



# Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Nonpressure Applications<sup>1</sup>

This standard is issued under the fixed designation D 3840; 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 fiberglass pipe fittings intended for use in gravity flow systems for conveying sanitary sewage, storm water, and those industrial wastes for which the fittings are determined to be suitable. Elbows, tees, laterals, crosses, reducers, and adapters are included. Both glass-fiber-reinforced and thermosetting-resin pipe (RTRP) and glass-fiber-reinforced polymer mortar pipe (RPMP) are fiberglass pipes.

NOTE 1—For the purposes of this standard, polymer does not include natural polymers.

1.2 This specification is intended to cover only dimensions, material properties, and workmanship rather than the structural design of the fittings. The structural design of the fittings shall be as agreed upon between purchaser and supplier and should take into consideration the anticipated conditions of installation and service.

1.3 This specification covers only fittings fabricated from cut sections of pipe, or from a combination of pipe sections and contact molded (hand layup), or machine fabricated components.

1.4 The values given in parentheses are provided for information purposes only.

1.5 The following safety hazards caveat pertains only to the test method 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 and health practices and determine the applicability of regulatory limitations prior to use.*

NOTE 2—There is no similar or equivalent ISO standard.

## 2. Referenced Documents

### 2.1 ASTM Standards:

D 638 Test Method for Tensile Properties of Plastics<sup>2</sup>

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D 20.23 on Reinforced Plastic Piping Systems and Chemical Equipment.

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<sup>2</sup> Annual Book of ASTM Standards, Vol 08.01.

D 883 Terminology Relating to Plastics<sup>2</sup>

D 1600 Terminology for Abbreviated Terms Relating to Plastics<sup>2</sup>

D 1763 Specification for Epoxy Resins<sup>3</sup>

D 2290 Test Method for Apparent Hoop Tensile Strength of Plastic or Reinforced Plastic Pipe by Split Disk Method<sup>3</sup>

D 3262 Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe<sup>4</sup>

D 3567 Practice for Determining Dimensions of Fiberglass (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings<sup>4</sup>

D 3892 Practice for Packaging/Packing of Plastics<sup>5</sup>

F 412 Terminology Relating to Plastic Piping Systems<sup>4</sup>

F 477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe<sup>4</sup>

## 3. Terminology

### 3.1 Definitions:

3.1.1 *General*—Definitions are in accordance with Terminologies D 883 and F 412. Abbreviations are in accordance with Terminology D 1600, unless otherwise indicated.

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *fiberglass pipe*—a tubular product containing glass fiber reinforcements embedded in or surrounded by cured thermosetting resin. The composite structure may contain aggregate, granular or platelet fillers, thixotropic agents, pigments or dyes. Thermoplastic or thermosetting liners or coatings may be included.

3.2.2 *reinforced polymer mortar pipe*—a fiberglass pipe with aggregate.

3.2.3 *reinforced thermosetting resin pipe*—a fiberglass pipe without aggregate.

3.2.4 *qualification*—One or more tests used to prove the design of a product. Not a routine quality control test.

NOTE 3—Qualification requirements appear in 6.1, 7.2, and 12.3.

## 4. Materials

### 4.1 Laminating Resin:

<sup>3</sup> Annual Book of ASTM Standards, Vol 08.02.

<sup>4</sup> Annual Book of ASTM Standards, Vol 08.04.

<sup>5</sup> Annual Book of ASTM Standards, Vol 08.03.

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

4.1.1 *Type 1*—Polyester thermosetting resin, with or without fillers or thixotropic agents or both.

NOTE 4—For the purpose of this standard, polyester includes vinyl ester resins.

4.1.2 *Type 2*—Epoxy resin, conforming to the requirements of Specification D 1763, with or without fillers or thixotropic agents, or both.

4.2 *Reinforcement:*

4.2.1 *Grade 1*—A commercial grade of glass fibers with a polyester-compatible finish.

4.2.2 *Grade 2*—A commercial grade of glass fibers with an epoxy-compatible finish.

4.3 *Gaskets*—The elastomeric gaskets used with the fittings joined to pipe shall conform to the requirements of Specification F 477.

**5. Fabrication**

5.1 *Permissible Components:*

5.1.1 Fittings covered under this specification shall be fabricated from cut section of pipe that conform to the requirements of Specification D 3262, or from a combination of such pipe sections and contact molded (hand layup) or machine fabricated components.

5.1.2 Saddles, wrappers, necked flanges, and other components of metal or other dissimilar materials may be incorpo-

rated as agreed upon between purchaser and supplier, provided the materials of such components are resistant to the corrosive effects of the internal and external environments anticipated in service, or are lined or coated or both with materials that provide equivalent protection.

5.2 *Bonding and Laminate Overlay Reinforcements:*

5.2.1 Sections of the fitting shall be aligned and bonded together using polyester (Type 1) or epoxy (Type 2) resin materials with or without fiberglass reinforcement. Fiberglass reinforcement materials shall be compatible with the laminating resin; Grade 1 reinforcements shall be used with Type 1 laminating resin, and Grade 2 reinforcements shall be used with Type 2 laminating resin.

