Designation: F2922 – 13[ε1]

Standard Specification for Polyethylene (PE) Corrugated Wall Stormwater Collection Chambers[1]

This standard is issued under the fixed designation F2922; 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.

ε[1] NOTE—5.3.8 and 5.3.9 were editorially corrected in December 2013.

1. Scope*

1.1 This specification covers requirements, test methods, materials, and marking for polyethylene (PE), open bottom, buried arch-shaped chambers of corrugated wall construction used for collection, detention, and retention of stormwater runoff. Applications include commercial, residential, agricultural, and highway drainage, including installation under parking lots and roadways.

1.2 Chambers are produced in arch shapes with dimensions based on chamber rise, chamber span, and wall stiffness. Chambers are manufactured with integral feet that provide base support. Chambers may include perforations to enhance water flow. Chambers must meet test requirements for arch stiffness, flattening, and accelerated weathering.

1.3 Analysis and experience have shown that the successful performance of this product depends upon the type and depth of bedding and backfill, and care in installation. This specification includes requirements for the manufacturer to provide chamber installation instructions to the purchaser.

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 safety hazards caveat pertains only to the test method portion, Section 6, 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]

D618 Practice for Conditioning Plastics for Testing
D1600 Terminology for Abbreviated Terms Relating to Plastics
D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
D2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
D2990 Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics
D3350 Specification for Polyethylene Plastics Pipe and Fittings Materials
D4329 Practice for Fluorescent Ultraviolet (UV) Lamp Apparatus Exposure of Plastics
D4703 Practice for Compression Molding Thermoplastic Materials into Test Specimens, Plaques, or Sheets
D6992 Test Method for Accelerated Tensile Creep and Creep-Rupture of Geosynthetic Materials Based on Time-Temperature Superposition Using the Stepped Isothermal Method
F412 Terminology Relating to Plastic Piping Systems
F2136 Test Method for Notched, Constant Ligament-Stress (NCLS) Test to Determine Slow-Crack-Growth Resistance of HDPE Resins or HDPE Corrugated Pipe
F2787 Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers

3. Terminology

3.1 *Definitions*—Definitions used in this specification are in accordance with the definitions in Terminology F412, and abbreviations are in accordance with Terminology D1600, unless otherwise indicated.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *chamber*—an arch-shaped structure manufactured of thermoplastic with an open-bottom that is supported on feet

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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

and may be joined into rows that begin with, and are terminated by, end caps (see Fig. 1).

3.2.2 *chamber storage capacity*—the bare chamber storage capacity excluding storage in end caps, stone porosity, distribution piping or other distribution components.

3.2.3 *corrugated wall*—a wall profile consisting of a regular pattern of alternating crests and valleys (see Fig. 2).

3.2.4 *crest*—the element of a corrugation located at the exterior surface of the chamber wall, spanning between two web elements (see Fig. 2).

3.2.5 *crown*—the center section of a chamber typically located at the highest point as the chamber is traversed circumferentially.

3.2.6 *end cap*—a bulkhead provided to begin and terminate a chamber, or row of chambers, and prevent intrusion of surrounding embedment materials.

3.2.7 *foot*—a flat, turned out section that is manufactured with the chamber to provide a bearing surface for transfer of vertical loads to the bedding (see Fig. 1).

3.2.8 *inspection port*—an opening in the chamber wall that allows access to the chamber interior.

3.2.9 *nominal height*—a designation describing the approximate vertical dimension of the chamber at its crown (see Fig. 1).

3.2.10 *nominal width*—a designation describing the approximate outside horizontal dimension of the chamber at its feet (see Fig. 1).

3.2.11 *period*—the length of a single repetition of the repeated corrugation, defined as the distance from the centerline of a valley element to the centerline of the next valley element (see Fig. 2).

3.2.12 *rise*—the vertical distance from the chamber base (bottom of the chamber foot) to the inside of a chamber wall valley element at the crown as depicted in Fig. 1.

3.2.13 *span*—the horizontal distance from the interior of one sidewall valley element to the interior of the other sidewall valley element as depicted in Fig. 1.

3.2.14 *valley*—the element of a corrugated wall located at the interior surface of the chamber wall, spanning between two webs (see Fig. 2).

