Designation: F 949 – 03

An American National Standard

Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings[1]

This standard is issued under the fixed designation F 949; 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 Department of Defense.

1. Scope

1.1 This specification covers requirements, test methods, and materials for 4 to 36-in. diameter poly(vinyl chloride) (PVC) corrugated pipe with a smooth interior. This profile wall pipe consists of an outer corrugated wall fused to a smooth inner wall providing pipe stiffness levels of 46 psi and 115psi. Joints and fittings are included in this specification.

1.2 The requirements of this specification are intended to provide pipe and fittings suitable for underground use in nonpressure applications for sanitary sewers, storm sewers, and perforated and unperforated pipes for subdrainage.

NOTE 1—Industrial waste disposal lines should be installed only with the specific approval of the cognizant code authority, since chemicals not commonly found in drains and sewers and temperatures in excess of 140°F (60°C) may be encountered.

1.3 Pipe and fittings produced to this specification shall be installed in accordance with Practice D 2321.

NOTE 2—For perforated pipe applications, the size of the embedment zone and permeability of the embedment material are important to the system's ability to provide the desired level of infiltration or exfiltration. The gradation of the embedment material must be compatible with the perforation slot size to avoid backfill migration into the pipe.

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

1.5 The following precautionary caveat pertains only to the test method portion, Section 7, 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]

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 Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

D 2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading

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

D 2564 Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

D 2855 Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings

D 3034 Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter

D 3212 Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

F 412 Terminology Relating to Plastic Piping Systems

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

[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.

F 679 Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings

F 1057 Practice for Estimating the Quality of Extruded Poly (Vinyl Chloride) (PVC) Pipe by the Heat Reversion Technique

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

AWWA Manual M45, Fiberglass Pipe Design[3]

2.3 *Federal Standard:*

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

2.4 *Military Standard:*

MIL-STD-129 Marking for Shipment and Storage[4]

3. Terminology

3.1 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) plastic is PVC.

3.2 *parting line*—a slight mark or surface irregularity in the pipe or fitting surface as a result of a mold separation at that location.

4. Materials and Manufacture

4.1 *Material Specification*—The pipe shall be made of PVC compound having a minimum cell classification of 12454 in accordance with Specification D 1784. The fittings shall be made of PVC compound having a cell classification of 12454, or 13343 as defined in Specification D 1784. Compounds that have different cell classifications because one or more properties are superior to those of the specified compounds are also acceptable.

4.2 *Rework Material*—Clean rework material, generated from the manufacturer's own pipe or fitting production, or both, may be used by the same manufacturer provided that the rework material meets the requirements of 4.1 and that the pipe and fittings produced meet the requirements of this specification.

4.3 *Pipe* shall be manufactured by simultaneous extrusion of the smooth and corrugated walls with the smooth inner wall fused to the outer corrugated wall.

4.4 *Fittings* shall be molded or fabricated.

4.5 *Joining Materials*:

4.5.1 *Gaskets*—Elastomeric seals (gaskets) shall be in accordance with the requirements of Specification F 477.

4.5.2 *Lubricant*—The lubricant used for assembly shall be as recommended by the manufacturer and shall have no detrimental effect on the gasket or on the pipe and fittings.

4.5.3 *Solvent Cement*—The PVC cement shall comply with Specification D 2564. The solvent cement shall be used only for bushings and saddle connections (see Fig. 1).

5. Requirements

5.1 *Workmanship*—The pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density, and other physical properties. Slots deliberately placed in pipe for perforations for subdrainage, etc., applications are acceptable.

5.2 *Dimensions and Tolerances*:

5.2.1 *Pipe*—Pipe dimensions shall meet the requirements given in Table 1 when measured in accordance with 7.3.

5.2.2 *Sockets*—All sockets (bells), dimensions on pipe, and fittings shall meet the requirements given in Table 2 when measured in accordance with 7.4. In the case of belled pipe, the thickness of wall in the bell shall be considered satisfactory if the pipe meets the minimum thicknesses listed in Table 1.

