Designation: F2984 – 13

Standard Specification for Segmental Panel System for the Grout-in-Place-Liner (GIPL) Rehabilitation Method of Existing Man-Entry Size Sewers, Culverts, and Conduits[1]

This standard is issued under the fixed designation F2984; 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 the requirements and test methods for the materials, dimensions, workmanship, and finished quality of injection molded poly vinyl chloride (PVC) profile sections used for the field fabrication of a PVC liner inside existing man-entry size circular and non-circular sewers; circular, non-circular, and box culverts, conduits, and vertical shafts or manholes having dimensions of 39.4 in. and larger (1000 mm and larger).

1.2 The segmental panel system produced under this specification is for non-pressure applications where the PVC liner is installed in the existing structure and the annular space between the liner and the existing structure is grouted with a low viscosity, high strength cementitious grout.

1.3 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.4 *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]

D618 Practice for Conditioning Plastics for Testing

D883 Terminology Relating to Plastics

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

F412 Terminology Relating to Plastic Piping Systems

G195 Guide for Conducting Wear Tests Using a Rotary Platform Abraser

3. Terminology

3.1 *General*—Definitions are in accordance with Terminology D883 and Terminology F412. Abbreviations are in accordance with Terminology D1600, unless otherwise indicated.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 See Fig. 1 to clarify terminology.

3.2.2 *PVC liner, n*—a tubular assembly field fabricated from injection molded PVC profile wall segments which are assembled into rings which are subsequently joined together which substantially conforms to the shape of the inner surface of the existing pipe structure or conduit over some portion of or its entire inner circumference.

3.2.3 *PVC segmental panels, n*—an element available in various geometries, consisting of a smooth inner surface and a ribbed outer surface (profile) with edge configurations to allow mechanical locking and sealing with adjacent panels.

4. Materials and Manufacture

4.1 The molded panel segments shall be made from a PVC compound meeting all of the requirements for a cell classification of 12344 or higher as defined in Specification D1784.

4.2 The sealant material shall be a polyurethane, mono-liquid, moisture setting type flexible gasket that can be applied to the grooved mating faces of the segmental pieces prior to assembly.

4.3 The connecting hardware (connecting screw rods, nuts, and bolts) shall be made of a low carbon, general purpose steel

[1] This test method is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.67 on Trenchless Plastic Pipeline Technology.

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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.