3.2.15 *web*—the element of a corrugated wall that connects a crest element to a valley element (see Fig. 2).

4. Materials and Manufacture

4.1 The chamber and end caps shall be made of virgin PE plastic compound meeting the requirements of Specification D3350 cell classification 516500C or 516500E, except that the carbon black content shall not exceed 3%. Compounds that have a higher cell classification in one or more properties shall be permitted provided all other product requirements are met. For slow crack growth resistance, acceptance of resins shall be determined by using the notched constant ligament-stress (NCLS) test on a finished compounded resin according to the procedure described in 6.2.11. The chamber sample shall be ground and a test plaque made in accordance with Practice D4703 Procedure C at a cooling rate of 27°F/min (15°C/min) and tested per 6.2.11. The average failure time of test specimens from plaques shall not be less than 100 h.

4.2 *Rework Material*—In lieu of virgin PE, clean rework material generated from the manufacturer's own chambers may be used, provided the material meets the cell class requirements of 4.1.

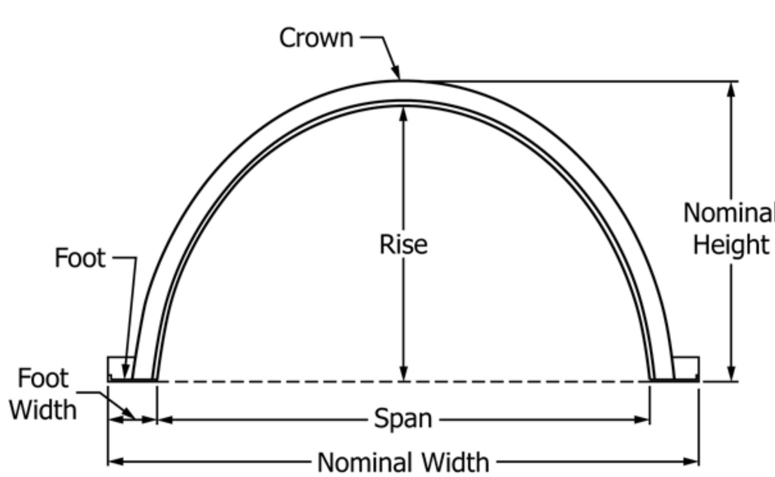
5. Requirements

5.1 *Chamber Description:*

5.1.1 Chambers shall be produced in arch shapes symmetric about the crown with corrugated wall and integral or attached feet for base support (see Fig. 1). Any arch shape is acceptable provided all the requirements of this specification are met.

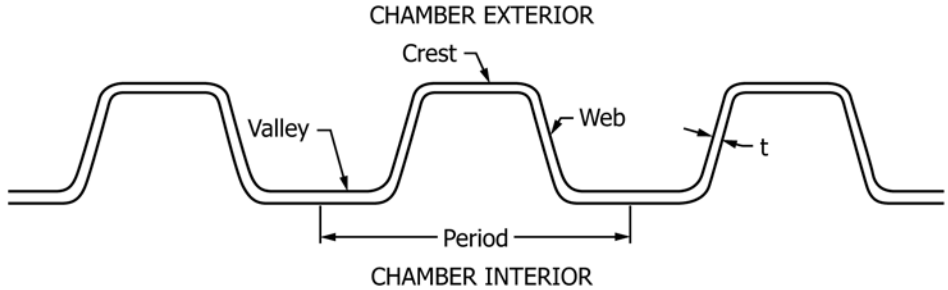
NOTE 1—For purposes of structural optimization, the wall geometry (for example, corrugation height, crest width, valley width, and web pitch) may vary around the chamber circumference.

5.1.2 Chambers shall be produced with maximum span at the base of the chamber (bottom of the chamber foot).



The model chamber shown in this standard is intended only as a general illustration. Any arch-shape chamber configuration is permitted, as long as it meets all the specified requirements of this standard.

FIG. 1 Model Chamber



The corrugation profile shown in this standard is intended only as a general illustration. Any corrugation pattern is permitted, as long as it meets all the specified test requirements of this standard.

FIG. 2 Model Corrugated Wall

5.1.3 Chambers may include access ports for inspection or cleanout. Chambers with access ports shall meet the requirements of this standard with access ports open and closed.

