Designation: F1697 – 09 (Reapproved 2015)

Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Strip for Machine Spiral-Wound Liner Pipe Rehabilitation of Existing Sewers and Conduit[1,2]

This standard is issued under the fixed designation F1697; 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 requirements and test methods for materials, dimensions, workmanship, stiffness factor, extrusion quality, and a form of marking for extruded poly(vinyl chloride) (PVC) profile strips used for machine made field fabrication of spirally wound pipe liners in the rehabilitation of a variety of gravity applications such as sanitary sewers, storm sewers, and process piping in diameters of 6 to 180 in. and for similar sizes of non-circular pipelines such as arched or oval shapes and rectangular shapes.

1.2 Profile strip produced to this specification is for use in field fabrication of spirally wound liner pipes in nonpressure sewer and conduit rehabilitation, where the spirally wound liner pipe is expanded until it presses against the interior surface of the existing sewer or conduit, or, alternatively, where the spirally wound liner pipe is inserted as a fixed diameter into the existing sewer or conduit and the annular space between the liner pipe and the existing sewer or conduit is grouted.

1.3 This specification includes extruded profile strips made only from materials specified in 5.1.

1.4 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 precautionary 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.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

A167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip (Withdrawn 2014)[4]

A176 Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip (Withdrawn 2015)[4]

A653/A653M Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

A879/A879M Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface

A924/A924M Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

D618 Practice for Conditioning Plastics for Testing

D790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

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

[1] This specification 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] The rehabilitation of existing pipelines and conduits by the insertion of a spiral wound liner pipe is covered by patents. (RibLoc Group Limited, Dry Creek, South Australia, Australia and Danby of North America, Inc., Cary, NC, USA). Interested parties are invited to submit information regarding the identification of acceptable alternatives to this patented item to the Committee on Standards, ASTM Headquarters, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Your comments will receive careful consideration at a meeting of the responsible technical committee which you may attend.

[3] 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.

[4] The last approved version of this historical standard is referenced on www.astm.org.

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

F412 Terminology Relating to Plastic Piping Systems
F1741 Practice for Installation of Machine Spiral Wound Poly (Vinyl Chloride) (PVC) Liner Pipe for Rehabilitation of Existing Sewers and Conduits

NOTE 1—F1741 Practice for Installation of Machine Spiral Wound Poly (Vinyl Chloride) (PVC) Liner Pipe for Rehabilitation of Existing Sewers and Conduits, is an accompanying standard to this document.

2.2 *Federal Standard:*
Federal Standard No. 123 Marking for Shipment (Civil Agencies)[5]
2.3 *Military Standard:*
MIL-STD-129 Marking for Shipment and Storage[5]

3. Terminology

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

3.2 *Definitions of Terms Specific to This Standard:*
3.2.1 *extruded PVC profile strips*—a product, available in various widths, consisting of a smooth inside surface and a ribbed outer surface with mechanically locked male and female edges which are self interlocking, or separate locking strips which serve the same purpose. Type A and Type B are different profiles an are installed by different installation methods. (See Fig. 1 and Table 1 for Type A and Fig. 2 and Table 2 for Type B.)

3.2.2 *non-circular pipe*—arched, oval or rectangular, or a combination thereof, shaped pipes.

3.2.3 *production run*—a continuous extrusion of a given profile type.

3.2.4 *spirally wound liner pipe*—a product field fabricated from extruded PVC profile strip into a round, or non-circular shape such as arched or oval or rectangular pipe (see Fig. 3).

3.2.5 *steel reinforcement*—a shaped steel strip or clip inserted into the inside of the PVC profile to provide additional reinforcement and stiffening (See Fig. 4 and Fig. 5.)

4. Application of Materials

4.1 The profile strip designations specified in Table 1 may be used for a range of existing sewer and conduit diameters. The selection of the profile designation to be used should be determined based on analysis of installation conditions.

4.2 The steel reinforcing strips shall be used to reinforce the extruded PVC profile strip where required by the design conditions, such as for pipes under high soil, surcharge or live loads throughout the design life. The steel reinforcing strips may be used to maintain the profile position during grouting.