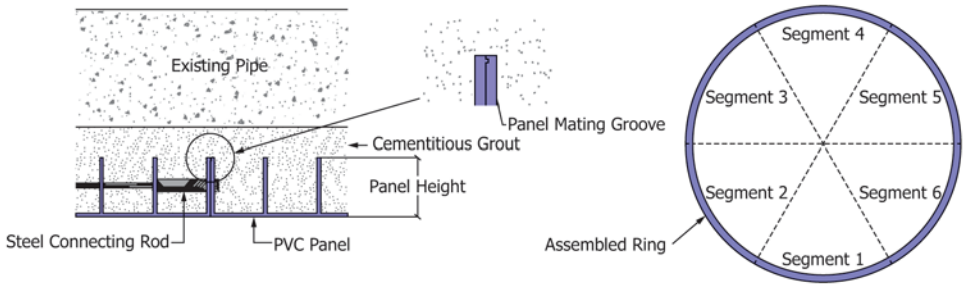


FIG. 1 Segmental Panel System Features

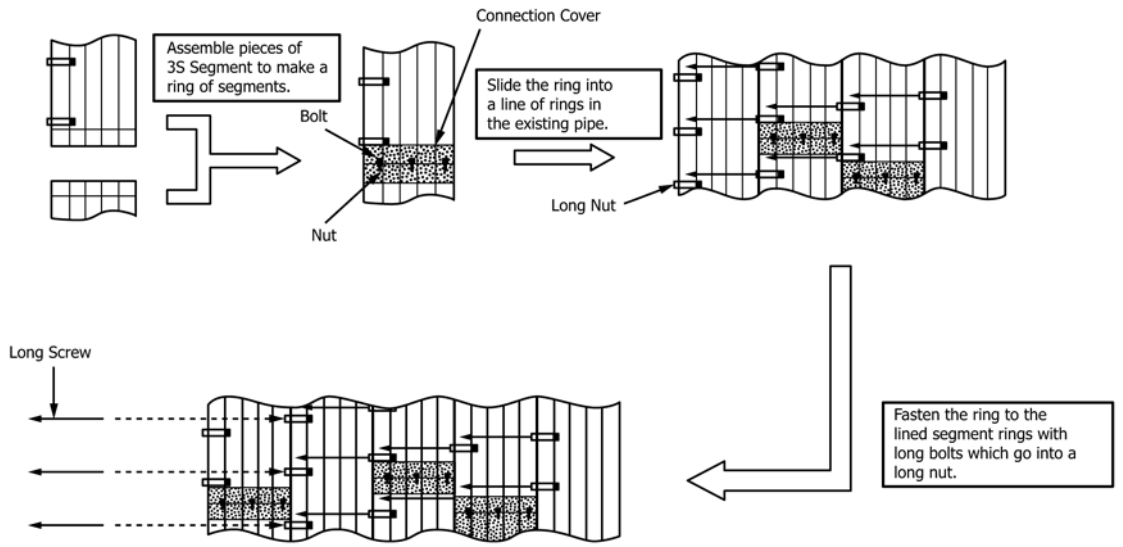


FIG. 2 Details of Fastening the Panel Segments into Rings and the Rings into the Tubular Shell

meeting the SAE designation 1020 that has uni-chrome plating applied, or equivalent.

4.4 *Rework Material*—Clean rework PVC material generated from the manufacturer's own production process may be used in the processing of new pieces provided that the finished product meets all the requirements of this specification.

5. Other Requirements

5.1 *Abrasion Resistance*—The resistance to abrasion of the finished panel materials shall be equivalent to or exceeding that of other PVC sewer pipeline specifications for applications in sanitary and storm sewer systems. In lieu of no abrasion performance requirements being stated in any of the existing PVC pipe standards, abrasion performance shall be obtained by taking a minimum of three samples of the molded panel per production run and abrading the interior wall surface using a Taber Abrasion Test Method as given in referenced Guide G195. The testing shall be done employing an H18 wheel with an applied test load of 1000 grams. The abrasion speed shall be set at 60 revolutions per minute and the test shall be conducted for 1000 continuous revolutions. The test specimens shall be tested at 73.4 ± 3.6°F (23 ± 2°C) in an environment where the relative humidity is 50 ± 5%. Materials deemed acceptable shall have an average mass change/loss for the sample set tested of less than 250 mg.

5.2 *Flexibility of the Assembled Rings*—The flexibility or ring stiffness of the assembled PVC panel segment rings shall be sufficient to allow for the grout's placement in approximately five to six lifts. The flexibility factor, FF, shall be equal to or greater than 0.05. The FF is defined as the span (or diameter) squared divided by EI of the subject panel segment.

5.3 *Joint Leakage*—Water tightness at the connection of one panel segment with another panel segment shall be qualified by performing both an internal and an external test of the joint with the sealant applied. The joint shall show no leakage when a water pressure of 43.5 psi (0.3 MPa) is exerted either internally or externally on the joint for a period of 3 min. This is a qualification test that shall be performed for each new PVC resin compound or new injection mold that is put into production to verify the tightness capabilities of the manufactured pieces therefrom.

6. Dimensions, Mass, and Permissible Variations

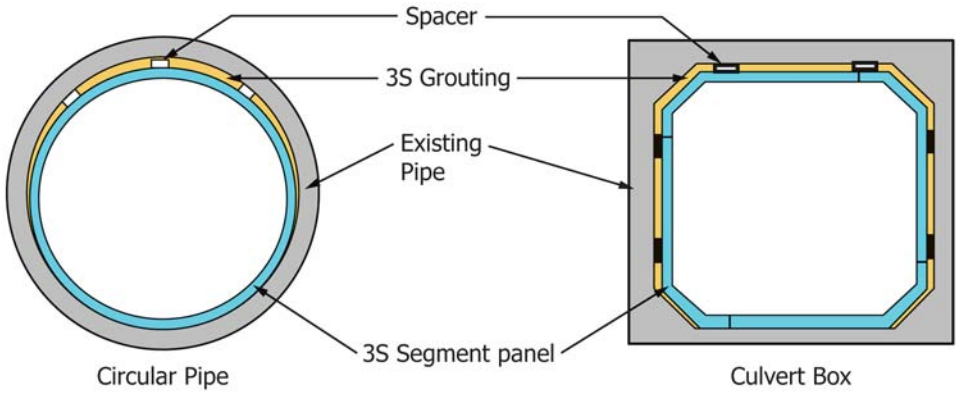
6.1 *Height of the Panel Segments' Profile*—The minimum height of the various panel segments shall be as shown in Tables 1 and 2.