5.2.3 *Fittings*—Molded fitting dimensions shall meet the requirements of Table 3 when measured in accordance with 7.4. The wall thickness of molded fittings shall meet the requirements given in Table 4, when measured in accordance with 7.4. Fittings may also be fabricated from pipe, meeting the requirements of this specification or from SDR 35 pipe meeting the requirements of Specification D 3034 or F 679. In the case of a fabricated fitting with a formed bell, the thickness of the bell shall be considered satisfactory if it was formed from pipe meeting the requirements of the standard to which the pipe was produced. For reducing fittings or those with smaller inlets, the minimum wall thickness of each inlet shall be no less than the minimum wall thickness for that size pipe.

5.2.4 *Perforations*—Perforation slots shall be clearly cut and uniformly spaced along the length of pipe. Slots shall be centered in the corrugation valleys. Dimensions and spacing of the slots shall be as listed in Table 5. Other slot dimensions and spacing may be provided to meet the needs of the specifier. Alternatively, where the valley is large enough to accommodate a suitably sized round hole perforation without penetrating the void under the corrugation, round hole perforations of a size, pattern, and open area agreed upon by the specifier may be provided. All measurements shall be made in accordance with 7.9.

5.3 *Performance Requirements*:

5.3.1 *Pipe Stiffness*—Pipe stiffness shall be a minimum of 46 psi or 115 psi when tested in accordance with 7.5. Pipe stiffness shall be marked on pipe as per 11.2.3.

NOTE 3—This test is intended only for use as a quality control test and not as a simulated service test.

5.3.2 *Flattening*—There shall be no evidence of splitting, cracking, breaking, or separation of the two walls when the pipe is tested in accordance with 7.5 (see Note 4).

5.3.3 *Impact Strength*—Pipe shall have the minimum impact strengths listed in Table 6, when tested in accordance with 7.6. Failure of the test specimen shall be any crack, split, or shattering of either the waterway or corrugation wall. Separation of the ribs of the exterior corrugation from the waterway wall constitutes a failure.

NOTE 4—This test is intended only for use as a quality control test at time of manufacture, and not as a simulated service test.

5.3.4 *Extrusion Quality*:

5.3.4.1 *Acetone Immersion*—The pipe shall not flake, disintegrate, or exhibit separation of the two walls when tested in accordance with 7.7.1.

[3] Available from American Water Works Assn., 6666 West Quincy Ave., Denver, CO 80235.