5.2.2 Laminated reinforcing overlays of bonded seams may be applied to either the outside or inside surface of the fitting, or to both inside and outside surfaces. The laminate shall be of chemically resistant construction suitable for the purpose and shall provide the additional strength necessary to meet the physical requirements shown in Table 1. Finished seam overlays shall be built up in two or more successive layers of reinforcement and shall be as crevice free as described in this paragraph and 5.2.3. The width of the first layer shall be 2 in. (50 mm) minimum. Successive layers shall increase uniformly in width to provide the specified minimum total width of overlay that shall be centered on the seam. Table 1 shows

**TABLE 1 Minimum Properties of Structural Laminates**

Nominal Diameter, in. (mm)	Minimum Hoop Tensile Strength, lbf/in. (kN/m) of width <sup>A</sup>	Minimum Axial Tensile Strength, lbf/in. (kN/m) of circumference <sup>A</sup>	Minimum Total Width of Overlay, in. (mm) <sup>B</sup>
8 (203)	1600 (280)	1600 (280)	4 (100)
10 (254)	1600 (280)	1600 (280)	4 (100)
12 (305)	1600 (280)	1600 (280)	4 (100)
14 (356)	1600 (280)	1600 (280)	4 (100)
15 (381)	1600 (280)	1600 (280)	4 (100)
16 (406)	1600 (280)	1600 (280)	4 (100)
18 (457)	1600 (280)	1600 (280)	4 (100)
20 (508)	1600 (280)	1600 (280)	4 (100)
21 (533)	1600 (280)	1600 (280)	4 (100)
24 (610)	1600 (280)	1600 (280)	4 (100)
27 (686)	1600 (280)	1600 (280)	4 (100)
30 (762)	1600 (280)	1600 (280)	4 (100)
33 (838)	1700 (300)	1700 (300)	6 (150)
36 (914)	1800 (315)	1800 (315)	6 (150)
39 (991)	2000 (350)	2000 (350)	6 (150)
42 (1067)	2100 (368)	2100 (368)	6 (150)
45 (1143)	2300 (403)	2300 (403)	6 (150)
48 (1219)	2400 (420)	2400 (420)	8 (200)
51 (1295)	2600 (455)	2600 (455)	8 (200)
54 (1372)	2700 (473)	2700 (473)	8 (200)
60 (1524)	3000 (525)	3000 (525)	8 (200)
66 (1676)	3300 (578)	3300 (578)	10 (250)
72 (1829)	3600 (630)	3600 (630)	10 (250)
78 (1981)	3900 (683)	3900 (683)	10 (250)
84 (2134)	4200 (736)	4200 (736)	12 (300)
90 (2286)	4500 (788)	4500 (788)	12 (300)
96 (2438)	4800 (841)	4800 (841)	14 (350)
102 (2591)	5100 (893)	5100 (893)	16 (400)
108 (2743)	5400 (946)	5400 (946)	16 (400)
114 (2896)	5700 (998)	5700 (998)	16 (400)
120 (3048)	6000 (1051)	6000 (1051)	16 (400)
132 (3353)	6600 (1156)	6600 (1156)	18 (450)
144 (3658)	7200 (1261)	7200 (1261)	20 (500)

<sup>A</sup> The values given are minimums only. Sound engineering practice dictates that all fittings be designed to withstand the loads and conditions anticipated in the service for which they are intended.

<sup>B</sup> The dimensions given are minimums for "butt-and-strap" type joints.

minimum widths of overlays required. The ends of each layer of reinforcement shall be overlapped a minimum of 1 in. (25 mm). Crevices between joined sections shall be filled with a filled resin paste, leaving a smooth inner surface. The interior of the seams shall also be sealed by covering with not less than a 0.03 in. (0.76 mm) thickness of reinforced resin-rich surface that provides corrosion resistance suitable for the intended service. Alternatively, when it is necessary to fabricate a fitting where the size and configuration do not allow adequate access to interior seams, the cut edges of sections shall be sealed prior to assembly and any reinforcing overlay protected by a resin-rich surface that provides corrosion resistance suitable for the intended service.

5.2.3 Components of dissimilar materials, such as steel to polyester or epoxy laminates, or polyester to epoxy laminates, shall be bonded with a resin compound capable of adhering to both materials. The resin compound shall contact the joining surfaces of both components with the spaces between the components filled. The excess resin compound that extrudes from the seam shall be removed, leaving a smooth fillet. Sealing laminates and reinforcing overlays shall be applied where required (see 5.1.1, 5.2.1, and 5.2.2).

**6. Joints**

6.1 The fitting joints shall be coupling or bell-and-spigot in accordance with the joint requirements of Specification D 3262, unless otherwise specified. Joint designs may be qualified on straight sections of pipe.

