



Standard Specification for Poly (Vinyl Chloride)(PVC) Closed Profile Gravity Pipe and Fittings Based on Controlled Inside Diameter ¹

This standard is issued under the fixed designation F 1803; 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 poly(vinyl chloride) (PVC) closed profile sewer pipe and fittings with integral bell and elastomeric seal joints or plain end pipe with couplings in sizes (18 to 60 in.) based on a controlled inside diameter.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 The following safety hazard 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.*

NOTE 1—Pipe and fittings produced to this specification should be installed in accordance with Practice D 2321.

2. Referenced Documents

2.1 ASTM Standards:²

- D 618 Practice for Conditioning Plastics for Testing
- D 1600 Terminology for Abbreviated Terms Relating to Plastics
- D 1784 Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
- D 2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
- D 2152 Test Method for Adequacy of Fusion of Extruded Poly(Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion
- D 2321 Practice for Underground Installation of Flexible Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

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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.

- D 2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
- D 2444 Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
- D 2855 Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
- D 3212 Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- F 402 Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
- F 412 Terminology Relating to Plastic Piping Systems
- F 477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F 679 Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer 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. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology F 412, and abbreviations are in accordance with Terminology D 1600, unless otherwise specified. The abbreviation for poly(vinyl chloride) is PVC.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *closed profile (CP) gravity sewer pipe, n*—a pipe product consisting of an essentially smooth waterway braced circumferentially or spirally with projections or ribs that are joined by an essentially smooth outer wall (see Fig. 1).

4. Significance and Use

4.1 The requirements of this specification are intended to provide pipe and fittings suitable for nonpressure drainage of sewage and surface water.

NOTE 2—Industrial waste disposal lines should be installed only with the specific approval of the governing code authority since chemicals not commonly found in drains and sewers and temperatures in excess of 140°F may be encountered.

³ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098.

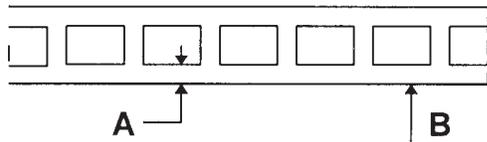


FIG. 1 Typical Closed Profile (CP) (A) Waterway minimum wall (B) Average inside diameter

5. Material

5.1 *Basic Materials*—The pipe and fittings shall be made of PVC plastic having a minimum cell classification of 12454C or 12364C as defined in Specification D 1784. Homopolymer PVC compounds must meet or exceed the requirements of the above listed minimum cell classification number.

5.2 *Rework Material*—Clean rework material generated from the manufacturer’s own pipe or fittings production may be used by the same manufacturer provided pipe or fittings produced meet all the requirements of this specification.

5.3 *Gaskets*—Elastomeric gaskets shall comply with the requirements described in Specification F 477.

5.4 *Lubricant*—The lubricant used for assembly shall be suitable for use with PVC pipe and elastomeric seals for this application and have no detrimental effect on the gasket or on the pipe.

6. Joining Systems

6.1 *Gasketed Joint*—The integral bell gasketed joint, coupling, or fitting joints shall be designed so that when assembled, the gasket (which is attached to either the bell or the spigot) will be compressed radially on the pipe spigot or in the bell to form a water-tight seal. The joints shall be designed to comply with and show no sign of leakage when tested in accordance with 7.7 when assembled with pipe for which they are intended.

6.2 *Couplings* shall form a water-tight seal when assembled with plain end pipe and show no sign of leakage when tested in accordance with 7.7 when assembled with pipe for which they are intended.

NOTE 3—The outside diameters of products manufactured to this specification are not specified and therefore joint compatibility should be reviewed.

6.3 The joint shall be designed to avoid displacement of the gasket when assembled in accordance with the manufacturer’s recommendation.

6.4 The assembly of joints shall be in accordance with the manufacturer’s recommendations.

7. Requirements

7.1 *Workmanship*—The pipe and fittings shall be essentially uniform in color, opacity, density, and other properties. The inside and outside surfaces shall be semimatte or glossy in appearance and free of chalking, sticky, or tacky material. The surfaces shall be free of excess bloom; that is, slight bloom is acceptable. The pipe walls shall be free of cracks, holes, blisters, voids, foreign inclusions, or other defects that are visible to the naked eye and that may affect the wall integrity. Bloom or chalking may develop in pipe exposed to direct rays of the sun (ultraviolet radiant energy) for extended periods and consequently these requirements do not apply to pipe after extended exposure to direct rays of the sun.

7.2 *Pipe Fitting Dimensions:*

7.2.1 *Diameter*—The inside diameter of the pipe shall meet the requirements given in Table 1 when measured in accordance with 8.4.1.