[4] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

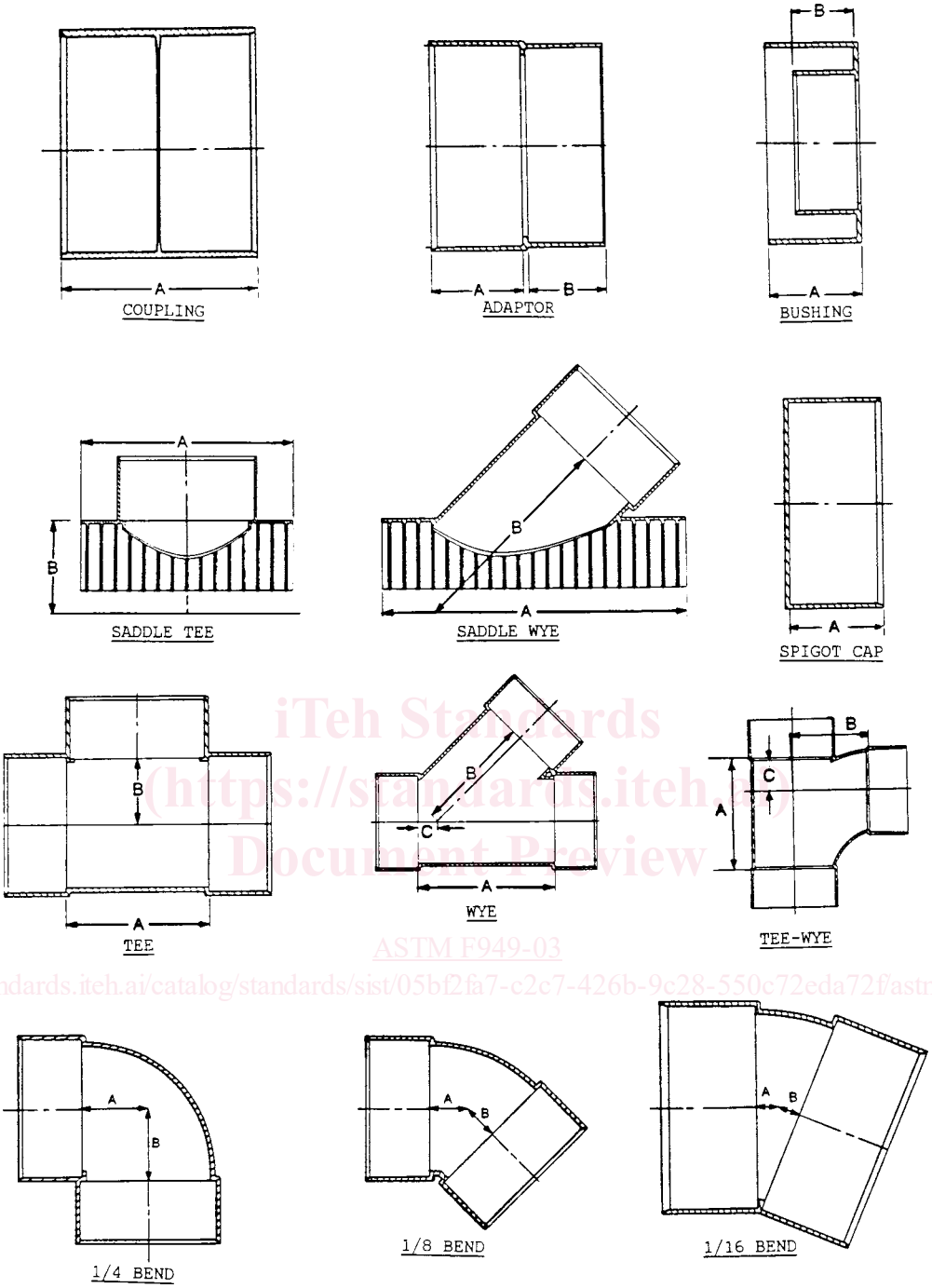


FIG. 1 Molded Fitting Dimensions (see Table 3)

5.3.4.2 *Heat Reversion*—The pipe shall not exhibit any of the effects listed in the suggested interpretation of results of Practice F 1057 when tested in accordance with 7.7.2.

5.3.5 *Bond*—The bond between the inner and outer walls (at the corrugation valley) shall not separate when tested in accordance with 7.10.

5.4 *Joint Tightness*—Gasketed pipe joints shall show no leakage when tested in accordance with 7.8.

NOTE 5—Testing for joint tightness is not intended to be a routine quality control test. The test is used to qualify pipe and fitting joints at a specified level of performance.

6. Sampling

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

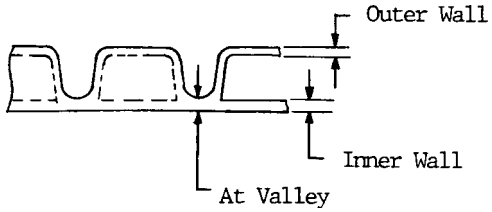
7. Test Methods

7.1 *Conditioning*:

7.1.1 *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

TABLE 1 Pipe Dimensions

NOTE 1—Other corrugation configurations, meeting the following dimensional requirements are permissible.