**7. Physical Requirements**

7.1 Properties of structural laminates, used either as seam reinforcing overlays or as contact molded or machine fabricated components, other than cut sections of pipe, shall be as shown in Table 1, when tested in accordance with 11.1.

7.2 *Shear Strength*—The minimum shear strength of seam reinforcing overlays shall be 500 psi (3.45 MPa) when tested in accordance with 11.2.

**8. Dimensions and Permissible Variations**

8.1 *Wall Thickness*—The wall thickness of any area of the fitting furnished under this specification shall not at any point be less than 87.5 % of the nominal wall thickness published in the manufacturers’ literature current at the time of purchase when measured in accordance with 11.3.1.

8.2 *Fitting Diameters*—Fittings shall be supplied in nominal diameters as given in Specification D 3262. The fitting diameter tolerances shall be as given in Specification D 3262, when measured in accordance with 11.3.2.

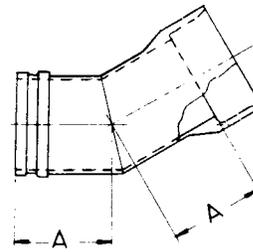
8.3 *Lengths*—The tolerance for the laying length and other significant dimensions shall be ±2 in. (±51 mm) or ±1 % of the dimension, whichever is greater. See Tables 2-6 and Figs. 1 and 2 for typical minimum laying lengths.

8.4 *Angular Dimensions*—Angular dimensions shall have a tolerance of ±1° when measured in accordance with 11.3.4.

**9. Workmanship, Finish, and Appearance**

9.1 The inside surfaces of each fitting shall blend smoothly and shall be free of bulges, dents, ridges, or other irregularities

TABLE 2 0° to 30° Elbow<sup>A</sup>



Pipe Size, in. (mm)	Dimension A <sup>B</sup> , in. (mm)
8 (203)	12 (305)
10 (254)	13 (330)
12 (305)	13 (330)
14 (356)	14 (356)
15 (381)	14 (356)
16 (406)	15 (381)
18 (457)	15 (381)
20 (508)	16 (406)
21 (533)	16 (406)
24 (610)	17 (432)
27 (686)	17 (432)
30 (762)	18 (457)
33 (838)	18 (457)
36 (914)	20 (508)
39 (991)	21 (533)
42 (1067)	22 (559)
45 (1143)	23 (584)
48 (1219)	24 (610)
54 (1372)	25 (635)
60 (1524)	26 (660)
66 (1676)	29 (737)
72 (1829)	29 (737)
78 (1981)	30 (762)
84 (2134)	34 (864)
90 (2286)	36 (914)
96 (2438)	38 (965)
102 (2591)	39 (991)
108 (2743)	41 (1041)

<sup>A</sup> Fitting end configurations other than the typical bell and spigot shown in the figure are acceptable as agreed upon between manufacturer and purchaser. Refer to Section 6.

<sup>B</sup> Dimensions given are typical minimum laying lengths. Laying lengths for fittings larger than 108 in. diameter shall be as agreed upon between purchaser and supplier.

that result in a variation of more than 1/8 in. (3.2 mm) from that obtained on adjacent portions of the surface.

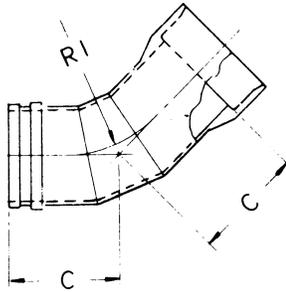
NOTE 5—This requirement is concerned with roughness and waviness and does not apply to diameter tolerances or thickness of internal seam reinforcement if present. See 8.2 for inside diameter tolerances, including internal reinforcement.

9.2 Joint sealing surfaces shall be free of dents, gouges, cracks, and other surface imperfections that will affect the integrity of the joints.

9.3 The inner surface of each reinforced plastic fitting component and connecting seam shall be composed of resin with or without reinforcement, aggregate, or filler. No glass fiber-reinforcement shall penetrate the interior surface of the fitting wall.

9.4 Internal and external reinforcements shall be free of voids, dry spots, cracks, and crazing. Some waviness in the internal reinforcement is permissible so long as the surface is smooth. Unless otherwise agreed upon between purchaser and supplier, all fittings shall meet the visual and repair criteria of Tables 7 and 8.

