



Designation: F758 – 14 (Reapproved 2023)

Standard Specification for Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage¹

This standard is issued under the fixed designation F758; 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 the requirements for smooth-wall perforated and nonperforated poly(vinyl chloride) (PVC) plastic pipe and couplings for use in subsurface drainage systems of highways, airports, and similar applications in nominal sizes of 4, 6, and 8 in. and in pipe stiffnesses (PS) that are designated as Type PS 28 and Type PS 46 in accordance with its minimum pipe stiffness.

1.2 Molded fittings for use with highway underdrain pipe are in accordance with Specification [D3034](#). For convenience, some of these fittings are reproduced in [Annex A1](#).

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

NOTE 1—Type PS 28 and Type PS 46 indicate “pipe stiffness” of 28 and 46, respectively, as outlined in [11.1](#).

NOTE 2—Pipe and fittings should be installed in accordance with Practice [D2321](#), or applicable state or local specifications.

1.4 *Units*—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.

1.5 The following safety hazards caveat pertains only to the test methods portion, Section [11](#), 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.*

1.6 *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 Recom-*

mendations 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](#)
- [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](#)
- [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 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](#)
- [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](#)
- [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](#)
- [D4396 Specification for Rigid Poly\(Vinyl Chloride\) \(PVC\) and Chlorinated Poly\(Vinyl Chloride\) \(CPVC\) Compounds for Plastic Pipe and Fittings Used in Nonpressure Applications](#)

¹ This specification is under the jurisdiction of ASTM Committee [F17](#) on Plastic Piping Systems and is the direct responsibility of Subcommittee [F17.65](#) on Land Drainage.

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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.

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

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

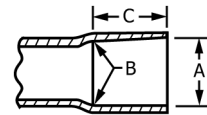
2.2 Federal Standard:

Fed. Std. No. 123 Marking for Shipments (Civil Agencies)³

2.3 Military Standard:

MIL-STD-129 Marking for Shipment and Storage³

TABLE 1 Socket-Type Bell Dimensions (Belled Ends for Solvent-Cement-Type Pipe and Bends)



in.			
Nominal Size, in.	A Entrance	B Socket Bottom	C Bell Depth, min
4	4.235 ± 0.009	4.210 ± 0.009	1.750
6	6.305 ± 0.011	6.270 ± 0.011	3.000
8	8.424 ± 0.012	8.388 ± 0.012	4.000

mm			
Nominal Size, in.	A Entrance	B Socket Bottom	C Bell Depth, min
4	107.57 ± 0.22	106.93 ± 0.22	44.44
6	160.15 ± 0.28	159.26 ± 0.28	76.20
8	213.97 ± 0.30	213.06 ± 0.30	101.60

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) plastic is PVC.

4. Classification

4.1 Two classes (or pipe stiffness) are included and designated as PS 28 and PS 46 as determined in accordance with 11.1.

5. Materials

5.1 The pipe shall be made of PVC plastic having a minimum cell classification of 12454 or 12364 as defined in Specification D1784 or a minimum cell classification of 11432 or 11332 as defined in specification D4396. Homopolymer PVC compounds must equal or exceed the requirements of the listed cell classification numbers.

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

6. Joint Systems

6.1 Gasket-Type Joints, meeting the applicable requirements of Specification D3212, may be utilized.

6.2 Solvent-Cement-Type Joints, made with bell ends meeting the requirements of Table 1; stop-type couplings in conformance with Table 2; or sleeve-type couplings in conformance with Table 3, may be utilized.

6.2.1 Belled ends shall be formed so as to provide a uniform shoulder around the entire circumference of the pipe.

6.2.2 Solvent-cemented joints shall be made using PVC cement meeting the requirements of Specification D2564, and shall be made in accordance with Practice D2855 and Practice F402.