For Pipe Stiffness of 46 PSI

Nominal Size in.	Outside Diameter		Inside Diameter		Minimum Wall Thickness		
	Average, in. (mm)	Tolerance on Average, in. (mm)	Average, in. (mm)	Tolerance on Average, in. (mm)	Inner Wall, in. (mm)	Outer Wall, in. (mm)	At Valley, in. (mm)
4	4.300 (109.2)	±0.009 (±0.229)	3.950 (100.3)	±0.011 (±0.279)	0.022 (0.559)	0.018 (0.457)	0.028 (0.711)
6	6.420 (163.1)	±0.011 (±0.279)	5.909 (150.1)	±0.015 (±0.381)	0.025 (0.635)	0.022 (0.559)	0.032 (0.813)
8	8.600 (218.4)	±0.012 (±0.305)	7.881 (200.2)	±0.018 (±0.457)	0.035 (0.889)	0.030 (0.762)	0.045 (1.143)
10	10.786 (273.9)	±0.015 (±0.381)	9.846 (250.1)	±0.021 (±0.533)	0.045 (1.143)	0.036 (0.914)	0.055 (1.397)
12	12.795 (325.0)	±0.018 (±0.457)	11.715 (297.6)	±0.028 (±0.711)	0.058 (1.397)	0.049 (1.245)	0.072 (1.829)
15	15.658 (397.7)	±0.023 (±0.584)	14.338 (364.2)	±0.035 (±0.889)	0.077 (1.956)	0.055 (1.397)	0.092 (2.337)
18	19.152 (486.5)	±0.028 (±0.711)	17.552 (445.8)	±0.042 (±1.067)	0.084 (2.134)	0.067 (1.702)	0.103 (2.616)
21	22.630 (574.8)	±0.033 (±0.838)	20.705 (525.9)	±0.049 (±1.24)	0.095 (2.413)	0.073 (1.854)	0.110 (2.800)
24	25.580 (649.7)	±0.039 (±0.991)	23.469 (596.1)	±0.057 (±1.448)	0.110 (2.791)	0.085 (2.161)	0.123 (3.124)
27	28.860 (733.0)	±0.049 (±1.25)	26.440 (671.6)	±0.069 (±1.75)	0.120 (3.048)	0.091 (2.311)	0.137 (3.486)
30	32.150 (816.6)	±0.059 (±1.50)	29.469 (748.5)	±0.081 (±2.057)	0.130 (3.302)	0.105 (2.667)	0.147 (3.734)
36	38.740 (984.0)	±0.079 (±2.007)	35.475 (901.1)	±0.105 (±2.667)	0.150 (3.810)	0.125 (3.175)	0.171 (4.343)

For Pipe Stiffness of 115 PSI

Nominal Size	Outside Diameter		Inside Diameter		Minimum Wall Thickness		
	Average, in. (mm)	Tolerance on Average, in. (mm)	Average, in. (mm)	Tolerance on Average, in. (mm)	Inner Wall, in. (mm)	Outer Wall, in. (mm)	At Valley, in. (mm)
8	8.600 (218.4)	±0.012 (±0.305)	7.710 (195.8)	±0.018 (±0.457)	0.037 (0.940)	0.050 (1.270)	0.048 (1.219)
10	10.786 (273.9)	±0.015 (±0.381)	9.644 (245.0)	±0.021 (±0.533)	0.046 (1.295)	0.052 (1.320)	0.065 (1.651)
12	12.795 (325.0)	±0.018 (±0.457)	11.480 (291.6)	±0.028 (±0.711)	0.070 (1.778)	0.068 (1.727)	0.091 (2.311)
15	15.658 (397.7)	±0.023 (±0.584)	14.053 (356.97)	±0.035 (±0.889)	0.092 (2.337)	0.088 (2.235)	0.118 (2.997)

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.

7.1.2 *Quality Control Tests*—For quality control tests, condition the specimens for a minimum of 4 h in air or 1 h in water at 73.4 ± 3.6°F (23 ± 2°C). Test the specimens at 73.4 ± 3.6°F without regard to relative humidity.

7.2 *Test Conditions*—Conduct tests in the Standard Laboratory Atmosphere at 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 tolerance shall be ±1.8°F (±1°C) and ±2 % relative humidity.

7.3 *Pipe Dimensions*:

7.3.1 *Pipe Diameters*—Measure the average outside diameter of the pipe in accordance with Test Method D 2122 using a circumferential wrap tape accurate to ±0.001 in. (±0.02 mm). The average inside diameter may be calculated from the average outside diameter and wall thickness measurements in accordance with Test Method D 2122.