TABLE 3 31° to 60° Elbow<sup>A</sup>



Pipe Size, in. (mm)	Dimension C <sup>B</sup> , in. (mm)	R1 (45°), in. (mm)
8 (203)	18.5 (470)	12.0 (305)
10 (254)	19.5 (495)	15.0 (381)
12 (305)	20.5 (521)	18.0 (457)
14 (356)	22.0 (559)	21.0 (533)
15 (381)	22.5 (572)	22.5 (572)
16 (406)	23.0 (584)	24.0 (610)
18 (457)	25.0 (635)	27.0 (686)
20 (508)	25.5 (648)	30.0 (762)
21 (533)	26.0 (660)	31.5 (800)
24 (610)	27.5 (699)	36.0 (914)
27 (686)	28.5 (724)	40.5 (1029)
30 (762)	31.0 (787)	45.0 (1143)
33 (838)	33.0 (838)	49.5 (1257)
36 (914)	34.5 (876)	54.0 (1372)
39 (991)	36.5 (927)	58.5 (1486)
42 (1067)	38.0 (965)	63.0 (1600)
45 (1143)	40.5 (1029)	67.5 (1715)
48 (1219)	41.5 (1054)	72.0 (1829)
54 (1372)	45.0 (1143)	81.0 (2057)
60 (1524)	48.5 (1232)	90.0 (2286)
66 (1676)	52.0 (1321)	99.0 (2515)
72 (1829)	55.5 (1410)	108.0 (2743)
78 (1981)	59.0 (1499)	117.0 (2972)
84 (2134)	62.5 (1588)	126.0 (3200)
90 (2286)	66.5 (1689)	135.0 (3429)
96 (2438)	70.0 (1778)	144.0 (3658)
102 (2591)	73.5 (1867)	153.0 (3886)
108 (2743)	77.0 (1956)	162.0 (4115)

<sup>A</sup>Fitting end configurations other than the typical bell and spigot shown in the figure are acceptable as agreed upon between the manufacturer and purchaser. Refer to Section 6.

<sup>B</sup>Dimensions given are typical minimum laying lengths. Laying lengths for fittings larger than 108 in. diameter shall be as agreed upon between purchaser and supplier.

9.5 Fittings shall show good workmanship, including uniformity from item to item.

## 10. Sampling

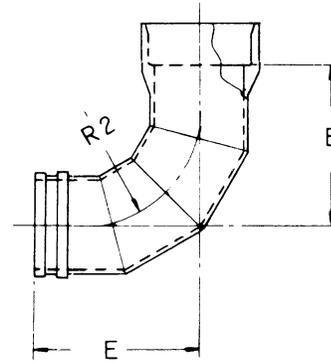
10.1 *Lot*—Unless otherwise agreed upon between purchaser and supplier, one lot shall consist of 100 fittings of each type, grade, and construction of laminate overlay reinforcement, or contact molded or machine fabricated component, or both.

10.2 *Unit Sample*—Select one fitting from each lot. Prepare a sample or representative laminate and test specimens to determine conformance with the requirements of 7.1 for ultimate tensile strength.

## 11. Test Methods

11.1 *Ultimate Tensile Strength*—Determine the ultimate tensile strength of sample laminate specimens cut from seam reinforcing overlays or contact molded or machine fabricated

TABLE 4 61° to 90° Elbow<sup>A</sup>



Pipe Size, in. (mm)	Dimension E <sup>B</sup> , in. (mm)	R2 (90°), in. (mm)
8 (203)	26.0 (660)	12.0 (305)
10 (254)	28.5 (724)	15.0 (381)
12 (305)	31.0 (787)	18.0 (457)
14 (356)	34.5 (876)	21.0 (533)
15 (381)	35.5 (902)	22.5 (572)
16 (406)	37.0 (940)	24.0 (610)
18 (457)	40.5 (1029)	27.0 (686)
20 (508)	43.0 (1092)	30.0 (762)
21 (533)	44.0 (1118)	31.5 (800)
24 (610)	46.0 (1219)	36.0 (914)
27 (686)	49.0 (1308)	40.5 (1029)
30 (762)	53.0 (1422)	45.0 (1143)
33 (838)	58.0 (1549)	49.5 (1257)
36 (914)	63.0 (1638)	54.0 (1372)
39 (991)	68.0 (1778)	58.5 (1486)
42 (1067)	71.0 (1854)	63.0 (1600)
45 (1143)	77.5 (1969)	67.5 (1715)
48 (1219)	80.0 (2070)	72.0 (1829)
54 (1372)	88.0 (2286)	81.0 (2057)
60 (1524)	95.0 (2489)	90.0 (2286)
66 (1676)	103.0 (2705)	99.0 (2515)
72 (1829)	115.0 (2921)	108.0 (2743)
78 (1981)	123.0 (3137)	117.0 (2972)
84 (2134)	131.5 (3340)	126.0 (3200)
90 (2286)	140.0 (3556)	135.0 (3429)
96 (2438)	148.5 (3772)	144.0 (3658)
102 (2591)	157.0 (3988)	153.0 (3886)
108 (2743)	165.5 (4204)	162.0 (4115)

<sup>A</sup>Fitting end configurations other than the typical bell and spigot shown in the figure are acceptable as agreed upon between the manufacturer and purchaser. Refer to Section 6.