6.2 *Wall Thickness of the Panel Segments*—The minimum average wall thickness between the ribs shall be 0.24 in. (6.0 mm); and no individual measurement shall be less than 0.22 in. (5.5 mm) when measured in accordance with 9.2.2.

TABLE 1 Circular Pipe—Number of Segment Panels and Finished Inner Diameter

Host Pipe (Nominal Inner Diameter), inches (mm)	Panel Segment				
	Segments per ring	Fin. Diameter, inches (mm)	Segment Height, inches (mm)	Moment of Inertia, in^4/in (mm^4/mm)	Neutral Axis Location, inches (mm)
39.4 (1000)	4	36.3 (922)	1.1 (29)	0.0437 (716)	0.35 (8.9)
41.7 (1060)	5	38.6 (980)	1.1 (29)	0.0437 (716)	0.35 (8.9)
43.3 (1100)	4	40.0 (1016)	1.2 (30)	0.0482 (790)	0.37 (9.3)
47.2 (1200)	4	43.8 (1112)	1.2 (30)	0.0482 (790)	0.37 (9.3)
49.2 (1250)	4	45.7 (1160)	1.2 (31)	0.0485 (794)	0.37 (9.4)
53.2 (1350)	4	49.2 (1249)	1.3 (32)	0.0583 (955)	0.39 (10.0)
59.0 (1500)	5	54.2 (1378)	1.4 (36)	0.0820 (1344)	0.45 (11.5)
65.0 (1650)	6	59.9 (1521)	1.5 (39)	0.1032 (1692)	0.50 (12.7)
70.9 (1800)	8	65.4 (1662)	1.7 (43)	0.1365 (2237)	0.56 (14.3)
78.7 (2000)	8	72.7 (1851)	1.9 (48)	0.1864 (3056)	0.65 (16.4)
86.6 (2200)	8	80.3 (2040)	2.1 (53)	0.2464 (4040)	0.73 (18.5)
94.5 (2400)	8	87.8 (2230)	2.3 (58)	0.3173 (5202)	0.82 (20.7)
102.4 (2600)	9	95.0 (2414)	2.4 (60)	0.3489 (5719)	0.85 (21.6)
110.2 (2800)	10	102.6 (2604)	2.5 (64)	0.4176 (6846)	0.92 (23.3)
118.1 (3000)	10	110.2 (2798)	2.6 (66)	0.4549 (7458)	0.95 (24.2)

TABLE 2 Box Culvert—Number of Panels and Finished Dimension



Nominal Inner Size of Structure, inches (mm)	Panel Segment				
	Segments per ring	Fin. Diameter, inches (mm)	Segment Height, inches (mm)	Moment of Inertia, in^4/in (mm^4/mm)	Neutral Axis Location, inches (mm)
39339 (100031000)	4	35.43335.43 (9003900)	1.58 (40)	0.1036 (1698)	0.52 (13.2)
42342 (110031100)	8	38.98338.98 (9903990)	1.58 (40)	0.1036 (1698)	0.52 (13.2)
48348 (120031200)	8	42.52342.52 (108031080)	1.58 (40)	0.1036 (1698)	0.52 (13.2)
54354 (135031350)	8	48.43348.43 (123031230)	1.58 (40)	0.1036 (1698)	0.52 (13.2)
60360 (150031500)	8	54.33354.33 (138031380)	1.58 (40)	0.1036 (1698)	0.52 (13.2)
66366 (165031650)	8	60.24360.24 (153031530)	1.58 (40)	0.1036 (1698)	0.52 (13.2)
72372 (180031800)	8	66.14366.14 (168031680)	1.58 (40)	0.1036 (1698)	0.52 (13.2)
78378 (200032000)	12	74.02374.02 (188031880)	1.58 (40)	0.1036 (1698)	0.52 (13.2)
90390 (220032200)	12	81.89381.89 (208032080)	1.58 (40)	0.1036 (1698)	0.52 (13.2)

6.3 *Width Tolerance of the Panel Segments*—The panel segments are to be typically produced in nominal 7.87 in. (200 mm) widths. Tolerances on this nominal width shall be ± 0.5% when measured in accordance with 9.2.3.