7.3.2 *Wall Thickness*—Measure the wall thicknesses in accordance with Test Method D 2122. Each specimen will need to be cut lengthwise into at least eight segments in order to obtain a minimum of eight measurements in accordance with Test Method D 2122. Do not measure on a mold line.

7.3.3 Measure the length of pipe with a steel tape with precision of at least 1/16-in. (1-mm) graduations in accordance with Test Method D 2122.

7.4 *Fitting Dimensions*:

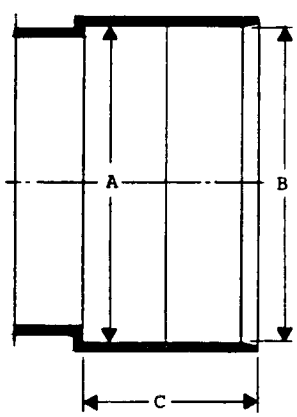
7.4.1 *Socket Diameters*—Measure the inside diameters of the sockets in accordance with Test Method D 2122. Calculate the average inside diameters of the socket as the arithmetic mean of all of the diameters measured at each cross section.

7.4.2 *Socket Depth*—Measure the fittings socket depth using a good commercial quality scale calibrated in 1/32-in. (1-mm) increments in accordance with Test Method D 2122.

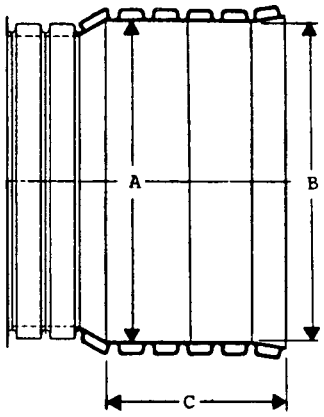
7.4.3 *Wall Thickness*—Measure the wall thickness in accordance with Test Method D 2122. Make sufficient readings, a minimum of 8, to ensure that the minimum thickness has been determined. Use a ball anvil or a cylindrical anvil tubing micrometer accurate to ±0.001 in. (±0.02 mm).

7.4.4 *Laying Lengths*—Measure the laying length of molded fittings with a good commercial steel scale calibrated in 1/32-in. (1-mm) increments in accordance with Test Method D 2122.

TABLE 2 Bell (Socket) Dimensions for Gasketed Joints



MOLDED SOCKET



INTEGRAL SOCKET

Nominal Diameter	A[A] in. (mm)	B[A] in. (mm)	C in. (mm)
4	4.362 ± 0.025	4.372 ± 0.025	1.75
	(110.79 ± 0.64)	(111.05 ± 0.64)	(44.5)
6	6.492 ± 0.030	6.512 ± 0.030	2.75
	(164.90 ± 0.76)	(165.40 ± 0.76)	(69.9)
8	8.680 ± 0.035	8.700 ± 0.035	3.75
	(220.47 ± 0.89)	(220.98 ± 0.84)	(95.3)
10	10.876 ± 0.045	10.900± 0.045	4.75
	(276.26 ± 1.14)	(276.86 ± 1.14)	(120.7)
12	12.873 ± 0.055	12.898± 0.055	5.75
	(326.97 ± 1.40)	(327.61 ± 1.40)	(146.1)
15	15.751 ± 0.065	15.776± 0.065	6.75
	(400.08 ± 1.65)	(400.71 ± 1.65)	(171.5)
18	19.260 ± 0.075	19.285± 0.075	6.75
	(489.20 ± 1.91)	(489.84 ± 1.91)	(171.5)
21	22.751 ± 0.080	22.781± 0.080	8.5
	(577.88 ± 2.032)	(578.64 ± 2.032)	(215.9)
24	25.758 ± 0.085	25.788± 0.085	8.5
	(654.25 ± 2.159)	(655.02 ± 2.159)	(215.9)
27	29.058 ± 0.090	29.088± 0.090	8.5
	(738.07 ± 2.286)	(738.84 ± 2.286)	(215.9)
30	32.368 ± 0.095	32.398± 0.095	8.5
	(822.15 ± 2.413)	(822.91 ± 2.413)	(215.9)
36	38.998 ± 0.105	39.028± 0.105	8.5
	(990.55 ± 2.667)	(991.31 ± 2.667)	(215.9)

[A] Some sockets, dependent on the method of the manufacturer, do not have taper on inside diameter of socket. Total bell inside diameter is equal to "A" dimension.