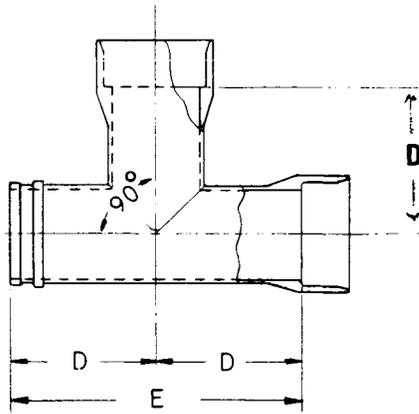
<sup>B</sup>Dimensions given are typical minimum laying lengths. Laying lengths for fittings larger than 108 in. diameter shall be as agreed upon between purchaser and supplier.

components, or from specimens of a laminate fabricated to be consistent in every way with the construction used in the reinforcing overlay or component of the fitting. One or both of the following test methods shall be employed at the manufacturer's option:

11.1.1 *Test Method D 2290*, using Type B specimens, except that the size of the specimens may be modified and speed of testing and rate of crosshead motion shall not apply. Record the load to fail of each specimen and determine the specimen width as close to the break as possible. Use the measured width and failure load to calculate the tensile strength.

11.1.2 *Test Method D 638*, using flat Type I specimens, except that the specimens shall be the actual thickness of the reinforcing overlay or fabricated component and the other dimensions shall be suitable for the specimen thickness and the

TABLE 5 Tee<sup>A</sup>



Pipe Size, in. (mm)	Dimension D <sup>B</sup> , in. (mm)	Dimension E <sup>B</sup> , in. (mm)
8 (203)	15.0 (381)	30.0 (762)
10 (254)	16.0 (406)	32.0 (813)
12 (305)	17.0 (432)	34.0 (864)
14 (356)	18.0 (457)	36.0 (914)
15 (381)	18.5 (470)	37.0 (940)
16 (406)	19.0 (483)	38.0 (965)
18 (457)	20.0 (508)	40.0 (1016)
20 (508)	21.0 (533)	42.0 (1067)
21 (533)	21.5 (546)	43.0 (1092)
24 (610)	24.0 (610)	48.0 (1219)
27 (686)	25.5 (648)	51.0 (1295)
30 (762)	27.0 (686)	54.0 (1372)
33 (838)	28.5 (724)	57.0 (1448)
36 (914)	30.0 (762)	60.0 (1524)
39 (991)	31.5 (800)	63.0 (1600)
42 (1067)	33.0 (838)	66.0 (1676)
45 (1143)	35.5 (902)	71.0 (1803)
48 (1219)	37.0 (940)	74.0 (1880)
54 (1372)	40.0 (1016)	80.0 (2032)
60 (1524)	43.0 (1092)	86.0 (2184)
66 (1676)	47.0 (1194)	94.0 (2388)
72 (1829)	50.0 (1270)	100.0 (2540)
78 (1981)	53.0 (1346)	106.0 (2692)
84 (2134)	56.0 (1422)	112.0 (2845)
90 (2286)	60.0 (1524)	120.0 (3048)
96 (2438)	63.0 (1600)	126.0 (3201)
102 (2591)	66.0 (1676)	132.0 (3353)
108 (2743)	69.0 (1753)	138.0 (3505)

<sup>A</sup> Fitting end configurations other than the typical bell and spigot shown in the figure are acceptable as agreed upon between the manufacturer and purchaser. Refer to Section 6.

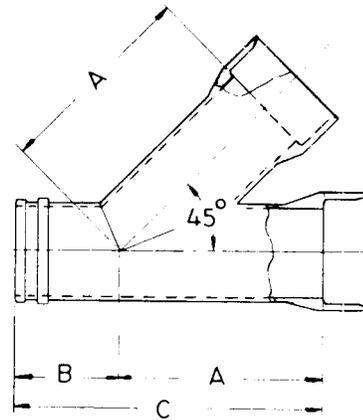
<sup>B</sup> Dimensions given are minimum laying lengths. Laying lengths for fittings larger than 108 in. diameter shall be as agreed upon between purchaser and supplier.

testing apparatus. Specimens may be machined on the edges, but shall not be machined on the surface. Tensile strength shall be the average of five specimens tested at a speed of 0.20 to 0.25 in. (5 to 6.4 mm)/min.

11.1.3 Conduct tests of anisotropic laminates to determine the ultimate tensile strength in both the hoop and axial directions. The ultimate tensile strength of isotropic laminates may be determined in either the hoop or axial direction.