5.1.4 Chambers may include provisions for hydraulic connections at various locations around the chamber. Chambers with hydraulic connections through the chamber shall meet the requirements of this standard with hydraulic connections *(1)* closed and *(2)* with the hydraulic connection fitting installed.

5.1.5 Chambers may include perforations. Perforations shall be cleanly fabricated in a size, shape, and pattern determined by the manufacturer. Chambers with perforations shall meet the requirements of this standard.

5.1.6 Chambers may include integral, repeating end walls. Chambers with integral repeating end walls shall meet the requirements of this standard at all locations along the chamber length. The chamber shall be capable of carrying the full load for which it was designed at all locations along the chamber length.

5.1.7 Chamber sections shall be manufactured to connect at the ends to provide rows of various lengths. Joints shall be configured to prevent intrusion of the surrounding embedment material and shall be capable of carrying the full load for which the chamber is designed.

5.1.8 Each row of chambers shall begin and terminate with an end cap. End caps may be an integral part of the chamber or a separate component. End caps that are injection molded shall meet the requirements of this standard.

5.1.9 Chamber classifications, dimensions, and tolerances are provided in Table 1. Chamber classifications are based on the nominal height and nominal width of the chambers, as illustrated in Fig. 1. Classifications shall be manufactured with the specified rise and span with tolerances, minimum foot width, and wall thickness requirements.

NOTE 2—The values for arch stiffness in Table 1 should not be considered comparable to values of pipe stiffness.

5.2 *Workmanship*—The chambers shall be homogeneous throughout and essentially uniform in color, opacity, density, and other properties. The interior and exterior surfaces shall be free of chalking, sticky, or tacky material. The chamber walls shall be free of cracks, blisters, voids, foreign inclusions, or other defects that are visible to the naked eye and may affect the wall integrity.

5.3 *Physical and Mechanical Properties of Finished Chamber:*

5.3.1 *Wall Thickness*—Chambers shall have minimum and average wall thicknesses not less than the wall thicknesses shown in Table 1 when measured in accordance with 6.2.1.

5.3.2 *Minimum Foot Width*—Chambers shall have a foot width not less than the minimum foot width as shown in Table 1 when measured in accordance with 6.2.2 (see also Fig. 1).

5.3.3 *Rise and Span Dimensions*——Chambers shall meet the rise and span dimension requirements shown in Table 1 when measured in accordance with Sections 6.2.3 and 6.2.4 (see also Fig. 1).

5.3.4 *Deviation From Straightness*—The chamber and its support feet shall not have a deviation from straightness greater than L/100, where L is the length of an individual chamber, when measured in accordance with 6.2.5.

NOTE 3—This check is to be made at the time of manufacture and is included to prevent pre-installation deformations in a chamber that meets all other requirements of this standard.

TABLE 1 Chamber Classifications, Dimensions, and Tolerances

Chamber Classification	Nominal Height	Nominal Width	Rise		Span		Minimum Foot Width	Wall Thickness		Minimum Arch Stiffness Constant
			Average	Tolerance ±	Average	Tolerance ±		Average	Minimum	
	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	lb/ft/%
16×33	16 (406)	33 (838)	13.5 (343)	1.0 (25)	25.0 (635)	1.0 (25)	4.0 (100)	0.130 (3.3)	0.120 (3.0)	300
30×51	30 (762)	51 (1295)	27.0 (686)	1.0 (25)	44.0 (1118)	1.1 (28)	4.0 (100)	0.180 (4.6)	0.165 (4.2)	300

5.3.5 *Storage Capacity*—Manufacturers shall provide the storage capacity of the bare chamber and end cap and a stage storage table for the chamber and end cap. Reported values shall be based on components "as-assembled" to eliminate double counting storage at joints and end caps. Volume determination shall be in accordance with 6.2.6.

5.3.6 *Creep Rupture Strength*—Specimens fabricated in the same manner and composed of the same materials including all additives, as the finished chambers shall have a 50 year creep rupture tensile strength at 73 °F (23°C) not less than 700 psi (4.8 MPa) when determined in accordance with 6.2.7.