5. Materials and Manufacture

5.1 *PVC Materials*—The extruded profile strip shall be made from PVC compound meeting all the minimum requirements for Cell Classifications 12344 or 13454 or higher, as defined in Specification D1784.

5.2 *Steel Materials*—The steel reinforcing strip shall be made of zinc-galvanized coated steel or stainless steel as defined in Specifications A879/A879M, A167, A176, A924/A924M or A653/A653M.

5.3 *Rework Material*—Clean rework material generated from the manufacturer's own extruded PVC strip production may be used by the same manufacturer provided extruded profile strip produced meets all the requirements of this specification.

6. Other Requirements

6.1 *Stiffness Factor*—Stiffness factor values for the extruded profile strip shall comply with Table 1 when tested in accordance with 11.3.

6.2 *Acetone Immersion*—The profile strip shall not flake or disintegrate when tested in accordance with 11.4.

NOTE 2—This is intended only for use as a quality control test and not for use as a simulated service test.

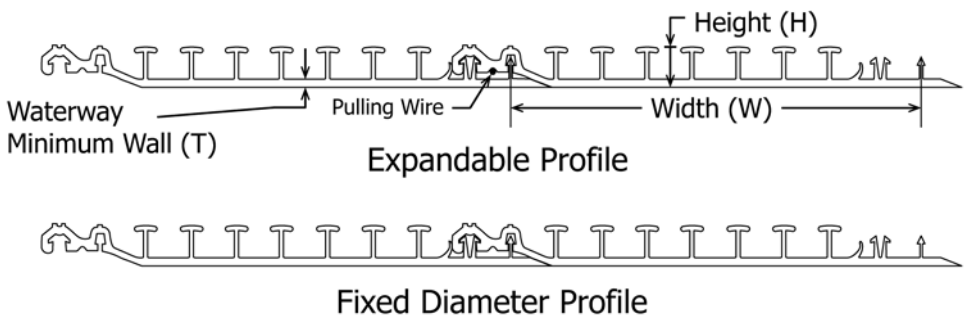
7. Dimensions and Permissible Variation

7.1 *Width of Profile Strip*—The width of the profile strip shall meet the requirements given in Table 1 when measured in accordance with 11.2.1.

7.2 *Height of Profile Strip*—The height of the profile strip shall meet the requirements given in Table 1 when measured in accordance with 11.2.2.

7.3 *Waterway Wall Thickness*—The waterway wall thickness of the profile strip shall meet the requirements given in Table 1 when measured in accordance with 11.2.3.

[5] Available from DLA Document Services, Building 4D, 700 Robbins Ave., Philadelphia, PA 19111-5094, http://quicksearch.dla.mil.



NOTE 1—For values of width, height, and waterway minimum wall, see Table 1.

FIG. 1 Type A-Typical PVC Profile Strip

TABLE 1 Type A-Typical Profile Strip Dimensions and Stiffness Factors

Profile Type	Minimum Width, W		Minimum Height, H		Waterway Minimum Wall, T		Minimum Stiffness Factor, (EI)[A]	
	in.	(mm)	in.	(mm)	in.	(mm)	$in.^3$-lbf/$in.^2$	(MPa-mm^3)
1	2.00	(51.0)	0.216	(5.5)	0.063	(1.60)	188.0	(21.2×10^3)
2	3.14	(80.0)	0.314	(8.0)	0.063	(1.60)	561	(63.4×10^3)
3	4.76	(121.0)	0.511	(13.0)	0.083	(2.10)	2148	(242.7×10^3)
4	4.33	(110.0)	0.480	(12.2)	0.040	(1.00)	1600.0	(180.8×10^3)
5	8.00	(203.2)	0.488	(12.4)	0.060	(1.50)	1600.0	(180.8×10^3)
6	12.00	(304.8)	0.488	(12.4)	0.060	(1.50)	1600.0	(180.8×10^3)

[A] Stiffness factor listed is the minimum value that will be provided by the manufacturer for the given profile type.

