ASTM F2418 â€“ Testing Requirements for Polypropylene Corrugated Wall Stormwater Chambers

Description

Introduction

ASTM F2418 â€“ Standard Specification for Polypropylene (PP) Corrugated Wall Stormwater Collection Chambers establishes material requirements, dimensional requirements, mechanical performance criteria, test procedures, sampling rules, acceptance criteria, and marking requirements for polypropylene underground stormwater chambers.

These chambers are open-bottom, arch-shaped thermoplastic structures designed for underground collection, detention, and retention of stormwater.

Typical applications include:

- Commercial drainage systems
- Residential stormwater systems
- Agricultural drainage
- Highway drainage
- Parking areas
- Roadways
- Underground stormwater retention systems
- Underground infiltration and detention installations

Because these chambers are installed below ground and are continuously exposed to soil loads, traffic loads, installation stresses, environmental ageing, and long-term polymer creep, ASTM F2418 evaluates both **short-term structural performance and long-term material behaviour**.

The major qualification requirements include:

- Polypropylene material properties
- Chamber dimensions
- Wall thickness
- Foot width
- Rise and span
- Straightness
- 50-year creep rupture strength
- 50-year creep modulus
- Arch Stiffness Constant (ASC)
- Flattening resistance
- Accelerated UV weathering

- Full-scale installation qualification

1. Construction of the Stormwater Chamber

The chamber is an arch-shaped structure having an open bottom.

The main structural features are:

- Crown
- Corrugated wall
- Crests
- Valleys
- Webs
- Integral feet
- End connections
- Optional inspection ports
- Optional perforations

The maximum chamber span occurs at the base of the chamber.

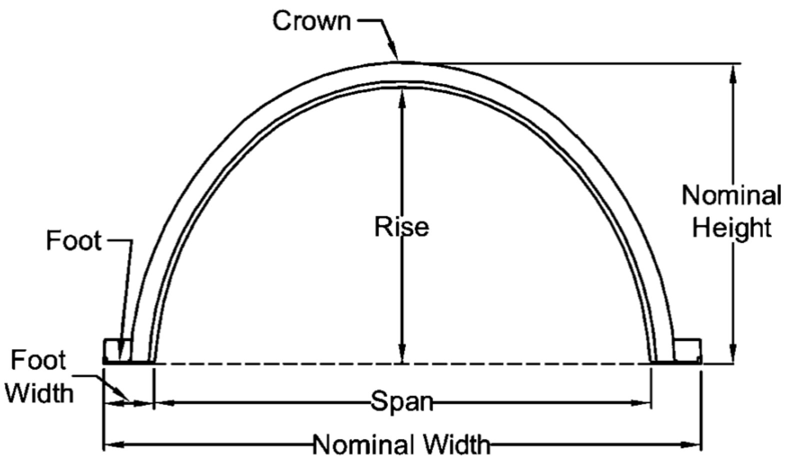
The feet provide the bearing surfaces through which vertical chamber loads are transferred to the bedding and foundation.

Chamber sections may be joined together longitudinally to create rows of different lengths.

The joints must:

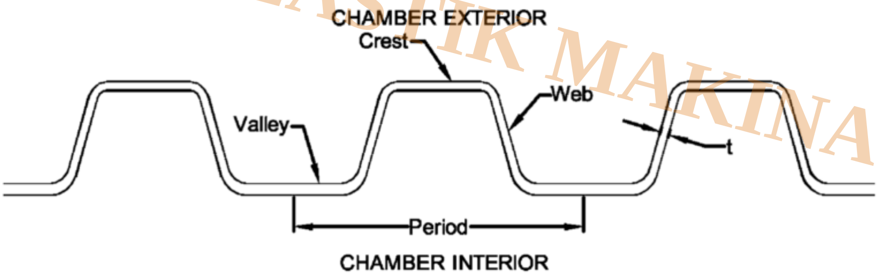
- Prevent intrusion of surrounding embedment material
- Maintain chamber alignment
- Carry the full structural load for which the chamber is designed

Each row begins and terminates with an end cap.



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

2. Polypropylene Material Requirements

The chamber and end-cap material must comply with the applicable polypropylene classification requirements.

The material classification specified by ASTM F2418 is: **PP0330B99945 according to ASTM D4101**

The polypropylene content of the material must be at least: **95% by weight**

The polymer formulation may include appropriate:

- Copolymers
- Pigments
- Impact modifiers
- Processing additives

provided the final material and chamber satisfy all requirements of ASTM F2418.

