Designation: F794 – 03 (Reapproved 2014)

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

This standard is issued under the fixed designation F794; 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.

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

1. Scope

1.1 This specification covers requirements for poly(vinyl chloride) (PVC) profile sewer pipe and fittings with integral bell and elastomeric seal joints or plain end pipe with couplings in sizes (4 to 48 in.) based on a controlled inside diameter.

1.2 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.

1.3 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 D2321.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D618 Practice for Conditioning Plastics for Testing

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

D2321 Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

D2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading

D2444 Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)

D2855 Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings

D3034 Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

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

F402 Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

F412 Terminology Relating to Plastic Piping Systems

F477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

F679 Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings

2.2 *American Water Works Association (AWWA) Standard:*

AWWA Manual M45 Fiberglass Pipe Design[3]

2.3 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)[4]

2.4 *Military Standard:*

MIL-STD-129 Marking for Shipment and Storage[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) is (PVC).

3.2 *Definitions of Terms Specific to This Standard:*

[1] This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.62 on Sewer.

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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 American Water Works Association (AWWA), 6666 W. Quincy Ave., Denver, CO 80235, http://www.awwa.org.

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

3.2.1 *dual wall corrugated profile (DWCP)gravity sewer pipe*—a pipe product consisting of a smooth waterway braced cumferentially with an external corrugated wall (see Fig. 1)

3.2.2 *open profile (OP) gravity sewer pipe*—a pipe product consisting of an essentially smooth waterway braced circumferentially or spirally with outside projections or ribs (see Fig. 2).

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.

5. Materials

5.1 *Basic Materials*—The pipe and fittings shall be made of PVC plastic having a minimum cell classification of 12454 or 12364 as defined in Specification D1784. 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 F477.

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.

FIG. 1 Typical Dual Wall Corrugated Profile (DWCP)

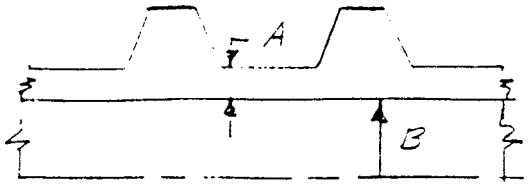

FIG. 2 Typical Open Profile (OP)

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[5]

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 and Fitting Dimensions:*

7.2.1 *Diameter*—The inside diameter of the pipe shall meet the requirements given in Table 1, Table 2, or Table 3 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 for open profile; and Table 2 or Table 3 for dual wall corrugated profile pipe when measured in accordance with 8.4.2. The wall thickness of fittings fabricated from pipes meeting the requirements of Specification D3034, SDR 35 and Specification F679 are also satisfactory. Molded fittings when made with an open profile shall conform to the minimum wall thickness requirements given in Table 1.

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 above 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 D3034, SDR 35 may also be used with profile gravity sewer pipe provided an adaptor (when required) is used to make the connection. The minimum wall

[5] Supporting data are available at ASTM Headquarters. Request RR:F17-1020.

TABLE 1 Pipe Dimensions and Stiffness (Open Profile Pipe)

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)	Minimum Pipe Stiffness Series 10, lbf/in.^{2} (kPa)	Waterway Minimum Wall Series 10, in. (mm)
4	3.939(100.0)	+0.034(0.86)	46(320)	0.030(0.76)	N/A	N/A
6	5.875(149.2)	+0.049(1.24)	46(320)	0.045(1.14)	N/A	N/A
8	7.863(199.7)	+0.053(1.35)	46(320)	0.060(1.52)	N/A	N/A
10	9.825(249.6)	+0.067(1.70)	46(320)	0.070(1.78)	N/A	N/A
12	11.687(296.8)	+0.085(2.16)	46(320)	0.085(2.16)	N/A	N/A
15	14.303(363.3)	+0.116(2.95)	46(320)	0.105(2.67)	N/A	N/A
18	17.510(444.8)	+0.195(4.95)	46(320)	0.130(3.30)	10(70)	0.070(1.78)
21	20.656(524.7)	+0.200(5.08)	46(320)	0.160(4.06)	10(70)	0.085(2.16)
24	23.412(594.7)	+0.204(5.18)	46(320)	0.180(4.58)	10(70)	0.105(2.66)
27	26.371(669.8)	+0.209(5.31)	46(320)	0.205(5.22)	10(70)	0.115(2.92)
30	29.388(746.5)	+0.220(5.59)	46(320)	0.235(5.96)	10(70)	0.130(3.30)
33	32.405(823.1)	+0.227(5.77)	46(320)	0.260(6.60)	10(70)	0.150(3.81)
36	35.370(898.4)	+0.235(5.97)	46(320)	0.290(7.36)	10(70)	0.165(4.20)
39	38.380(974.9)	+0.245(6.22)	46(320)	0.315(8.00)	10(70)	0.195(4.95)
42	41.370(1050.8)	+0.255(6.48)	46(320)	0.345(8.76)	10(70)	0.215(5.46)
45	44.365(1126.9)	+0.265(6.73)	46(320)	0.370(9.40)	10(70)	0.225(5.72)
48	47.355(1202.8)	+0.285(7.24)	46(320)	0.400(10.16)	10(70)	0.230(5.84)

