Designation: F2418 – 09

An American National Standard

Standard Specification for Polypropylene (PP) Corrugated Wall Stormwater Collection Chambers[1]

This standard is issued under the fixed designation F2418; 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, test methods, materials, and marking for polypropylene (PP), open bottom, buried 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 *This standard does not purport to address water quality issues or hydraulic performance requirements associated with its use. It is the responsibility of the user to ensure that appropriate engineering analysis is performed to evaluate the water quality issues and hydraulic performance requirements for each installation.*

1.6 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]

D256 Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
D618 Practice for Conditioning Plastics for Testing
D638 Test Method for Tensile Properties of Plastics
D790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
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
D4101 Specification for Polypropylene Injection and Extrusion Materials
D4329 Practice for Fluorescent UV Exposure of Plastics
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

2.2 *AASHTO Specification:*

Section 12 Buried Structures and Tunnel Liners, 12.12 Thermoplastic Pipes[3]

[1] This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.65 on Land Drainage.
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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.

[3] AASHTO LRFD Bridge Design Specifications-Dual Units, Third Edition, 2004. Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001.

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

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.

3.1.1 *chamber*—an arch-shaped structure manufactured of thermoplastic with an open-bottom that is supported on feet and may be joined into rows that begin with, and are terminated by, end caps (see Fig. 1).

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

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

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

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

3.1.6 *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).

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

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

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

3.1.10 *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).

3.1.11 *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.

3.1.12 *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.

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

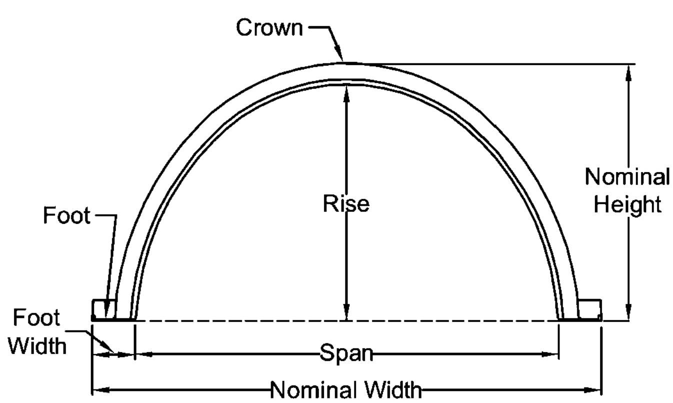
3.1.14 *web*—the element of a corrugated wall that connects a crest element to a valley element (see Fig. 2).

4. Materials and Manufacture

4.1 This specification covers chambers made from virgin and rework PP plastic materials as defined by material mechanical requirements and chamber performance requirements.

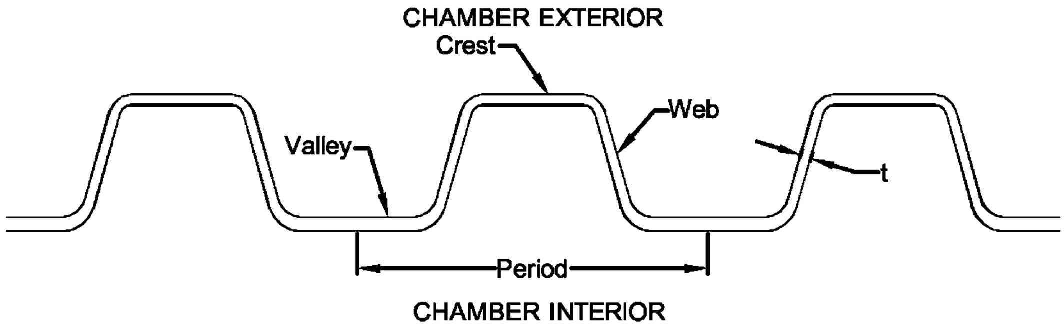
4.2 Polypropylene materials may be combined with copolymers, pigments, and impact modifiers which together are suitable for manufacture. Manufactured chamber and end cap material shall meet or exceed the requirements of designation PP0330B99945, Specification D4101. The minimum amount of polypropylene plastic in the material shall be 95 % by weight. The minimum tensile stress at yield, Test Method D638, shall not be less than 3 100 psi (21 MPa). The minimum flexural modulus (1 % secant), Test Method D790, Procedure A, shall not be less than 145 000 psi (1 000 MPa). The minimum Izod Impact Resistance at 73 ºF (23 ºC), Method A in Test Method D256, shall not be less than 4 ft-lb/in. (215 J/m). Materials shall meet the creep requirements in 5.3.5 and 5.3.6 of this standard.