5.3.7 *Creep Modulus*—Specimens fabricated in the same manner and composed of the same materials including all additives, as the finished chambers shall have a 50 year tensile creep modulus at 73 °F (23°C) of not less than 20,000 psi (138 MPa) when tested at a stress level of 500 psi (3.5 MPa) or the design service stress, whichever is greater. The creep modulus shall be determined in accordance with 6.2.8. The actual test derived creep modulus shall be used in the design of the chamber.

NOTE 4—The specified minimum modulus provides assurance of long-term stiffness for a chamber resin. It does not provide assurance that all chambers manufactured with a resin of this stiffness will be adequate for all long-term load conditions. Structural calculations to demonstrate adequacy are still required in accordance with 5.5 and 5.6.2.

NOTE 5—The 50 year creep rupture strength and 50 year creep modulus values, determined by the test methods in 6.2.7 and 6.2.8, are used to define the slope of the logarithmic regression curves to describe the required material properties sampled from the product. They are not to be interpreted as service life limits.

5.3.8 *Arch Stiffness Constant*—Chambers shall have an arch stiffness constant (ASC) not less than the minimum arch stiffness constant shown in Table 1 when determined in accordance with 6.2.9.

5.3.9 *Flattening*—Chambers shall show neither splitting, cracking, or breaking under normal light and the unaided eye nor loss of load carrying capacity when tested in accordance with 6.2.10.

5.3.10 *Slow Crack Growth Resistance*—compression molded samples from the finished chamber shall exhibit an average failure time of not less than 100 hrs when tested for slow crack growth resistance in accordance with 6.2.11.

5.4 *Accelerated Weathering*—Specimens fabricated in the same manner and composed of the same materials as the finished chambers shall meet all material requirements in 4.2 after accelerated weathering described in 4.1.

5.5 *Design and Installation Requirements*—Chambers shall be structurally designed in accordance with Practice F2787. The chamber manufacturer shall provide the purchaser with the requirements for the proper installation of chambers and the minimum and maximum allowable cover height for specific traffic and non-traffic loading conditions that meet the requirements of Practice F2787.

5.6 *Design Data:*

5.6.1 *Hydraulic Data*—The manufacturer shall provide the purchaser with data required for hydraulic design, including chamber length, storage volume, stage-storage, and number, size and location of access ports and perforations.

5.6.2 *Structural Data*—If requested by the purchaser, the chamber manufacturer shall provide data to enable verification of structural design safety factors, including chamber geometry, wall centroid, wall area, wall moment of inertia, and material strain limits.

5.7 *Installation Qualification*—The manufacturer shall verify the installation requirements and design basis with full-scale installation qualification testing of representative chambers under design earth and live loads, in accordance with Practice F2787.

6. Test Methods

6.1 *Conditioning*—Condition all test specimens in accordance with Procedure A of Practice D618 at 73.4 ± 3.6 °F (23 ± 2 °C) and 50 ± 5% relative humidity for not less than 4 h prior to test. Conduct tests under the same conditions of temperature and humidity, unless otherwise specified in the test method.

6.2 *Physical and Mechanical Properties of Finished Chamber:*

6.2.1 *Wall Thickness:*

6.2.1.1 *Standard Measurement*—Measure the wall thickness of chambers in accordance with the requirements of Test Method D2122. Take readings at a minimum of two locations along the longitudinal axis of the chamber. At each longitudinal location, take readings at a minimum of eight positions evenly spaced around the circumference of the chamber. At each circumferential position take four readings across the corrugation profile (see Fig. 2), one at the valley, one at the crest, and one at each web. Report the minimum and average thickness for all the measurements. Where mold flow channels create thickness variations within the chamber wall, exclude this area from the readings and report the thickness of the flat region of the chamber wall adjacent to the flow channel. At end corrugations, where chamber corrugations will overlap with adjacent chambers or end caps, the required thickness may be reduced to 75% of the thickness in Table 1.

6.2.1.2 *Nondestructive Measurement*—Use of properly calibrated ultrasonic thickness tester is permitted under this specification.

6.2.2 *Foot Width*—Measure the width of the chamber feet (see Fig. 1) by taking three measurements on each foot, one at each end of the chamber and one at mid-length. Report the minimum and average width for each foot (that is, average of three measurements).