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

TABLE 2 Pipe Dimensions and Stiffness (Dual Wall Corrugated) Pipe for Series 46 and Series 10

Nominal Pipe Size, in.	Minimum Inside Diameter, in. (mm)	Tolerance on Inside Diameter, in. (mm)	Minimum Pipe Stiffness Series 46, lbf/in.^{2} (kPa)	Waterway Minimum Wall Series 46, in. (mm)	Minimum Pipe Stiffness Series 10, lbf/in.^{2} (kPa)	Waterway Minimum Wall Series 10, in. (mm)
4	3.939(100.0)	+0.034(0.86)	46(320)	0.022(0.56)	N/A	N/A
6	5.875(149.2)	+0.049(1.24)	46(320)	0.025(0.64)	N/A	N/A
8	7.863(199.7)	+0.053(1.35)	46(320)	0.035(0.89)	N/A	N/A
10	9.825(249.6)	+0.067(1.70)	46(320)	0.045(1.14)	N/A	N/A
12	11.687(296.8)	+0.085(2.16)	46(320)	0.058(1.40)	N/A	N/A
15	14.303(363.3)	+0.116(2.95)	46(320)	0.077(1.96)	N/A	N/A
18	17.510(444.8)	+0.195(4.95)	46(320)	0.084(2.13)	10(70)	0.070(1.78)
21	20.656(524.7)	+0.200(5.08)	46(320)	0.095(2.41)	10(70)	0.070(1.78)
24	23.412(594.7)	+0.204(5.18)	46(320)	0.110(2.79)	10(70)	0.070(1.78)
27	26.371(669.8)	+0.209(5.31)	46(320)	0.120(3.05)	10(70)	0.070(1.78)
30	29.388(746.5)	+0.220(5.59)	46(320)	0.130(3.30)	10(70)	0.085(2.16)
33	32.405(823.1)	+0.227(5.77)	46(320)	0.150(3.81)	10(70)	0.095(2.41)
36	35.370(898.4)	+0.235(5.97)	46(320)	0.155(3.94)	10(70)	0.105(2.67)
39	38.380(974.9)	+0.245(6.22)	46(320)	0.200(5.08)	10(70)	0.120(3.05)
42	41.370(1050.8)	+0.255(6.48)	46(320)	0.200(5.08)	10(70)	0.130(3.30)
45	44.365(1126.9)	+0.265(6.73)	46(320)	0.200(5.08)	10(70)	0.145(3.68)
48	47.355(1202.8)	+0.285(7.24)	46(320)	0.200(5.08)	10(70)	0.160(4.06)

TABLE 3 Pipe Dimensions and Stiffness (Dual Wall Corrugated) Pipe for Series 115

Nominal Pipe Size, in.	Minimum Inside Diameter, in. (mm)	Tolerance on Inside Diameter, in. (mm)	Minimum Pipe Stiffness Series 115, lbf/in.^{2} (kPa)	Waterway Minimum Wall Series 115, in. (mm)
8	7.692 (195.4)	+0.053 (1.35)	115 (800)	0.037 (0.94)
10	9.623 (244.4)	+0.067 (1.70)	115 (800)	0.046 (1.30)
12	11.452 (290.9)	+0.085 (2.16)	115 (800)	0.070 (1.78)
15	13.998 (355.5)	+0.116 (2.95)	115 (800)	0.092 (2.34)

thickness of the molded fittings and adaptors shall coincide with the values listed in Table 1 of Specification D3034 for SDR 35. The thickness in the wall of the adaptor bell shall be considered satisfactory if formed from pipe meeting the above requirements. When a molded fitting is used to join different types of plastic pipes, the bell and the body or branch area extending from the bell shall also conform to the minimum wall thickness and profile of the pipe being installed into the bell.