7.2.2 *Wall Thickness*—The minimum wall thickness of the waterway of pipe and fittings fabricated from pipe sections shall meet the requirements given in Table 1 when measured in accordance with 8.4.2. The wall thickness of fittings fabricated from pipes meeting the requirements of Specification F 679 are also satisfactory.

7.2.3 *Bell Wall Thickness*—In the case of belled pipe and fittings fabricated from pipe sections, the thickness of the wall in the bell shall be considered satisfactory if it was formed from pipe meeting the previous requirements. For reducing fittings or those with smaller inlets, the minimum wall thickness for each inlet shall be no less than the minimum wall thickness for that size pipe.

7.2.4 *Fittings:*

7.2.4.1 *Molded Fittings*—Molded fittings conforming to the requirements of Specification F 679 may also be used with profile gravity sewer pipe provided an adapter (when required) is used to make the connection. The minimum wall thickness of the molded fittings and adapter shall coincide with the

TABLE 1 Pipe Dimensions and Stiffness

Nominal Pipe Size, in.	Minimum Inside Diameter, ^A in. (mm)	Tolerance on Inside Diameter, in. (mm)	Minimum Pipe Stiffness Series 46, lbf/in. ² (kPa)	Waterway Minimum Wall Series 46, in. (mm)
18	17.595 (446.91)	+0.110 (+2.79)	46 (320)	0.070 (1.78)
21	20.690 (525.53)	+0.120 (+3.05)	46 (320)	0.080 (2.03)
24	23.430 (595.12)	+0.140 (+3.56)	46 (320)	0.100 (3.54)
27	26.420 (671.01)	+0.160 (+4.06)	46 (320)	0.115 (2.92)
30	29.410 (747.01)	+0.180 (+4.57)	46 (320)	0.125 (3.18)
33	32.405 (823.09)	+0.190 (+4.83)	46 (320)	0.140 (3.56)
36	35.395 (899.03)	+0.210 (+5.33)	46 (320)	0.150 (3.81)
39	38.385 (974.98)	+0.230 (+5.84)	46 (320)	0.165 (4.19)
42	41.375 (1050.93)	+0.250 (+6.35)	46 (320)	0.180 (4.57)
45	44.370 (1127.00)	+0.260 (+6.60)	46 (320)	0.195 (4.95)
48	47.360 (1202.94)	+0.280 (+7.11)	46 (320)	0.210 (5.33)
54	53.350 (1355.09)	+0.300 (+7.62)	46 (320)	0.225 (5.72)
60	59.340 (1507.24)	+0.320 (+8.128)	46 (320)	0.240 (6.10)

^A In-plant quality control manufacturing. Base inside diameter calculations should include out-of-roundness as a result of shipping and handling.

values listed in Table 1 of Specification F 679. The thickness in the wall of the adapter bell shall be considered satisfactory if formed from pipe meeting the previous requirements.

7.2.4.2 *Fabricated Fittings*—Fabricated fittings shall be made from the pipe meeting the requirements of this specification, or Specification F 679. Fabricated fittings with solvent cement components shall be made in accordance with Practice D 2855 and taking cognizance of Practice F 402. Unreinforced solvent cement mitred joints shall not be used. Fabricated joints shall be adequately lapped or fusion butt welded and, when needed, additionally reinforced.

NOTE 4—A fabricated fittings standard is currently being developed by ASTM Subcommittee F17.10.

7.3 *Pipe Flattening*—There shall be no evidence of splitting, cracking, breaking, or separation of ribs or seams when pipe is tested in accordance with 8.5.

7.4 *Pipe Impact Strength*—The impact strength shall not be less than the values shown in Table 2 when tested in accordance with 8.6.

NOTE 5—This requirement is intended only for use as a quality control test, not a simulated service test.

7.5 *Pipe Stiffness*—Pipe stiffness values for the pipe shall comply with Table 1 when tested in accordance with 8.7.

7.6 *Gaskets*—Gaskets shall meet the low head application requirements of Specification F 477 and be molded into a circular form or extruded to the proper section and then spliced into circular form.

7.7 *Joint Tightness*—All joints shall show no signs of leakage when tested in accordance with Specification D 3212 and Fig. 2. All surfaces of the joint upon which the gasket may bear shall be smooth and free of imperfections, ridges, fractures, or cracks that could adversely affect sealability.

7.8 *Acetone Immersion*—The pipe shall meet the requirements as defined in Test Method D 2152 when tested in accordance with 8.8.

NOTE 6—This is intended only for use as a quality control test and not for use as a simulated service test.

7.9 *Air Test*—When pipe is made in such a manner that a seam or exposed channel is present, each length shall pass a 3.5-psi air test in accordance with 8.9.