6.2.3 *Rise*—Measure the rise on a chamber placed on a flat, level surface and subjected to no loads in excess of self-weight. Measure the maximum vertical dimension from the level surface to the inside face of the valley at the chamber crown (see Fig. 1) at three locations, one at each end of the chamber and one at mid-length. Report the average of the three measurements.

6.2.4 *Span*—Measure the span on a chamber placed on a flat, level surface and subjected to no loads in excess of self-weight. Measure the horizontal dimension from the inside surface of the valley across the chamber interior to the opposing inside valley surface at the chamber foot (see Fig. 1) at three locations, one at each end of the chamber and one at mid-length. Report the average of the three measurements.

6.2.5 *Deviation From Straightness*—Deviation from straightness measurements shall be performed on the chamber, placed on a flat, level surface and subjected to no loads in excess of self-weight (see Fig. 3). Take a total of three measurements, one along the chamber crown and one along each foot. Draw a straight line from each end of the chamber element being measured. Record the maximum deviation from the straight line at any point along the chamber length.

6.2.6 *Storage capacity*—Determine the storage volume of the bare chamber and end cap by physical methods using actual chambers as produced in accordance with this standard. Physical methods require filling the inverted chamber or end cap with an incompressible material and measuring the volume required to fill the component. The volume shall be based on a horizontal plane across the bottom of the chamber feet and vertical planes across the open ends at the centerline of the chamber joint or face of the end cap. Volumes by physical methods shall be conducted three times. Report the average of the three measurements to the nearest 0.1 ft^3. Alternatively, computer modeling may be used as long as the physical shape and dimensions of the finished products standard are properly represented in the computer model.

6.2.7 *Creep Rupture Strength*—Determine creep rupture strength at 73°F (23°C) in accordance with tensile creep test methods in Test Method D2990, except as follows. Tests shall include an additional stress level selected so as to produce rupture at approximately 10 000 hrs. Alternatively, use time-temperature superposition methods.

6.2.8 *Creep Modulus*—Determine creep modulus at 73°F (23°C) in accordance with tensile creep test methods in D2990, except as follows. Test duration shall be 10 000 hrs. Tests shall include a minimum of 5 stress levels that are selected in approximately even increments up to 500 psi (3.5 MPa) or the design service stress, whichever is greater. Alternatively, use time-temperature superposition methods.

NOTE 6—The time-temperature superposition method in Test Method D6992 may be used to determine the tensile creep modulus and tensile creep rupture strength.