7.2.4.2 *Fabricated Fittings*—Fabricated fittings shall be made from pipe meeting the requirements of this specification, Specification D3034, SDR 35, or Specification F679. Fabricated fittings with solvent cement components shall be made in accordance with Practice D2855 and taking cognizance of Practice F402. 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 F 17.10.

7.3 *Pipe Flattening*—There shall be no evidence of splitting, cracking, breaking, or separation of ribs, seams, or corrugations, 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 4 when tested in accordance with 8.6.

NOTE 5—This requirement is intended only for use as a quality control

TABLE 4 Minimum Impact Strength, 73°F (23°C)

Nominal Size, in.	Impact Strength, ft·lbf (J)
4	100 (136)
6	140 (190)
8	210 (284)
10 to 48	220 (299)

test, not as a simulated service test. Aged impact data are currently under study by an ASTM Committee F-17 task group.

7.5 *Pipe Stiffness*—Pipe stiffness values shall comply with Table 1, Table 2, or Table 3 for the respective pipe series when tested in accordance with 8.7.

7.6 *Gaskets*—Gaskets shall meet the low head application requirements of Specification F477 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 D3212 and Fig. 3. Some grades of pipe may not have the capability in the pipe wall of withstanding the 22 in. Hg vacuum test. In such cases, the joint may be considered as meeting these criteria if a pipe and joint system, incorporating a geometrically identical joint and heavier walled pipe, meets the criteria satisfactorily. 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 D2152 when tested in accordance with 8.8.

7.8.1 *Bond*—The bond between the inner and outer walls (at the corrugation valley) shall not separate when tested in accordance with 8.8.1.

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 is present, each length shall pass a 3.5-psi air test in accordance with 8.9.

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 D618 at 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5 % relative humidity for not less than 40 h prior to 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