11.2 *Minimum Shear Strength*—Determine the shear strength of axially oriented laminate specimens in accordance with 11.1.2, except that the specimens shall be representative of an overlay reinforced seam joining two cut sections of pipe in straight alignment (See Fig. 3). Calculate the shear strength by dividing the maximum load by the area of both sides of the

TABLE 6 45° Wye<sup>A</sup>



Pipe Size, in. (mm)	Dimension A <sup>B</sup> , in. (mm)	Dimension B <sup>B</sup> , in. (mm)	Dimension C <sup>B</sup> , in. (mm)
8 (203)	24.0 (610)	13.0 (330)	37.0 (940)
10 (254)	26.5 (673)	13.5 (343)	40.0 (1016)
12 (305)	29.0 (737)	13.5 (343)	42.5 (1080)
14 (356)	31.0 (787)	14.0 (356)	45.0 (1143)
15 (381)	32.5 (826)	14.5 (368)	47.0 (1194)
16 (406)	33.5 (851)	14.5 (368)	48.0 (1219)
18 (457)	36.0 (914)	15.0 (381)	51.0 (1295)
20 (508)	38.5 (978)	15.5 (394)	54.0 (1372)
21 (533)	39.5 (1003)	15.5 (394)	55.0 (1397)
24 (610)	43.5 (1105)	16.0 (406)	59.5 (1511)
27 (686)	47.0 (1194)	17.0 (432)	64.0 (1626)
30 (762)	50.5 (1283)	17.5 (445)	68.0 (1727)
33 (838)	54.0 (1372)	18.0 (457)	72.0 (1829)
36 (914)	58.0 (1473)	18.5 (470)	76.5 (1943)
39 (991)	61.5 (1562)	19.0 (483)	80.5 (2045)
42 (1067)	66.0 (1676)	21.0 (533)	87.0 (2210)
45 (1143)	69.5 (1765)	21.5 (546)	91.0 (2311)
48 (1219)	73.5 (1867)	22.0 (559)	95.5 (2426)
54 (1372)	80.5 (2045)	23.5 (597)	104.0 (2642)
60 (1524)	88.0 (2235)	24.5 (622)	112.5 (2858)
66 (1676)	97.0 (2464)	28.0 (711)	125.0 (3175)
72 (1829)	104.5 (2654)	29.0 (737)	133.5 (3391)
78 (1981)	111.5 (2832)	30.0 (762)	141.5 (3594)
84 (2134)	120.0 (3048)	32.5 (826)	152.5 (3874)
90 (2286)	127.0 (3226)	33.5 (851)	160.5 (4077)
96 (2438)	134.5 (3416)	35.0 (889)	169.5 (4305)
102 (2591)	141.5 (3594)	36.0 (914)	176.5 (4483)
108 (2743)	150.0 (3810)	38.5 (978)	188.5 (4788)

<sup>A</sup> Fitting end configurations other than the typical bell and spigot shown in the figure are acceptable as agreed upon between the manufacturer and purchaser. Refer to Section 6.

<sup>B</sup> Dimensions given are typical minimum laying lengths. Laying lengths for fittings larger than 108 in. diameter shall be as agreed upon between purchaser and supplier.

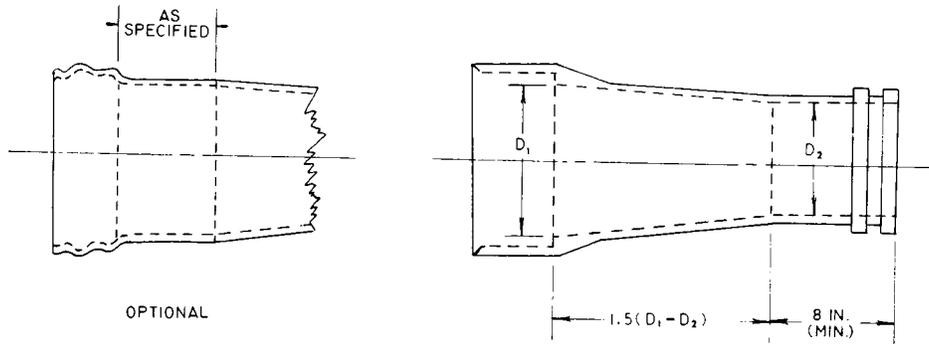
pipe section covered by the reinforcing overlay on one side of the seam. If the specimen does not fail or if the failure occurs outside of the reinforced area, consider the results satisfactory provided the shear strength calculated from the maximum load exceeds 500 psi (3.45 MPa).

11.3 *Dimensions:*

11.3.1 *Wall Thickness*—Determine in accordance with Practice D 3567.

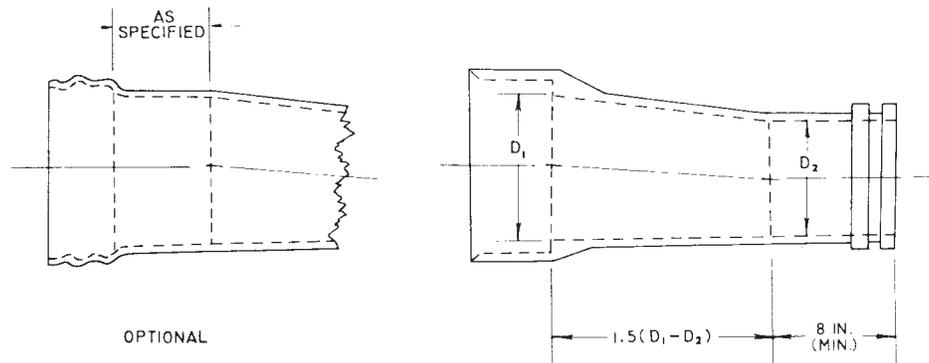
11.3.2 *Inside Diameter*—Determine in accordance with Practice D 3567.