7.5 *Pipe Stiffness and Flattening*:

7.5.1 For purposes of conducting pipe stiffness and flattening tests, the pipe inside diameter shall be considered as the nominal diameter and the ΔY shall be the plate travel of the apparatus.

7.5.2 *Pipe Stiffness*—Determine the pipe stiffness at 5 % deflection in accordance with Test Method D 2412. For diameters 4 through 18 in., test three specimens, each a minimum of 6 in. (152 mm) in length. For diameters 21 through 36 in., test three specimens, each a minimum of 12 in. (305 mm) in length. Specimens shall be cut in corrugation valley. All three specimens must pass.

NOTE 6—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.

7.5.3 *Pipe Flattening*—Flatten three specimens between parallel plates until the distance between the plates, expressed as a % of the inside pipe diameter, is reduced by the value as determined by [3.43 (OD)/ (OD-ID)] for pipes with a 46 psi pipe stiffness or by the value as determined by [4.62 (OD)/ (OD-ID)] for pipes with a 115 psi pipe stiffness. OD and ID are the average outside and inside diameters of the pipe. (See Table 1.) The test specimens for pipes 4 through 18 in. in diameter shall be a minimum of 6 in. (152 mm) long. The specimens shall be a minimum of 12 in. (305 mm) long for larger diameters. All specimens shall be cut to length by cutting through the corrugation valleys. After flattening, remove the load and examine the specimens for evidence of splitting, cracking, breaking, or the separation of the two walls.

NOTE 7—Flattening test may be run in conjunction with pipe stiffness test in accordance with Test Method D 2412.

NOTE 8—The amount of flattening required in 7.5.3 develops bending strains at least as great as those developed when flattening of a DR 35 pipe by 60 %. See Appendix X4.

TABLE 3 Minimum Molded Fitting Dimensions (see Fig. 1)

NOTE 1—Fittings 10 in. and larger are typically fabricated. Contact the manufacturer for details on fittings. Bell dimensions meet the requirements of Table 2.

Fitting, in.	A in. (mm)	B in. (mm)	Fitting, in.	A in. (mm)	B in. (mm)	C in. (mm)
Couplings			Tees			
4	4.0 (102)		4 × 4 × 4	4.6 (117)	2.1 (53)	
6	6.0 (152)		6 × 6 × 4	6.7 (170)	3.1 (79)	
8	8.0 (203)		6 × 6 × 6	6.7 (170)	3.0 (7)	
10	10.0 (254)		8 × 8 × 4	8.5 (216)	5.0 (127)	
Saddle Tees			8 × 8 × 6	10.2 (259)	5.3 (135)	
6 × 4	8.0 (203)	3.3 (84)	8 × 8 × 8	9.0 (229)	4.1 (104)	
8 × 4	10.3 (262)	4.6 (117)	Wyes			
8 × 6	10.3 (262)	4.5 (114)	4 × 4 × 4	6.5 (165)	5.6 (142)	1.0 (25)
10 × 4	10.7 (272)	5.6 (137)	6 × 6 × 4	9.5 (241)	8.2 (208)	1.3 (33)
10 × 6	10.7 (272)	5.4 (137)	6 × 6 × 6	9.5 (241)	8.1 (206)	1.3 (33)
Saddle Wyes			8 × 8 × 4	11.5 (292)	7.5 (191)	0.7 (18)
6 × 4	9.0 (229)	6.5 (168)	8 × 8 × 6	13.3 (338)	8.0 (203)	1.7 (43)
8 × 4	14.5 (368)	10.3 (262)	8 × 8 × 8	17.0 (432)	8.3 (211)	3.5 (89)
8 × 6	14.5 (368)	10.2 (259)	Tee-Wye			
10 × 4	15.1 (384)	11.5 (292)	8 × 8 × 4	5.4 (137)	6.3 (160)	2.8 (71)
10 × 6	15.1 (384)	11.4 (290)	8 × 8 × 6	5.4 (137)	6.2 (157)	2.8 (71)
Spigot Caps			Bushing			
4	2.0 (51)		6 × 4	3.0 (76)	2.0 (51)	
6	3.0 (76)		8 × 6	4.0 (102)	3.0 (76)	
8	4.0 (102)		Adaptors			
10	5.0 (127)		4	2.0 (51)	2.0 (51)	
¼ Bend			6	3.0 (76)	2.5 (63)	
4	2.1 (53)	2.3 (58)				
6	3.1 (79)	2.4 (86)				
⅛ Bend						
4	1.1 (28)	1.1 (28)				
6	1.6 (41)	1.6 (41)				
8	2.2 (56)	2.2 (56)				
1/16 Bend						
4	0.5 (13)	0.5 (13)				
6	0.7 (18)	0.7 (18)				