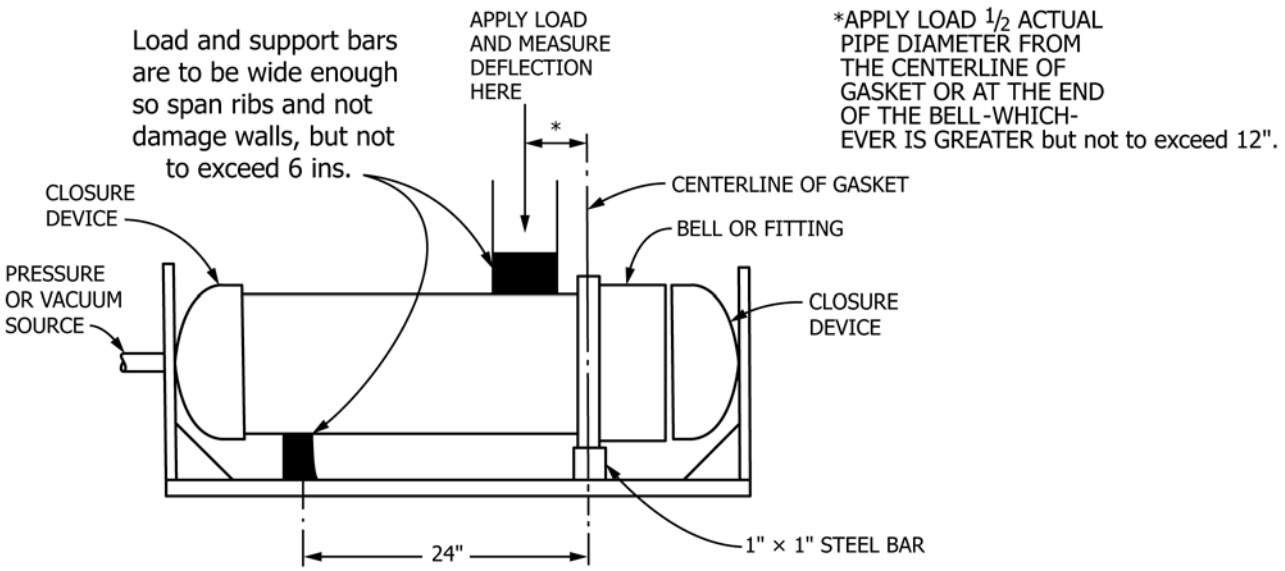

FIG. 3 Shear Deflection Test

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 D2122 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; and between the valleys under the corrugations in accordance with Test Method D2122. Make sufficient readings, a minimum of eight, to ensure that the minimum thickness has been determined. (See Tables 1-3.)

8.5 *Flattening*—Flatten three specimens of pipe between parallel plates until the distance between the plates, expressed as a % of the inside pipe diameter is reduced by the greater of 40 % or of the value as determined by [2.09 (OD)/(OD-ID)] for pipes with 10 psi minimum pipe stiffness, of the value as determined by [3.43 (OD)/(OD-ID)] for pipes with a 46 psi minimum pipe stiffness or of the value as determined by [4.62 (OD)/(OD-ID)] for pipes with a 115 psi minimum pipe stiffness. Prior to running the test, the pipe OD must be determined by measuring in accordance with Test Method D2122, using a circumferential wrap tape accurate to ± 0.001 in. (± 0.02 mm).

NOTE 7—The amount of flattening required in 8.5 develops bending strains at least as great as those developed when flattening DR 35 pipe by 60 % (see Appendix X1).

8.5.1 The rate of loading shall be uniform and such that the compression is completed within 2 to 5 min. The specimens shall pass if no splitting, cracking, breaking, or separation of ribs, seams or corrugations is observed under normal light with the unaided eye. Small tears initiated at the cut end of the rib shall not constitute failure. 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 at less than 30 % deflection.

8.5.2 Test specimens shall be 6 in. (152 mm) long when testing 4 in. through 15 in., and 12 in. (305 mm) long when testing 18 in. or larger.

8.6 *Impact Resistance*—Determine the impact resistance of the pipe in accordance with conditions and apparatus in Test Method D2444. Impact tests shall be conducted at three different locations where possible. The three locations are (*1*) directly on the rib or corrugation so that one of the ribs or corrugations receives the impact essentially centered on the tup face; (*2*) directly on the pipe midway between ribs or corrugations (when physical spacing of the ribs or corrugations does not alloy a direct hit, this orientation is omitted); and (*3*) 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 ribs or corrugations from the waterway or seams constitutes a failure.

NOTE 8—Small tears observable after tests may be up to approximately 10 % of the nominal diameter in length.

NOTE 9—Test a total of six specimens, with two specimens at each orientation. Where one or more orientations are omitted, the six specimens are divided equally between the remaining test orientations.

NOTE 10—If a rib is chipped by an indirect hit, the specimen may be replaced in the test.

8.6.1 In sizes 4 in. through 48 in., test six specimens, using a 20-lb (9-kg) Tup B or a 30-lb. (15-kg) Tup B and flat plate Holder B. Specimens shall be a minimum of 6 in. long, such that the specimens are cut midway between the ribs or corrugations and contain an odd number of ribs or corrugations. 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 D2412. The pipe stiffness of each specimen tested shall equal or exceed the minimum value listed in Table 1, Table 2, or Table 3.

8.7.1 Three specimens are to be run per test. The length of the specimens are specified in Table 5. Circumferentially ribbed test specimens must be selected so that they are representative of the entire pipe. Select a specimen length 6 in. or greater, depending on pipe size (see Table 5), such that the specimens both begin and terminate midway between ribs. Dual wall corrugated pipe specimens shall be cut in the valley, between corrugations.

NOTE 11—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 12—The 5 % deflection criterion, which 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 D2152. This 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.

8.8.1 *Bond for DWC Pipe*—Test the bond between the inner and outer wall with a probe or knife point. It shall not be possible to cleanly separate the two walls at the corrugation valley. Test samples at eight equally spaced joints around its circumference.

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 5.