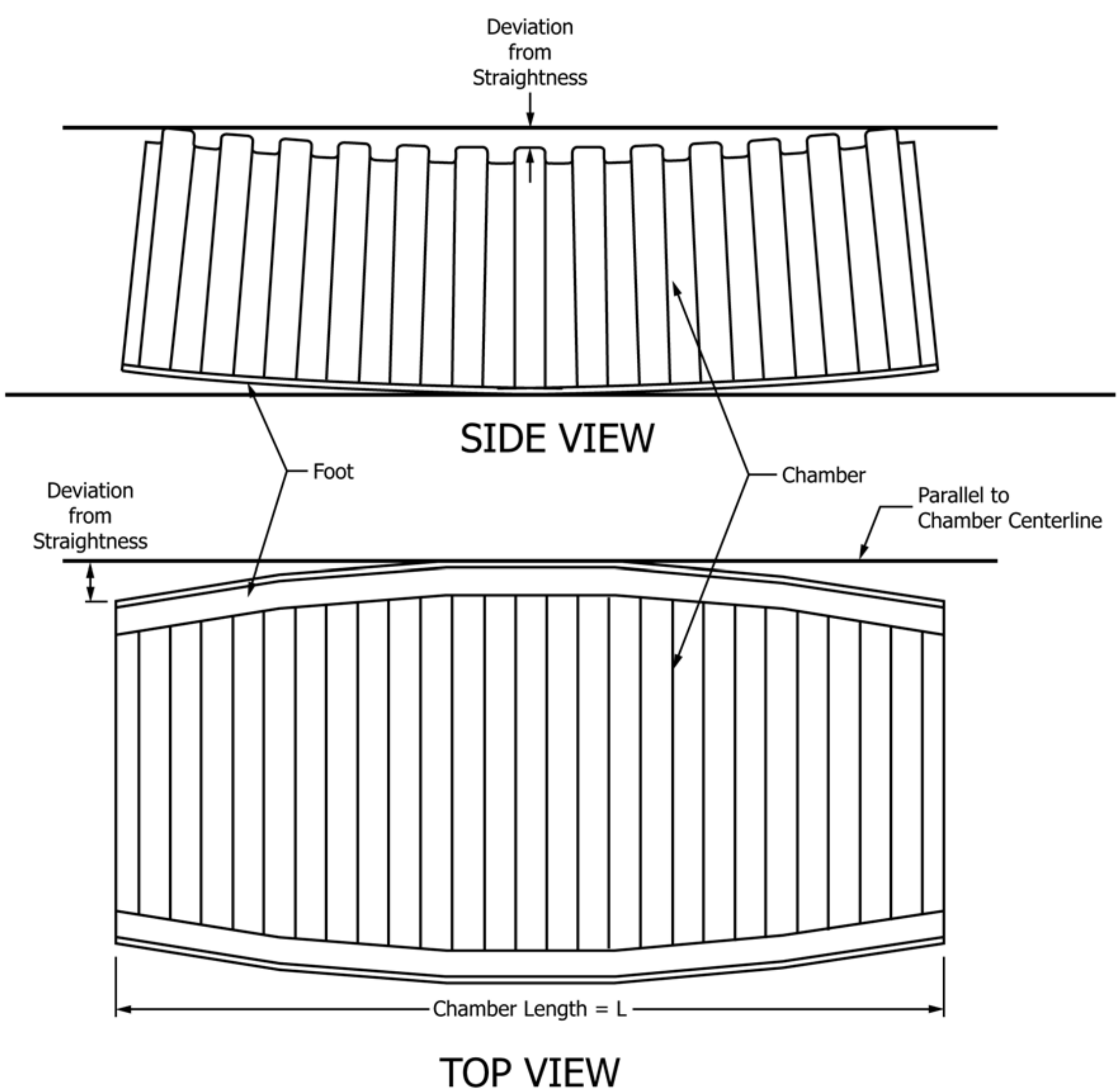


FIG. 3 Measurement of Deviation From Straightness (shape exaggerated for illustration)

6.2.9 *Arch Stiffness Constant*—Determine the ASC by dividing the plate load (F/L in Fig. 4,) in pounds per foot of chamber, by the resulting deflection, in percent, at 2% deflection. The test shall be conducted in accordance with Test Method D2412 with the following modifications:

6.2.9.1 The total specimen length shall be a minimum of two full periods of the corrugation. Specimen ends shall be squarely cut.

6.2.9.2 Specimens shall include representatives of the lowest chamber stiffness with respect to perforations, access ports, or varying geometry.

6.2.9.3 Throughout testing, crosshead motion shall be maintained at a constant rate equal to 2.0 ± 0.2% of the average rise (Table 1) per minute.

6.2.9.4 The chamber foot shall be restrained against lateral motion at the outer edge of the foot. The foot shall be free to rotate. Fig. 4 shows a suggested method for foot restraint.

6.2.9.5 Calculate the Arch Stiffness Constant as follows:

$$ASC = F/(\Delta y \times L)\ (lb/ft/\%\ deflection) \quad (1)$$

where:

F = plate load to cause 2 % vertical deflection (lb)
L = length of test specimen (ft)
Δy = test deflection (%) = 2

6.2.10 *Flattening*—After determining the load at vertical deflection equal to 2% of the rise in accordance with 6.2.5, continue the test at the same crosshead speed until vertical deflection equals 8% of the original rise, then inspect under normal light and the unaided eye.

6.2.11 *Slow Crack Growth Resistance*—Test specimens from the chamber wall in accordance with Test Method F2136, except for the following modifications.

6.2.11.1 The applied stress shall be 230 psi (1.72 MPa).

6.2.12 *Accelerated Weathering*—Test in accordance with Practice D4329, Cycle A, for a minimum exposure time of 500 h.

7. Sampling, Inspection, and Retest

7.1 *Sampling and Inspection*—If sampling is requested by the purchaser, reasonable notice shall be given to the manufacturer to accommodate the sampling request. Unless otherwise specified, a minimum of 5 randomly selected samples shall be tested.

