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An American National Standard

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

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## 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 D 3139 and the elastomeric seal shall meet the requirements of Specification F 477. 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 in parentheses are given for information only.

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:*

D 618 Methods of Conditioning Plastics & Electrical Insulating Materials for Testing[2]

D 883 Terminology Relating to Plastics[2]

D 1598 Test Methods for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure[3]

D 1599 Test Method for Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings[3]

D 1600 Terminology of Abbreviated Terms Relating to Plastics[2]

D 1784 Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds[3]

D 2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings[3]

D 2152 Test Method for Degree of Fusion of Extruded Poly(Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion[3]

D 2444 Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)[3]

D 2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials[3]

D 3139 Specification for Joints for Plastic Pressure Pipe Using Flexible Elastomeric Seals[3]

F 412 Terminology Relating to Plastic Piping Systems[3]

F 477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe[3]

2.2 *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 *Definitions:*

3.1.1 *General*—Definitions are in accordance with Terminologies D 883 and F 412 and abbreviations are in accordance with Terminology D 1600, unless otherwise indicated. The abbreviation for poly(vinyl chloride) plastics is PVC.

3.1.2 *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.

3.2 *Definitions of Terms Specific to This Standard:* D

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

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

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[2] *Annual Book of ASTM Standards*, Vol 08.01.

[3] *Annual Book of ASTM Standards*, Vol 08.04.

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

[5] Available from Plastics Pipe Institute, 1275 K St. N.W., Suite 400, Washington, DC 20005.

3.2.2 *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.

3.2.3 DISCUSSION—A complete material designation code shall consist of four letters and four figures (for example; a PVCO pipe manufactured from 12454B (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).

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

3.2.5 *wall-thickness-ratio (WTR)*—the ratio of the starting stock wall thickness to the wall thickness of the finished PVCO pipe.

## 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 D 2837. Finished PVCO pipe shall have a hydrostatic design stress of 3550 psi (24.46 MPa) or 3150 psi (21.70 MPa) determined by testing in accordance with Test Methods D 1598, with data evaluated in accordance with Test Methods D 2837, 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 D 1784.

5.3 The PVC compound used for the starting stock of this pipe shall equal or exceed one of the following cell classifications described in Specification D 1784: PVC 12454-B (Type 1, Grade 1), 12454-C (Type 1, Grade 2). 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 D 2122. 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 D 2122.

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 (3.2.1), or the WTR (3.2.5), 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 D 1598 at the test pressures given in Table 5 when tested in accordance with 7.4.

6.3.2 *Accelerated 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 (46.92 MPa) or 6040 psi (41.62 MPa) (see Table 1 for Hydrostatic Design Basis Categories of Test Method D 2837). At the option of the manufacturer, the accelerated regression test may be used as a substitute for both pressure tests, sustained and burst (6.4.1).

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.

**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) |