7. Requirements

7.1 Workmanship—The pipe shall be homogeneous throughout and essentially uniform in color, opacity, density, and other properties. The inside and outside surfaces shall be semimatte or glossy in appearance (depending on the type of plastic) and free of chalking, sticky, or tacky material. The surfaces shall be free of excessive bloom, that is, slight bloom is acceptable. The pipe walls shall be free of cracks, holes,

blisters, voids, foreign inclusion, or other defects that are visible to the naked eye and that may affect the wall integrity. Holes deliberately placed in perforated pipe are acceptable. 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 Dimensions and Tolerance:

7.2.1 Outside Diameter—The outside diameter and tolerances shall meet the requirements of Table 4 when measured in accordance with Test Method D2122. The tolerances for out-of-roundness shall apply to pipe prior to shipment.

7.2.2 Wall Thickness—The actual wall thickness of pipe shall be the wall required to meet the physical requirements of this specification but not less than that shown in Table 4 when measured in accordance with Test Method D2122.

7.2.3 Length—Laying length shall be 20 ft (6.1 m) (or as mutually agreed upon between the purchaser and the manufacturer). A tolerance of ±1 in. (±25 mm) shall be permitted.

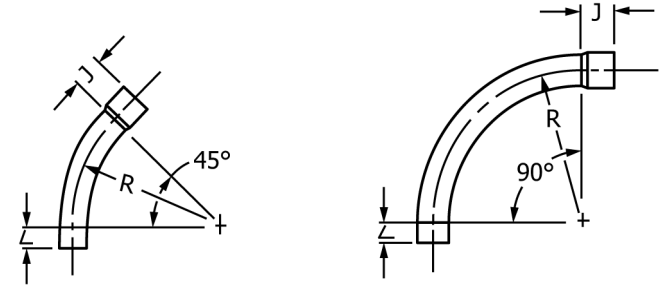
7.2.4 Perforations—Perforated pipe shall be perforated in accordance with Table 5. The perforations shall be approximately circular and cleanly cut. The spigot end, and bell, of belled-end pipe may be unperforated for a length equal to the depth of the socket or shoulder, or both.

7.2.5 Integral Bell Dimensions—Integral bell dimensions of pipe, bends, and sweeps shall comply with Table 1. Elastomeric seal joints shall meet dimensions recommended by the manufacturer. The thickness of the wall shall be considered satisfactory if the bell was formed from pipe meeting the requirements of this specification.

7.2.6 Sleeve-Type Coupling Dimensions—Dimensions shall be in accordance with Table 3. Sleeve-type couplings shall have a wall thickness not less than that required for pipe and shall meet the requirements of Section 8.

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

TABLE 2 Dimensions of Bends

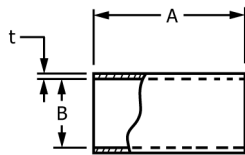


		in.		
Nominal Size, in.	Angle	Radius	Socket Depth ^A	Length of Tangent
			Dimension J, min	Dimension L, min
4	45°	16, 24, 36	1.750	2.00
	90°	16, 24, 36		
6	45°	24, 36	3.000	3.50
	90°	24, 36		
8	45°	24, 36	4.000	5.00
	90°	24, 36		

		mm		
Nominal Size, in.	Angle	Radius	Socket Depth ^A	Length of Tangent
			Dimension J, min	Dimension L, min
4	45°	406.4 609.6 914.4	44.44	50.80
	90°	406.4 609.6 914.4		
6	45°	609.6 914.4	76.20	88.90
	90°	609.6 914.4		
8	45°	609.6 914.4	101.60	127.00
	90°	609.6 914.4		

^A Socket dimensions shall be as shown in Table 1.

TABLE 3 Sleeve Coupling Dimensions



		in.		
Nominal Pipe Size, in.	Dimension A	Dimension B	Dimension t, min	
			4	3.5 ± 0.250
6	6.0 ± 0.250	6.291 ± 0.005	0.180	
8	8.0 ± 0.250	8.418 ± 0.006	0.240	

		mm		
Nominal Pipe Size, in.	Dimension A	Dimension B	Dimension t, min	
			4	88.8 ± 6.34
6	152.4 ± 6.34	159.77 ± 0.13	4.57	
8	203.2 ± 6.34	213.74 ± 0.15	6.10	