7. Workmanship, Finish, and Appearance

7.1 The injection molded panel segments shall be homogeneous throughout and free from visible cracks, foreign inclusions, or other injurious defects. The panel segments shall be as uniform as commercially practical in color, translucency (enough to visually monitor the cementitious grout's placement during installation), density, and other physical properties.

8. Sampling

8.1 Samples of the molded panel segments shall be taken from each production run to assure the quality of the finished product is achieved.

8.2 The frequency of the sampling shall be as per the manufacturer's internal statistical variation level.

8.3 Initial and any retest samples shall be drawn from the same production run.

9. Test Methods

9.1 *Test Conditions*—Conduct tests in the standard laboratory atmosphere of 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5% relative humidity, with test specimens conditioned in accordance with Procedure A of Practice D618, unless otherwise specified in the test methods or in this specification.

9.2 *Panel Profile Dimensions:*

9.2.1 *Height of the Panel's Profile*—Measure the height of the panel in accordance with Section 6 of Test Method D2122. Measurements shall be made from the smooth surface (finished liner's inner face) to the top of the ribs.

9.2.2 *Wall Thickness of the Inner Wall Surface*—Measure the average wall thickness of the cross-section in the gaps between the ribs in accordance with Section 6 of Test Method D2122.

9.2.3 *Width of the Panel Segment*—Measure the width of the panel segment in accordance with Section 11 of Test Method D2122.

9.3 *Acetone Immersion*—Test shall be run in accordance with Test Method D2152 on full width samples of the panel segment. This procedure is to be used to verify the quality of the injection molded piece as indicated by its reaction to immersion in anhydrous acetone. It is applicable only for distinguishing between unfused and properly fused PVC.

10. Retest and Rejection

10.1 If the results of any of the outlined test(s) do not meet the requirements of this specification, the test(s) may be conducted again in accordance with Section 11. In the retesting the product requirements of this specification shall be met and the test methods designated in this specification shall be met. There shall be no lowering of the minimum requirements of this specification by such means as omitting one or more of the required tests, substituting or modifying a test method, or by changing the specification limits. If, upon retest, failure occurs, the quality of the product represented by the test(s) does not meet the requirements of this specification.

11. Inspection

11.1 Inspection of the material shall be made as agreed upon by the purchaser and the seller as part of the purchase contract.

12. Certification

12.1 When specified in the purchase order or contract, a manufacturer's certification shall be furnished to the purchaser that the material was manufactured, sampled, tested, and inspected in accordance with this specification, and has been found to meet the requirements therein. Each certification so furnished shall be signed by an authorized agent of the manufacturer.

13. Product Marking

13.1 Each injection molded part in compliance with this specification shall be permanently marked with the manufacturer's name or trademark and production code from which plant location, machine, and date of manufacture can be identified.

14. Packaging and Package Marking

14.1 The segmental panel pieces shall be placed on pallets and wrapped for storage and shipping. The joining hardware, positioning wedges or spacers, and connection covers will be boxed up and placed on the pallet as well, or shipped separately. All packaging will clearly identify the materials contained therein, the shipping destination, and reference this standard.

14.2 When the materials are going to be stored at the vendor's site or on the project site for an extended period of time (i.e., greater than 90 days), the pallets should be covered with tarps that will prevent the UV light from degrading the plastic materials. Preferably the storage will be under a roof with temperatures less than 90°F.

15. Quality Assurance

15.1 When this product is marked with this ASTM designation, F2984, 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 the specification.

16. Keywords

16.1 culvert; grouted in place liner; PVC segmental panels; sanitary sewer; storm sewer