7.10 *Exposed Channels*—Cut exposed channels of closed profile pipe shall be sealed with a material to provide an adequate seal to prevent infiltration and exfiltration and be resistant to sewer and drainage environments.

8. Test Methods

8.1 *Conditioning:*

8.1.1 *Referee Testing*—When conditioning is required for referee tests, condition the specimens in accordance with Procedure A of Practice D 618 at 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5 % relative humidity for not less than 40 h prior to test.

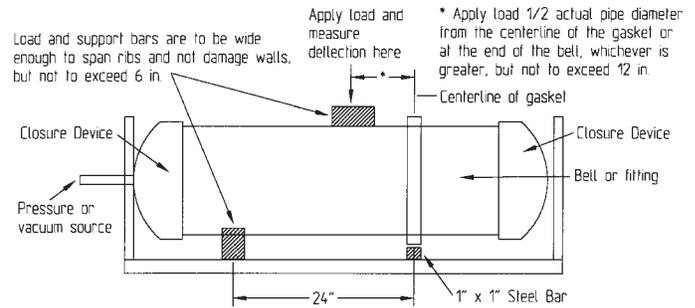


FIG. 2 Shear Deflection Test

Conduct tests under the same conditions of temperature and humidity, unless otherwise specified.

8.1.2 *Quality Control Testing*—Condition specimens for a minimum of 4 h in air or 1 h in water at 73.4 ± 3°F (23 ± 2°C). Test the specimens at 73.4 ± 3°F without regard to relative humidity.

8.2 *Test Conditions*—Conduct 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. In cases of disagreement, the tolerances shall be ± 1.8°F (± 1°C) and ± 2 % relative humidity.

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

8.4 *Dimensions:*

8.4.1 *Inside Diameter*—Determine the average inside diameter using an internal micrometer or telescoping gage accurate to ± 0.001 in. (± 0.02 mm). Take sufficient readings, a minimum of four, to ensure that the maximum and minimum have been determined. Calculate the average diameter as the arithmetic mean of the diameters measured. As an alternative method, an inside-diameter-type circumferential tape may be used if proper care is taken to align it at right angles to the pipe axis. A tapered plug gage as described in Test Method D 2122 may also be used.

8.4.2 *Wall Thickness*—Measure the wall thickness of the thinnest cross section of the waterway in the gaps between ribs in accordance with Test Method D 2122. Make sufficient readings, a minimum of eight, to ensure that the minimum thickness is determined. (See Table 1).

8.5 *Flattening*—Flatten three specimens of pipe between parallel plates in a suitable press until (the pipe inside diameter is reduced by 60 % of its original dimension) the distance between the plates expressed as a % of the inside diameter is reduced by the greater of 40 % or of the value as determined by $[3.43 (OD)/(OD - ID)]$. The rate of loading shall be uniform and such that the compression is completed within 2 to 5 min. The specimen shall pass if no splitting, cracking, breaking, or separation of seams is observed under normal light with the unaided eye. The specimen shall be considered as failing this test if the load does not increase continuously (or smoothly) with increasing deflection to the point of maximum load. The maximum load point shall not be less than 30 % deflection.

8.5.1 Test specimens shall be 12 in. (305 mm) long.

TABLE 2 Minimum Impact Strength, 73°F (23°C)

Nominal Size, in.	Impact Strength, ft-lbf(J)
18 to 60	220(299)

8.6 *Impact Resistance*—Determine the impact resistance of the pipe in accordance with conditions and apparatus in Test Method D 2444. Impact tests shall be conducted at two different locations. The two locations are (1) directly on the pipe midway between ribs, and (2) directly on the seam. (Where a seam cannot be struck directly, this orientation is omitted.) Failure of the test specimen shall be any crack, split, or shattering of the waterway. Separation of seams constitutes a failure.

8.6.1 Test six specimens, three at each orientation, each 12 in. (305 mm) long, using either 20-lb (9-kg) Tup B, or 30-lb (15-kg) Tup B and flat plate Holder B. All six specimens shall pass. If one fails, test another six specimens. Eleven passes out of twelve tested shall be acceptable.

8.7 *Pipe Stiffness*—Determine the pipe stiffness at 5 % deflection datum in accordance with Test Method D 2412. The pipe stiffness of each specimen tested shall equal or exceed the minimum value listed in Table 1.

8.7.1 Three specimens are to be run per test. The length of the specimens are specified in Table 3. Circumferentially ribbed test specimens must be selected so that they are representative of the entire pipe.

NOTE 7—A representative stiffness specimen contains the proper ratio of ribs and flat area lengths to exhibit the entire pipe length. When properly selected, specimens cut consecutively from a pipe length and untrimmed will provide stiffness results that are approximately equal.