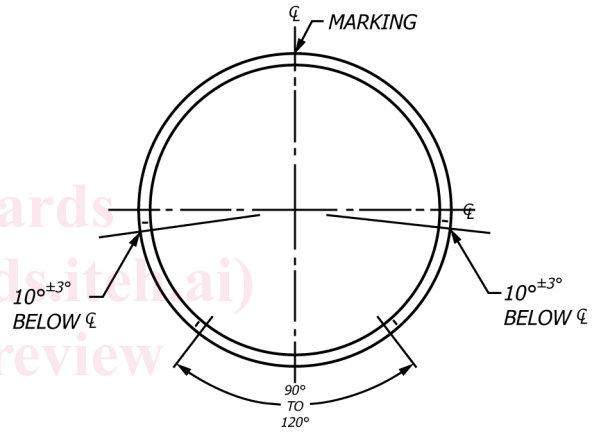
TABLE 4 Pipe Dimensions

		in.			
Nominal Size, in.	Average Tolerance	Outside Diameter		Minimum Wall Thickness	
		Out-of-Roundness ^A min	max	Type PS 28	Type PS 46
4	4.215 ± 0.009	4.165	4.265	0.103	0.120
6	6.275 ± 0.011	6.225	6.325	0.153	0.180
8	8.400 ± 0.012	8.325	8.475	0.205	0.240

		mm			
Nominal Size, in.	Average Tol-erance	Outside Diameter		Minimum Wall Thickness	
		Out-of-Roundness ^A min	max	Type PS 28	Type PS 46
4	107.06 ± 0.22	105.80	108.34	2.62	3.05
6	159.38 ± 0.28	158.12	160.66	3.88	4.57
8	213.36 ± 0.30	212.08	214.62	5.20	6.10

^A The tolerance for out-of-roundness applies only at the time of production.

TABLE 5 Perforations^A



Nominal Diameter, in.	Minimum Rows of Perforations	Hole Size ^A		Hole Spacing ^A	
		mm	in.	mm	in.
4	2	4.8 to 9.7	3/16 to 3/8	82.55 ± 6.35	3 1/4 ± 1/4
6	4	4.8 to 9.7	3/16 to 3/8	82.55 ± 6.35	3 1/4 ± 1/4
8	4	4.8 to 9.7	3/16 to 3/8	82.55 ± 6.35	3 1/4 ± 1/4

^A Combination of hole size and spacing of holes shall provide a minimum inlet area greater than 0.2200 in.²/ft of pipe (that is, 3/16-in. holes at 3-in. center would permit a 0.2206-in.² area).

7.2.7 Fitting Dimensions:

7.2.7.1 Molded Fittings—See Annex A1.

7.2.7.2 Fabricated fittings are acceptable provided they are made from pipe that meets or exceeds all of the applicable requirements of this specification.

7.2.8 Bend Dimensions:

7.2.8.1 The dimensions for bends shall be as shown in Table 2.

7.2.8.2 The thickness of the wall shall be considered satisfactory if the bend was formed from Type PS 46 pipe that meets the requirements of this specification.

8. Performance Requirements

8.1 General:

8.1.1 *Pipe Stiffness*—The pipe stiffness ($F/\Delta Y$) values shall be in conformance with **Table 6**, when tested in accordance with **11.1**.

8.2 *Quality Control:*

8.2.1 *Scope*—The tests in this section are producer’s quality control tests and are not intended for simulated service tests.

8.2.2 *Impact Strength*—The minimum drop weight impact strength values for pipe and fabricated fittings shall be as given in **Table 7**, when tested in accordance with **11.2**.

NOTE 3—Development of a test for molded fittings is under study by ASTM. Requirements will be included when available.

8.2.3 *Pipe Flattening*—When examined without the use of magnification equipment, there shall be no evidence of splitting, cracking, or breaking when pipe is tested in accordance with **11.3**.

8.2.4 *Solvent Cement Joint Tightness (Referee Test)*—The solvent-cement-type joints of nonperforated pipe shall not leak when tested in accordance with **11.4**.

8.2.5 *Extrusion Quality*—The pipe shall not flake or disintegrate when tested for 20 min in accordance with Test Method **D2152**.