NOTE 1—The polypropylene melt flow rate is specified for chamber manufacture by injection molding. The melt flow rate may be less than 10 if the manufactured chamber meets all other requirements in this standard. This cell class will be re-evaluated when new chamber classifications are added to Table 1.



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

FIG. 1 Model Chamber



NOTE—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

TABLE 1 Classifications, Dimensions, and Tolerances

Chamber Classification	Nominal Height	Nominal Width	Rise		Span		Minimum Foot Width	Minimum Wall Thickness	Minimum Arch Stiffness Constant[A]
	in. (mm)	in. (mm)	Average in. (mm)	Tolerance ± in (mm)	Average in. (mm)	Tolerance ± in (mm)	in. (mm)	in. (mm)	lb/ft/%
16×33	16 (406)	33 (838)	13.1 (333)	0.4 (10)	24.3 (617)	0.4 (10)	4.0 (100)	0.125 (3.18)	300
30×51	30 (762)	51 (1295)	26.7 (678)	0.4 (10)	42.6 (1082)	0.4 (10)	4.0 (100)	0.175 (4.45)	300

[A] The values for arch stiffness should not be considered comparable to values of pipe stiffness.

NOTE 2—Polypropylene plastic is prepared by the polymerization of propylene or propylene with other alpha olefins as described in Specification D4101.

4.3 *Rework Material*—Clean rework material generated from the manufacturer's own chambers may be used by the same manufacturer, using the same type and grade resin, provided that the chambers produced meet all the requirements of this specification.

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 feet for base support (see Fig. 1). Any arch shape is acceptable provided all the requirements of this specification are met.

NOTE 3—For purposes of structural optimization, the wall geometry (e.g. 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).

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 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.

5.1.5 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.

5.1.6 Each row of chambers shall begin and terminate with an end cap.

5.1.7 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 minimum wall thickness.

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 *Minimum Wall Thickness*—Chambers shall have a wall thickness not less than the minimum wall thickness 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 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 4—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.

5.3.5 *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 ºF (23 ºC) not less than 700 psi (4.8 MPa), when determined in accordance with 6.2.6.

5.3.6 *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 ºF (23 ºC) not less than 24 000 psi (165 MPa) when tested at a stress level of 500 psi (3.5 MPa) or design service stress, whichever is greater. The creep modulus shall be determined in accordance with 6.2.7. The actual test derived creep modulus shall be used in the design of the chamber (Note 5).

NOTE 5—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 with 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 6—The 50 year creep rupture strength and 50 year creep modulus values, determined by the test methods in 6.2.6 and 6.2.7, 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.

5.3.7 *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 6.2.8.

5.3.8 *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 6.2.9.

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 6.3.

5.5 *Installation Requirements*—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. The installation requirements shall be based on a design that satisfies the safety factors specified in the AASHTO LRFD Bridge Design Specifications, Section 12.12 for Thermoplastic Pipe for earth and live loads, with consideration for impact and multiple vehicle presences.

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.

6. Test Methods

6.1 *Conditioning*—Condition all test specimens in accordance with Procedure A of Practice D618 at 73.4 ± 3.6 ºF (23 ± 2 ºC) 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 in accordance with the requirements of Test Method D2122. Make at least two sets of readings along the longitudinal axis of the chamber. Each set shall include a minimum of 8 readings, evenly spaced, around the circumference of the chamber. Report the minimum and average thickness for each set of measurements. Where gas assist flow channels create void spaces within the chamber wall, exclude the void space from the reported thickness reading.

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 (i.e. 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.