TABLE 4 Molded Fittings

Nominal Diameter	Minimum Wall[A,B] Thickness, in.
4	0.120
6	0.180
8	0.240
10	0.300
12	0.360
15	0.437
18	0.499

[A] The skirts on saddle fittings have a minimum wall thickness of 0.180 in.

[B] The wall thickness is a minimum value except that a ±10 % variation resulting from core shift is allowable. In such a case, the average of two opposite wall thicknesses shall equal or exceed the value shown in the table.

TABLE 5 Perforation Dimensions[A]

Nominal Size, in.	Rows of Slots	Slot Size		Spacing, in. (mm)
		Maximum Width, in. (mm)	Length, in. (mm)	
4	2	0.125 (3.2)	1 1/16 ± ¼ (27.0 ± 6.4)	0.416 (10.49)
6	2	0.125 (3.2)	1⅜ ± ¼ (34.9 ± 6.4)	0.516 (13.11)
8	2	0.125 (3.2)	1¾ ± ¼ (44.5 ± 6.4)	0.689 (17.50)
10	2	0.125 (3.2)	2⅛ ± ¼ (54.0 ± 6.4)	0.826 (20.98)
12	2	0.125 (3.2)	1 11/16 ± ¼ (42.9 ± 6.4)	1.033 (26.24)
15	2	0.125 (3.2)	2¼ ± ¼ (57.1 ± 6.4)	1.377 (34.98)
18	2	0.125 (3.2)	2¼ ± ¼ (57.1 ± 6.4)	1.377 (34.98)
21	2	0.125 (3.2)	1¾ ± ¼ (44.5 ± 6.4)	1.897 (48.18)
24	2	0.125 (3.2)	1¾ ± ¼ (44.5 ± 6.4)	1.897 (48.18)
27	2	0.125 (3.2)	2 3/16 ± ¼ (55.6± 6.4)	2.318 (58.88)
30	2	0.125 (3.2)	2 3/16 ± ¼ (55.6 ± 6.4)	2.318 (58.88)
36	2	0.125 (3.2)	2 7/16 ± ¼ (61.9 ± 6.4)	2.608 (66.24)

[A] Minimum slot inlet areas of 1.5 in.^{2}/ft of pipe length for diameters through 18 in. and 2.0 in.^{2}/ft of pipe length for larger diameters must be provided.

7.6 *Impact Resistance*—Determine the impact resistance of the pipe in accordance with the conditions and apparatus in Test Method D 2444. Impact tests shall be conducted at two different locations. These are (*1*) directly on the crown of the corrugation so that it receives the impact essentially centered on the tup face, and (*2*) directly on the midway point between corrugations. Omit Location (*2*) if the geometry of the corrugation does not provide a sufficiently wide valley to allow the tup to strike the valley wall directly. Failure of the test specimen shall be any crack, split, or shatter of the waterway. Separation of the corrugation from the inner wall constitutes a failure. Test a total of six specimens, with three specimens at each orientation. Where the valley wall orientation is omitted, test all six specimens at the first orientation.

7.6.1 In sizes 4 through 36 in., test six specimens, using a 20-lb (9-kg) Tup B or a 30-lb (15kg) Tup B and flat plate