11.3.3 *Outside Diameter*—Determine in accordance with Practice D 3567.



NOTE 1—Fitting end configurations other than the typical bell and spigot shown in the figure are acceptable as agreed upon between the manufacturer and purchaser. Refer to Section 6.

FIG. 1 Concentric Reducer



NOTE 1—Fitting end configurations other than the typical bell and spigot shown in the figure are acceptable as agreed upon between the manufacturer and purchaser. Refer to Section 6.

FIG. 2 Eccentric Reducer

11.3.4 *Lengths*—Determine in accordance with Practice D 3567. Straightedges, levels, squares, and other devices may be employed as required by the configuration of the fitting or component.

11.3.5 *Angular Dimensions*—Measure with a protractor or other suitable device having graduations of 1 deg or less. Straightedges, levels, squares, and other devices may be employed as required by the configuration of the fitting or component. Alternatively, angular dimensions may be calculated from linear measurements.

**12. Inspection**

12.1 Visually and dimensionally inspect each fitting. Discrepancies shall be corrected or the defective fitting shall be rejected, as agreed upon between purchaser and supplier.

12.2 If the results of the test for ultimate tensile strength requirements of 7.1 fall below the required minimums, then, at the option of the supplier, that test shall be repeated on two additional sample laminates representative of that same lot, each of which shall conform to the requirements specified. If either of these two additional samples fail, the lot may be rejected at the option of the purchaser.

12.3 The initial design of reinforcing overlays and fabricated components shall be qualified by dimensional and visual inspection and by testing in accordance with the requirements

of 7.1 and 7.2. The overlay or component shall be requalified when any change occurs in either the resin formulation, the total amount of the reinforcement, the grade or composition of the finish (sizing or coating) of the reinforcement, the application method, or the technique of fabrication.

12.4 Additional inspections and tests shall be as agreed upon by the purchaser and the supplier as part of the purchase contract.

**13. Packaging, Marking, and Shipping**

13.1 Fittings shall be marked on the outside surface in letters not less than 1/2 in. in height and of bold type style in a color and type that will remain legible under normal handling and installation procedures. The marking shall include this ASTM specification number: D 3840, manufacturer's name or trademark, nominal size, and the words "GRAVITY SEWER."

13.2 Fittings shall be prepared for shipment so as to ensure acceptance by common or other carriers.

13.3 All packing, packaging, and marking provisions of Practice D 3892 shall apply to this specification.

**14. Keywords**

14.1 dimensions; fabrication; fiberglass; fittings; overlays; pipe

**TABLE 7 Visual Inspection and Repair Criteria for Inside Surfaces of Fiberglass Pipe Fittings**

Indication	Description	Acceptable Without Repair		Permitted Repair	Maximum Repairs/ft <sup>2</sup>
		Maximum Size	No./ft <sup>2</sup>		
Air bubble (void)	air entrapment within the liner reinforcement	1/16 in. in diameter	2/in. <sup>2</sup>	<sup>A</sup>	10
Chip	small piece broken from edge or surface	1/4 in. long and 1/2 the liner thickness	10	<sup>A</sup>	10
Crack	separation of the laminate extending through the thickness of the liner	none permitted	0	<sup>A</sup>	5
Crazing	fine cracks at or under the surface	none permitted	0	<sup>A</sup>	10
Dry-spot	area where reinforcement was not thoroughly wetted with resin	none permitted	0	<sup>A</sup>	0.35 ft <sup>2</sup> in area
Lack of fill-out	area where resin has drained from reinforcement	1 in. long and 1/2 the liner thickness	5	<sup>A</sup>	0.35 ft <sup>2</sup> in area
Pits (pinholes)	small craters in surface	1/8 in. long and 1/2 the liner thickness	15	<sup>A</sup>	15
Scratch	shallow mark, groove, furrow, or channel	maximum 1/4 of the liner thickness; if exceeds 1/2 of the liner thickness use repair <sup>A</sup>	no limit	<sup>B</sup>	no limit <sup>B</sup> 0.35 ft <sup>2</sup> area <sup>A</sup>
Wrinkle	an imperfection that has the appearance of a wave molded into the reinforcement material	no limit, provided wrinkle has not cracked the structural wall	no limit	none required	0

<sup>A</sup> Permitted repairs—Replace liner material in the discrepant area.

<sup>B</sup> Permitted repairs—Coat with liner resin.

