCO 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 Sustained Pressure Test Conditions for Water at 73°F (23°C) for PVCO Plastic Pipes with IPS and CIOD Outside Diameters

Pressure Rating	Test Pressures[A]	
	psi	MPa
150	320	(2.21)
160	335	(2.31)
200	420	(2.89)
250	525	(3.48)

[A]The fiber stress used to derive these test pressures is as follows:
PVCO 1135 7400 psi (50.99 MPa)

TABLE 6 Burst Pressure Requirements for Water at 73°F (23°C) for PVCO Plastic Pipe with IPS and CIOD Outside Diameters

Pressure Rating	Test Pressures[A]	
	psi	MPa
150	475	(3.27)
160	505	(3.48)
200	630	(4.35)
250	790	(5.44)

[A]The fiber stress used to derive these test pressures is as follows:
PVCO 1135 11 100 psi (76.48 MPa)

TABLE 7 Impact Resistance at 73°F (23°C) for PVCO Pipe

Size, in.	Impact Resistance, ft·lbf (J)—All Series
4	100 (136)
6	150 (203)
8	200 (271)
10	200 (271)
12	200 (271)

modifying a test method, or by changing the specification limits. In retesting, the product requirement of this specification shall be met and the test method designated in the specification shall be followed. If, upon retest, failure occurs, the quantity of product represented by the test(s) does not meet the requirement of this specification.

9. Product Marking

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

9.1.1 Nominal pipe size.

9.1.2 The outside diameter system (IPS or CIOD).

9.1.3 The letters PVCO.

9.1.4 The type of plastic pipe material in accordance with the designation code given in 3.3.4 (for example, PVCO 1135).

9.1.5 Maximum operating pressure rating, psi.

9.1.6 ASTM designation F1483 with which the pipe complies.

9.1.7 Manufacturer's name (or trademark) and code. The manufacturer's code shall include year, month, day, shift, plant, and extruder of manufacture.

9.1.8 Pipe intended for the transport of potable water shall also include the standard to which it was evaluated and the mark of the laboratory making the evaluation for that purpose. Manufacturers using the seal or mark of a laboratory must obtain prior authorization from the laboratory concerned.

9.1.9 Mark on the pipe "DO NOT SOLVENT CEMENT".

10. Quality Assurance

10.1 When the product is marked with ASTM designation F1483, 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.

11. Keywords

11.1 PVCO oriented polyvinyl chloride; pipe pressure

SUPPLEMENTARY REQUIREMENTS

GOVERNMENT/MILITARY PROCUREMENT

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

S1. *Responsibility for Inspection* —S1.1 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 disapproved by the purchaser. 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 Government 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 material shall be packaged in accordance with the supplier's standard practice in a manner ensuring arrival at destination in a satisfactory condition and which will be acceptable to the carrier at lowest rates. Containers and packaging shall comply with Uniform Freight Classification rules of National Motors 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. Federal Government procurement requirements should not be construed as an indication that the U.S. Government uses or endorses the products described in this specification.

SUMMARY OF CHANGES

Committee F17 has identified the location of selected changes to this standard since the last issue (F1483–12) that may impact the use of this standard.

(1) 6.3.2, 6.3.2.1, 7.5—Replaced "accelerated regression" with "a regression test per D2837".

(2) 7.5—Removed reference to lower HDB.

(3) Added Note 3 concerning implementation time.