NOTE 8—The 5 % deflection criterion that was arbitrarily selected for testing convenience should not be considered as a limitation with respect to in-use deflection. The engineer is responsible for establishing the acceptable deflection limit.

8.8 *Acetone Immersion*—Conduct this test in accordance with Test Method D 2152. The procedure is used for determining the degree of fusion of extruded PVC plastic pipe as indicated by reaction to immersion in anhydrous acetone. It is applicable only for distinguishing between unfused and properly fused PVC.

8.9 *Air Test*—Test each full length of pipe for air tightness at 3.5 psig (24.1 kPa) for the minimum dwell period specified in Table 4.

8.9.1 Seal pipe ends with a suitable restrained closure. If exposed channel seals exist, the restrained closures should be positioned such that the air test checks the seals. Pressurize the pipe with air at 3.5 psig (24.1kPa) and cut off the air source. (Pipe may be pressurized above 3.5 psig and then the pressure reduced to this level before commencing the dwell period.) Commence timing the dwell period specified in Table 4. If the pressure falls below 3.375 psig (23.3 kPa) within the designated test period, reject the pipe. If not, accept the pipe.

9. Retest and Rejection

9.1 If the results of any test(s) do not meet the requirements of the specification, the test shall be conducted again only by

TABLE 3 Specimen Size for Pipe Stiffness

Pipe Configuration	Pipe Diameter, in.
	18 to 60
Circumferential	12, min
Helical	12 or one full wrap, whichever is larger

TABLE 4 Dwell Period for Air Test

Nominal Pipe Diameter in.	Min Dwell Period, min:s
18	2:10
21	2:25
24	2:50
27	3:10
30	3:30
33	3:55
36	4:15
39	4:35
42	4:55
45	5:20
48	5:40
54	6:00
60	6:20

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 specification.

10. Marking

10.1 *Pipe Marking*—Each standard and random length of pipe in compliance with this specification shall be clearly marked by the producer in accordance with the following example at the interval of (5 ft) 1.5 m or less:

10.1.1 Manufacturer’s name, trade name, or trademark, and code.

10.1.2 Nominal pipe size in inches.

10.1.3 The PVC minimum cell classification as listed in Table 1, Specification D 1784.

10.1.4 The legend “PS 46 PVC Sewer Pipe.”

10.1.5 This designation, ASTM F 1803.

10.2 *Fittings Marking*—The fittings in compliance with this specification shall be clearly marked in accordance with the following example:

10.2.1 Manufacturer’s name or trademark and code.

10.2.2 Nominal size in inches.

10.2.3 The material designation “PVC.”

10.2.4 The designation, ASTM F 1803.

NOTE 9—Manufacturer’s code to include day, month, year, shift, plant, and extruder of manufacturer.

10.3 The markings shall be applied to the pipe in such a manner that they remain legible after installation and inspection has been completed.

11. Inspection

11.1 *Notification*—If inspection is specified by the purchaser, the manufacturer shall notify the purchaser in advance of the date, time, and place of testing of the pipe in order that the purchaser may be represented at the test.

11.2 *Access*—The inspector shall have free access to those parts of the manufacturer’s plant that are involved in work performed under this specification. The manufacturer shall afford the inspector all reasonable facilities for determining whether the pipe meets the requirements of this specification.

12. Certification

12.1 When agreed upon in writing by the purchaser and the seller, a certification shall be made on the basis of acceptance of the material. This shall consist of a copy of the manufacturer's test report or a statement by the seller, accompanied by a copy of the test results, that the material has been sampled, tested, and inspected in accordance with the provisions of this specification. Each certification, so furnished, shall be signed by an authorized agent of the seller or manufacturer.

13. Quality Assurance

13.1 When the product is marked with this ASTM designation (F 1803), it 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.

14. Delivery

14.1 All pipe and couplings and fittings shall, unless otherwise specified, be packaged for standard commercial shipment.

15. Keywords

15.1 closed profile wall; PVC; sewer pipe

SUPPLEMENTARY REQUIREMENTS GOVERNMENT/MILITARY PROCUREMENT

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

S1. 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 all 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 forward in this specification where such inspections are deemed necessary to ensure that material conforms to prescribed requirements.

NOTE —In U.S. federal contracts, the contractor is responsible for inspections.

S2. Packaging and Marking for U.S. Government Procurement:

S2.1 **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 the lowest rates. Containers and packaging shall comply with Uniform Freight Classification rules or National Motor 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 —The inclusion of U.S. Government procurement requirements should not be construed as an indication that the U.S. Government uses or endorses the product described in this specification.

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