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 the 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. Conditioning

10.1 *Referee Testing*—When conditioning is required for tests, the specimens shall be conditioned in accordance with Procedure A in Practice **D618** at $73.4\text{ °F} \pm 2\text{ °F}$ ($23\text{ °C} \pm 2\text{ °C}$) and $50\% \pm 10\%$ relative humidity for not less than 40 h prior to test. The impact specimens and the surrounding conditioning medium are to be in thermal equilibrium with one another at a temperature of 32 °F to 34.9 °F (0 °C to 1.6 °C). Tests shall be conducted under the same conditions of temperature and humidity, unless otherwise specified.

10.2 *Quality Control:*

TABLE 6 Pipe Stiffness
(Minimum Pipe Stiffness at 5 % Deflection ($F/\Delta y$))

Nominal Pipe Size, in.	Pipe Stiffness, kPa		Pipe Stiffness, lbf/in.-in.	
	Type PS 28	Type PS 46	Type PS 28	Type PS 46
4	190	320	28	46
6	190	320	28	46
8	190	320	28	46

TABLE 7 Impact Strength at 0°C

Nominal Pipe Size, in.	J		ft-lbf	
	Type PS 28	Type PS 46	Type PS 28	Type PS 46
4	75	88	55	65
6	88	115	65	85
8	102	129	75	95

10.2.1 For quality control tests, specimens shall be conditioned for a minimum of 3 h in air, or 1 h in liquid at $73.4\text{ °F} \pm 2\text{ °F}$ ($23\text{ °C} \pm 2\text{ °C}$). They shall be tested at $73.4\text{ °F} \pm 2\text{ °F}$ ($23\text{ °C} \pm 2\text{ °C}$) without regard to relative humidity.

10.2.2 For the impact test, specimens shall be conditioned at 0 to 1.6 °C for at least 1 h in liquid or other suitable means to obtain thermal equilibrium.

11. Test Methods

11.1 *Pipe Stiffness*—Determine the pipe stiffness at 5 % deflection using Test Method **D2412**. Test three specimens each $6 \pm 1/16$ in. ($150\text{ mm} \pm 2\text{ mm}$) long and determine the average pipe stiffness at 5 % deflection in accordance with 9.1.9 of Test Method **D2412**. The pipe stiffness shall equal or exceed the minimum values listed in **Table 6**. Nonperforated pipe samples shall be placed so that the minimum wall thickness is uppermost (adjacent to the top bearing plate). Perforated pipe samples shall be placed with the marking uppermost (see **Table 5**).

11.2 *Impact Resistance*—Five specimens, each $6 \pm 1/16$ in. ($150 \pm 2\text{ mm}$) long, shall be tested in accordance with Test Method **D2444**, using a 20 lb (9.1 kg) Tup B, and the flat plate (Holder B). When testing is performed in an environment where temperatures are above 32 °F (0 °C), no more than 15 s shall elapse from the time of removal of the specimen from the conditioning bath until completion of that test. Perforated specimens must be positioned with the print marking uppermost, as shown in **Table 5**; other specimens may be positioned with a random surface uppermost. All specimens shall be located so that the contact point is centered under the tup. All five specimens shall pass. If one specimen fails, another five specimens shall be tested; nine out of ten specimens passing shall be acceptable.

11.3 *Pipe Flattening*—Flatten three specimens of pipe each 6 in. $\pm 1/16$ in. ($150\text{ mm} \pm 2\text{ mm}$) long, between parallel plates in a suitable press until the distance between the plates is twice the wall thickness plus 5 % of the nominal diameter of the pipe. The rate of loading shall be uniform and such that the compression is completed within 2 min to 5 min. Remove the load and examine the specimens. There shall be no evidence of splitting, cracking, or breaking.

11.4 *Solvent Cement Joint Tightness, Referee Test*—A section of unperforated pipe shall be cemented to a bell or coupling, using the manufacturer’s recommendations or, in their absence, the methods described in Practice **D2855**. Unless otherwise specified, the assembly shall be allowed to stand for at least 6 h. It shall then be subjected to an internal pressure of at least 25 psi (170 kPa) using water as the test medium. The