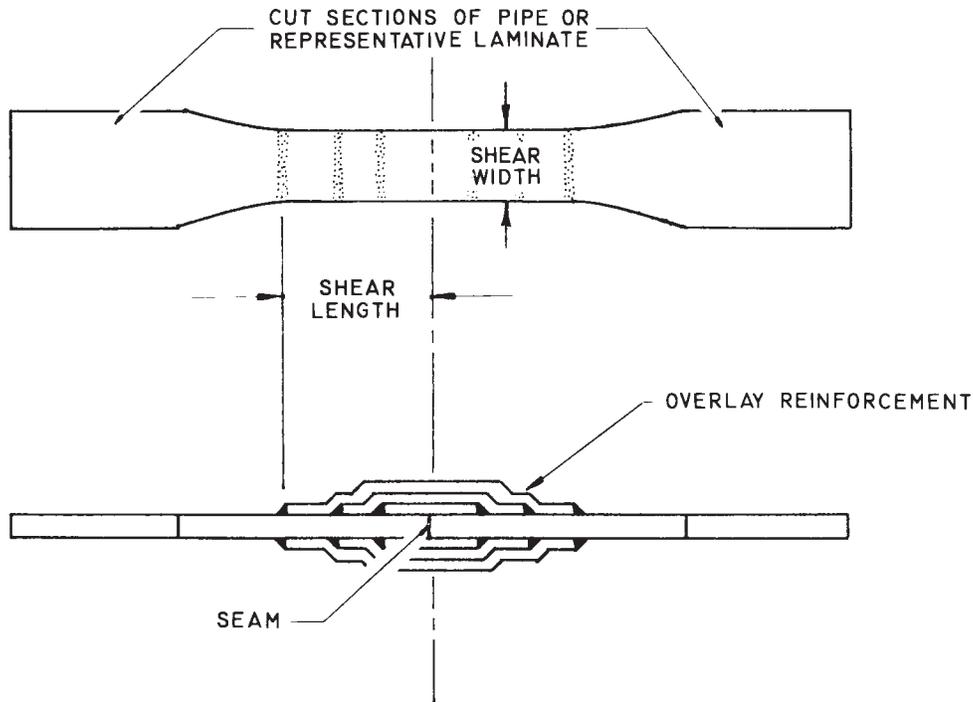
**TABLE 8 Visual Inspection and Repair Criteria for Exterior Surfaces of Fiberglass Pipe Fittings**

Indication	Description	Acceptable Without Repair		Permitted Repair	Maximum Repairs/ft <sup>2</sup>
		Maximum Size	No./ft. <sup>2</sup>		
Burn	thermal decomposition evidenced by distortion or destruction of the surface, or both	5 % of the wall thickness; repair not permitted if decomposition extends beyond 35 % of wall thickness	5	<sup>A</sup>	1
Chip	small piece broken from edge or surface	maximum ¼ in. long by 10 % of wall thickness (NTE ⅛ in. deep); if over ¼ in. deep use repair <sup>B</sup>	2	<sup>A</sup>	5
Crack	separation of the laminate extending through the wall and visible on opposite surfaces	none permitted	0	<sup>A</sup>	5
Cut roving	broken or cut outer rovings due to scraping or scuffing during handling	none permitted; repair not permitted if damage extends beyond 35 % of wall thickness.	0	<sup>A</sup>	1
Crazing	fine cracks at or under the surface, exposing reinforcement	none permitted	0	<sup>A</sup>	5
Drip, resin	resin protrusion	½ in. high	no limit	<sup>C</sup>	no limit
Dry spot	area where reinforcement was not thoroughly wetted with resin	none permitted	0	<sup>B</sup>	5
Fish-eye	small globular mass that has not blended completely into the surrounding material	¼ in. high	no limit	<sup>C</sup>	no limit
Fracture	rupture of laminate surface without complete penetration	none permitted; repair not permitted if fracture penetrates beyond outer ½ of wall thickness	0	<sup>A</sup>	2
Lack of fill-out	area where resin has drained from the reinforcement	2 in. long	5	<sup>B</sup>	0.5 ft <sup>2</sup> in area
Pits (pinholes)	small craters in surface	⅛ in. long with no exposed reinforcement	15	<sup>B</sup>	0.5 ft <sup>2</sup> in area
Scratch	shallow mark, groove, furrow, or channel caused by improper handling	no exposed reinforcement	no limit	<sup>B</sup>	20

<sup>A</sup> Apply a structural overlay extending at least 2 in. beyond the damaged area and resulting in a minimum total wall thickness in the repaired area of the wall thickness of the fitting or component in the affected area.

<sup>B</sup> Coat with resin.

<sup>C</sup> Grind excess to within tolerance.



NOTE 1—The number of layers (symmetrically applied) and shear area may be adjusted, if desired, to assure that shear is the failure mode.  
**FIG. 3 Shear Test Specimen**

### SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue, D 3840–99, that may impact this standard.

(1) Changed acronym, RPMP, definition from reinforced *plastic* mortar pipe to reinforced *polymer* mortar pipe.

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