7.1.1 *Access*—The manufacturer shall afford the purchaser all reasonable facilities for determining whether the chamber meets the requirements of this specification.

7.2 *Retest and Rejection*—If the results of any test(s) do not meet the requirements of this specification, the test(s) shall be conducted again only if agreed to by the purchaser and the seller. There shall be no agreement to lower the minimum requirements of the specification, substitute or modify a test method, or change the specification limits. In retesting, the product requirements of this specification shall be met and the test methods designated in this specification shall be followed. If failure occurs upon retest, the quantity of product represented by the test(s) does not meet the requirements of this specification.

8. Certification

8.1 When specified in the purchase order or contract, a manufacturer's certification shall be furnished to the purchaser that the material was designed, manufactured and tested 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.

9. Marking

9.1 Marking on the chambers shall include the following:

9.1.1 The letters "ASTM" followed by the designation number of this specification.

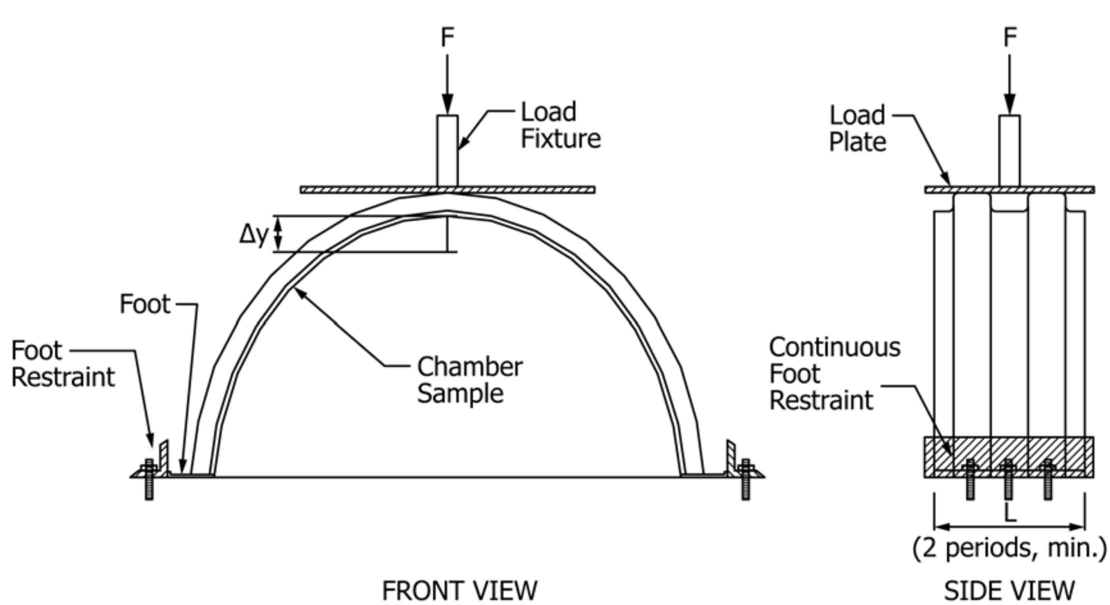


FIG. 4 Arch Stiffness and Flattening Test Model Configuration

9.1.2 The letters "PE" followed by the material classification.

9.1.3 The product name which identifies unique chamber geometry.

9.1.4 The name or trademark of the manufacturer.

9.1.5 The production code from which location and date of manufacture can be identified.

10. Packaging

10.1 Unless otherwise specified in the contract, materials shall be packaged in accordance with the supplier's standard practice in a manner ensuring arrival at the destination in satisfactory condition.

11. Quality Assurance

11.1 When the product is marked with this designation, F2922, 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 this specification.

12. Keywords

12.1 ASC; arch stiffness constant; chamber; corrugated wall; end cap; detention; drainage; exfiltration; first flush; infiltration; PE; polyethylene; retention; stormwater; subsurface; thermoplastic; underground

SUMMARY OF CHANGES

Committee F17 has identified the location of selected changes to this standard since the last issue (F2922-12$^{\varepsilon 1}$) that may impact the use of this standard.

(1) Rise average, rise tolerance, span average, and span tolerance were revised in Table 1.