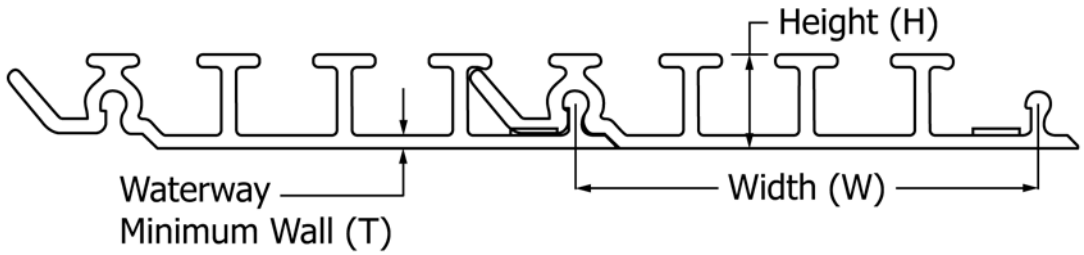


FIG. 2 Type B-Typical PVC Profile Strip

TABLE 2 Type B-Typical Profile Strip Dimensions and Stiffness Factors

Profile Type	Minimum Width, W		Minimum Height, H		Waterway Minimum Wall, T		Minimum Stiffness Factor, (EI)[A]	
	in.	(mm)	in.	(mm)	in.	(mm)	$in.^3$-lbf/$in.^2$	(MPa-mm^3)
1	3.19	(81.0)	0.32	(8.10)	0.06	(1.44)	362.5	40955
2	3.09	(78.3)	0.42	(10.71)	0.06	(1.62)	745.0	84127
3	2.84	(72.0)	0.58	(14.67)	0.09	(2.34)	1946.3	219900
4	2.80	(71.1)	0.76	(19.35)	0.12	(3.06)	3971.0	448656
5	2.81	(71.28)	1.12	(28.53)	0.15	(3.69)	14116.0	1594900
6	3.60	(91.44)	0.56	(14.22)	0.06	(1.44)	1513.8	171042

[A] Stiffness factor listed is the minimum value that will be provided by the manufacturer for the given profile type.

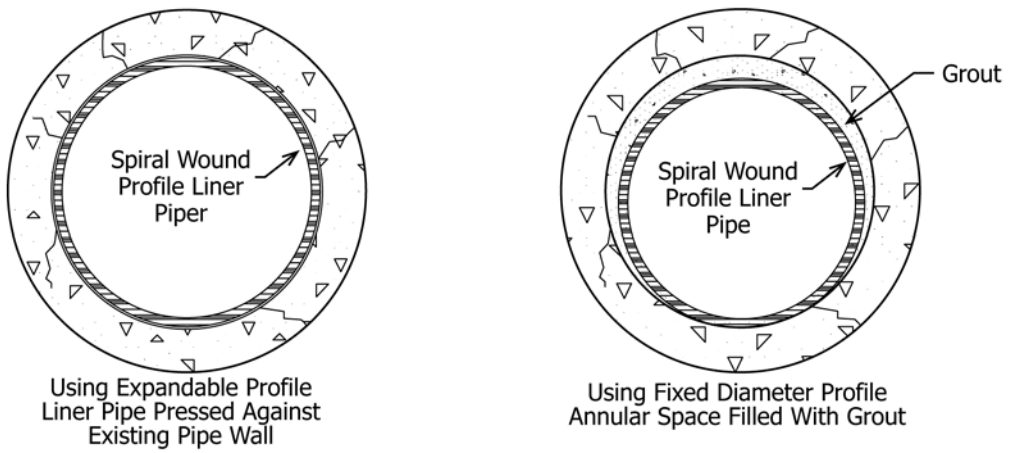


FIG. 3 Typical Spiral-Wound Liner Pipe

FIG. 4 Steel Reinforcing Strip Type A

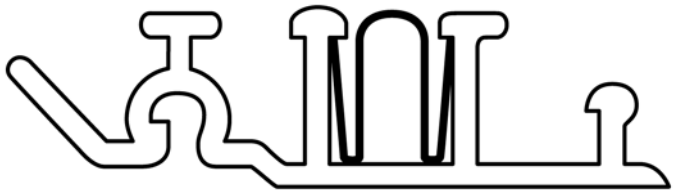


FIG. 5 Steel Reinforcing Strip Type B

8. Workmanship, Finish, and Appearance

8.1 The extruded profile strip shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. The extruded profile strip shall be as uniform as commercially practical in color, opacity, density, and other physical properties.