8.9.1 Seal pipe ends with a suitable restrained closure. Pressurize the pipe with air to 3.5 psig (24.1 kPa) 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 6. If the pressure falls below 3.375 psig (23.3 kPa) within the designated test period, reject the pipe. If not, accept the pipe.

TABLE 5 Specimen Size for Pipe Stiffness

Pipe Configuration	Pipe Diameter, in.	
	4 to 15	18 to 48
Circumferential	6 min	12 min
Helical	6 or one full wrap, whichever is larger	12 or one full wrap, whichever is larger

TABLE 6 Dwell Period for Air Test

Nominal Pipe Diameter, in.	Min Dwell Period, min:s
4	2:00
6	2:00
8	2:00
10	2:00
12	2:00
15	2:00
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

9. Retest and Rejection

9.1 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 requirement of the specification by such means as omitting tests that are a part of the specification, substituting or modifying a test method, or by changing the specification limits. In retesting, the product requirements of this specification shall be met, and the test methods designated in this specification shall be followed. If, upon retest, failure occurs, the quantity of product represented by the test(s) does not meet the requirements of this 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 intervals 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 D1784.

10.1.4 The legend "PS 115 PVC Sewer Pipe," "PS 46 PVC Sewer Pipe," or "PS 10 PVC Sewer Pipe."

10.1.5 This designation, ASTM F794.

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 This designation, ASTM F794.

NOTE 13—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 have been completed.

10.4 *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.

10.5 *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.

10.6 *Certification*—When agreed upon in writing by the purchaser and the seller, a certification shall be made on the basis of acceptance of 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.

11. Delivery

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

12. Quality Assurance

12.1 When the product is marked with this designation, F794, 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.

13. Keywords

13.1 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 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 S1.1—In U.S. federal 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 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.

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. 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. METHOD FOR DETERMINING FLATTENING LEVEL

X1.1 Profile wall pipes have thicker major walls (deeper profiles) than the wall thickness of equal stiffness, solid wall pipes of the same material. Therefore, profile wall pipes develop greater bending strains when flattened to the same degree. The methodology presented here selects a flattening level for profile wall pipes that better equates these strain levels. Because bending tension strains cause failure, they are the major consideration here. Bending strains for profile and solid wall pipes may be expressed as follows see AWWA Manual 45:

$$\varepsilon\rho = Df(\Delta\rho)\,(C_{max}/R) \quad \text{(X1.1)}$$

$$\varepsilon s = Df(\Delta s)\,(0.5t/R) \quad \text{(X1.2)}$$

where:

$\varepsilon\rho$ = bending strain in the profile wall pipe,
εs = bending strain in an equal stiffness solid wall pipe,
$\Delta\rho$ = flattening level in the profile wall pipe, %,
Δs = flattening level in a solid wall pipe = 60 %,
Df = factor to account for the shape of the defected pipe, Since the deflected shape varies with stiffness, the value of Df is the same for pipes with the same stiffness; Df cancels out in this analysis,
C_{max} = extreme fiber distance of the pipe wall,
t = thickness of solid wall pipe wall = OD/DR,
DR = dimension ratio of a solid wall pipe = outside diameter/t = OD/t, (use DR 57.5 for 10 psi stiffness pipe), and
R = mean pipe radius.

X1.2 To select an equivalent flattening level to develop equal strains, set Eq X1.1 equal to Eq X1.2 and solve for the profile wall pipe deflection ($\Delta\rho$) necessary to produce the strain level in the solid wall pipe (ε_s) as follows:

$$\Delta\rho = 0.3[t(C_{max})] \quad \text{(X1.3)}$$

X1.3 For an approximate solution, simplify by setting $t = OD/DR$ and multiply by 100 to express Δ_ρ as a percent as follows:

$$\Delta\rho = 0.3[OD/DR\,(C_{max})]\,100, \% \quad \text{(X1.4)}$$

If C_{max} is not known, for bending tension at the spring line, conservatively assume the following:

$$C_{max} = (OD - ID)/4 \text{ and for } DR35 \quad \text{(X1.5)}$$

(that is, 46 − psi or 320 − kPa pipe stiffness)

$$\Delta_\rho = 3.43\ OD/(OD - ID), \% \quad \text{(X1.6)}$$

where:

OD = measured as per 8.5, and
ID = averaged inside pipe diameters from Tables 1-3.