9. Significance and Use

9.1 The requirements of this specification are intended to provide extruded PVC profile strip suitable for the field fabrication of spirally wound liner pipe for the rehabilitation of existing pipelines and conduits conveying sewage, process flow, and storm water under gravity flowconditions.

NOTE 3—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.

10. Sampling

10.1 Samples of extruded profile strip of sufficient length to conduct the necessary quality control tests shall be cut from each extrusion production run of a given profile designation.

10.2 The frequency of sampling shall be as agreed upon between the purchaser and the seller.

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

11. Test Methods

11.1 *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.

11.2 *Extruded Profile Dimensions:*

11.2.1 *Width of Profile Strip*—Measure the width of the profile strip in accordance with the applicable sections of Test Method D2122 for determining length of pipe.

11.2.2 *Height of Profile Strip*—Measure the height of the profile strip in accordance with the applicable sections of Test Method D2122 for determining wall thickness. Measurements shall be made from the smooth surface to the outer surface of the ribs.

11.2.3 *Wall Thickness*—Measure the wall thickness of the thinnest cross section of the waterway in the gaps between ribs in accordance with Test Method D2122.

11.3 *Stiffness Factor*—A flat (no curvature) specimen not less than 12 in. (300 mm) long, including an assembled joint, shall be prepared from each production run. Using the specimen oriented as shown in Fig. 6, the stiffness factor shall be determined in accordance with Test Methods D790, Tangent Modulus of Elasticity, Procedure B, where the equation for E_B is replaced by $EI = L^3m/48\ b$. Procedure B of Test Methods D790 shall be used in this test. The calculated stiffness factor

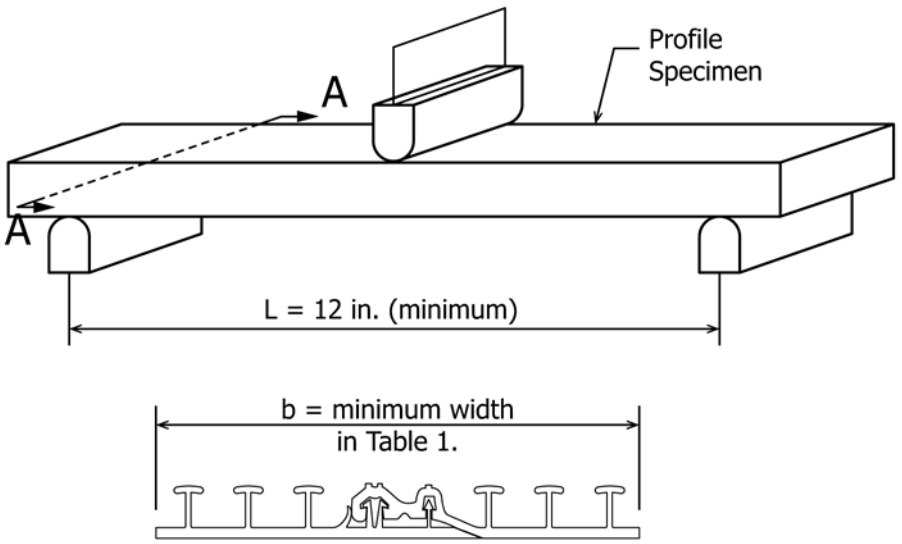


FIG. 6 Stiffness Factor Specimen Orientation

shall equal or exceed the minimum value listed in Table 1 for the profile type tested.

NOTE 4—The stiffness factors determined by test should not be used to calculate pipe stiffness.

11.4 *Acetone Immersion*—Tests shall be run in accordance with Test Method D2152 on profile strip samples. This procedure is used for determining the extrusion quality of extruded PVC profile strip as indicated by reaction to immersion in anhydrous acetone. It is applicable only for distinguishing between unfused and properly fused PVC.

11.5 *Joint Tightness*—Each profile type in Table 1 shall be tested for joint tightness.

11.5.1 Fabricate a length of spiral-wound liner pipe, either expanded or fixed diameter, with a minimum length of six times the outside diameter. Assemble this length of liner pipe as shown in Fig. 7. The opening may be sealed using end caps or mechanical sealing devices.

11.5.2 Perform the pressure and vacuum tests as described in 11.5.5 and 11.5.6 on the liner pipe in straight alignment.

11.5.3 Suitably restraining the pipe deflect it to form a minimum angle of 10° at a bend radius specified by the manufacturer as shown in Fig. 8. Hold this position and perform pressure and vacuum tests as described in 11.5.5 and 11.5.6.

NOTE 5—As an example some profile liner pipe manufacturers recommend a bend radius equal to 150 times the pipe outside diameter.

11.5.4 Restrain the liner pipe at both ends as shown in Fig. 8, Fig. 9 and apply a load at the middle of the liner pipe until the point of load application has moved downward 5 % of the liner pipe's outside diameter. Hold this position and perform pressure and vacuum tests as described in 11.5.5 and 11.5.6.

11.5.5 *Internal Pressure Test*—Fill the liner pipe assembly with water. Apply a pressure of 10.8 psi (74 kPa) (gage) (25-ft. head) for 10 min. Visible leaks in the joint constitute failure.

11.5.6 *Vacuum Test*—Fill the liner pipe assembly with air only. Apply a vacuum of 22 in. Hg (74 kPa). Close the valve and remove the vacuum line. Allow the assembly to stand for 10 min to check for leaks before testing. The internal pressure shall not change more than 1 in. Hg (3 kPa). Perform the test required, noting the internal pressure after the test condition is attained and again 10 min later. The internal pressure shall not change more than 5 in. Hg (17 kPa) during this second 10-min period. Some profile types (see Table 1) may not have the capability of withstanding the 22-in. Hg (74-kPa) vacuum test. In such cases, the joint may be considered as meeting these criteria if the test liner pipe incorporating a strengthened wall with exposed joint meets the criteria satisfactorily.

NOTE 6—It may be found easier to perform all the pressure tests, followed by the vacuum tests, rather than alternate them. As an option, the sequence of tests may be pressure, vacuum, pressure for each condition in 11.5.2, 11.5.3, and 11.5.4.

NOTE 7—The test methods described for the liner pipe joints are not intended to be routine quality control tests but to be reliability or performance requirements.

12. Inspection

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

13. Retest and Rejection

13.1 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.

14. Certification

14.1 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. When specified in the purchase order or contract, a report of the test results shall be furnished. Each certification so furnished shall be signed by an authorized agent of the manufacturer.

15. Product Marking

15.1 Extruded profile strip in compliance with this specification shall be clearly marked at intervals of 30 ft (9.0 m) or less as follows:

15.1.1 Manufacturer's name or trademark and production code from which plant location, machine, and date of manufacture can be identified.

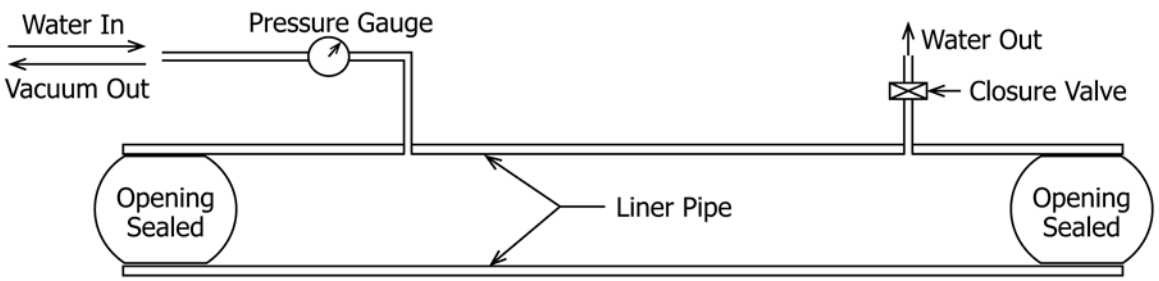


FIG. 7 Test Specimen in Straight Alignment

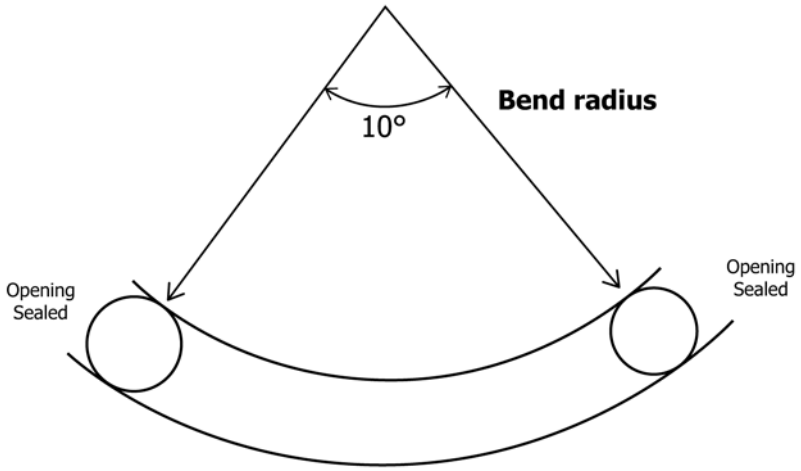


FIG. 8 Test Specimen in Axial Misalignment

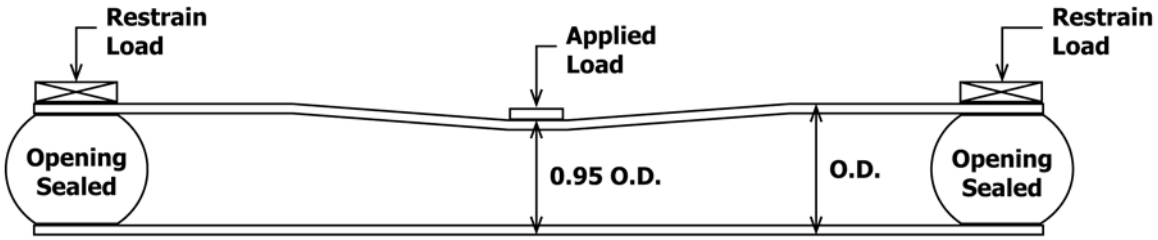


FIG. 9 Test Specimen in Shear Deflection

15.1.2 Profile type, for example, Type 1, Type 2, and so forth.

15.1.3 The PVC cell classification, for example "13454C".

15.1.4 This designation "Specification F1697."

16. Packaging

16.1 The extruded PVC profile strip is coiled onto a reel in a continuous length for storage and shipping.

17. Quality Assurance

17.1 When the product is marked with this designation, F1697, 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.

18. Keywords

18.1 expandable; gravity applications; grouted; machine-made; PVC profile strip; rehabilitation; spiral-wound liner 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 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 Motors Freight Classification rules.

S2.2 *Marking*—Marking for shipment shall be in accordance with Federal Standard 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.

SUMMARY OF CHANGES

Committee F17 has identified the location of selected changes to this standard since the last issue (F1697–08$^{\varepsilon 1}$) that may impact the use of this standard. (Approved April 1, 2009.)

(1) Revision of wording in 11.3.

(2) Revision of Fig. 6.

Committee F17 has identified the location of selected changes to this standard since the last issue (F1697–07) that may impact the use of this standard.

(1) Revision of wording in 4.2.
(2) Table 2: changes to Waterway minimum wall values and minimum width values to correct conversion errors.