3. Reworked Material

Clean reworked polypropylene generated from the manufacturerâ€™s own chamber production may be reused.

However:

- The rework must originate from the same manufacturer.
- The same type and grade of resin must be used.
- The finished chamber must continue to satisfy every requirement of ASTM F2418.

Use of rework does not reduce any acceptance requirement.

4. Minimum Tensile Yield Strength

The PP material must be tested according to:

ASTM D638 â€“ Tensile Properties of Plastics

The minimum tensile stress at yield is: **21 MPa**

or: **3100 psi**

Therefore:

Tensile Stress at Yield â‰¥ 21 MPa â†’ PASS

Tensile Stress at Yield < 21 MPa â†’ FAIL

The tensile test equipment should consist of a calibrated universal testing machine equipped with:

- Appropriate tensile grips
- Calibrated load cell
- Controlled crosshead movement
- Suitable extensometer where required
- Data acquisition system

TABLE 1 Classifications, Dimensions, and Tolerances

Chamber Classification	Nominal Height	Nominal Width	Rise		Span		Minimum Foot Width	Wall Thickness	
								Average	Minimum
			Average	Tolerance ±	Average	Tolerance ±			
	in. (mm)	in. (mm)	in. (mm)	in (mm)	in. (mm)	in (mm)	in. (mm)	in. (mm)	in. (mm)
16×33	16 (406)	33 (838)	13.1 (333)	0.4 (10)	24.3 (617)	0.4 (10)	4.0 (100)	0.130 (3.3)	0.120 (3.0)
30×51	30 (762)	51 (1295)	26.7 (678)	0.4 (10)	42.6 (1082)	0.4 (10)	4.0 (100)	0.180 (4.6)	0.165 (4.2)
45×76	45 (1143)	76 (1930)	41.0 (1041)	1.0 (25)	67 (1702)	2.0 (51)	5.0 (127)	0.225 (5.7)	0.205 (5.2)
60 ×101	60 (1524)	101 (2565)	54.7 (1389)	1.0 (25)	85 (2159)	2.0 (5.1)	8.0 (203)	0.245 (6.2)	0.225 (5.7)

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

5. Minimum Flexural Modulus

Flexural modulus must be determined according to: **ASTM D790 â€“ Procedure A**

The specified property is the: **1% Secant Flexural Modulus**

Minimum acceptable value: **1000 MPa**

or: **145,000 psi**

Therefore:

Flexural Modulus â‰¥ 1000 MPa â†’ PASS

6. Izod Impact Resistance

Impact resistance is evaluated according to: **ASTM D256 â€“ Method A**

Test temperature: **23 Â°C**

Minimum impact resistance: **215 J/m**

or: **4 ft-lb/in**

Therefore: **Izod Impact Resistance â‰¥ 215 J/m â†’ PASS**

Testing should be performed using a calibrated pendulum impact tester with the required:

- Pendulum capacity
- Specimen support
- Striker geometry
- Notching equipment
- Temperature conditioning

7. General Conditioning of Test Specimens

Unless another test method specifies different conditions, specimens must be conditioned according to:

ASTM D618 â€“ Procedure A

Required conditioning environment:

Temperature: 23 Â± 2 Â°C

Relative Humidity: 50 Â± 5%

Minimum conditioning duration: **4 hours**

Tests should also be conducted under the same temperature and humidity conditions unless the specific test method specifies otherwise.

This requirement is important because PP mechanical properties depend upon temperature.

8. Visual Acceptance of Finished Chambers

Before dimensional or mechanical testing, chambers should be visually inspected.

The product must be essentially homogeneous and reasonably uniform in:

- Colour
- Opacity
- Density
- Surface condition
- Material distribution

The internal and external surfaces must be free from:

- Chalking
- Sticky material
- Tacky surfaces

The chamber wall must also be free from visible:

- Cracks
- Blisters
- Voids
- Foreign inclusions
- Other defects that can impair structural wall integrity

Inspection is made under normal conditions using the unaided eye.

A visible defect capable of affecting chamber integrity constitutes a non-conforming condition.

9. Dimensional Inspection Equipment

A complete dimensional inspection station should preferably include:

- Precision caliper
- Micrometer
- Steel rule
- Measuring tape
- Height gauge
- Flat and level reference table
- Straight edge or tensioned reference line
- Ultrasonic thickness gauge when nondestructive thickness measurement is required

For large stormwater chambers, appropriate large-format fixtures may be required.

10. Chamber Wall Thickness Measurement

Wall thickness is evaluated according to ASTM F2418 with dimensional principles based on ASTM D2122.

Measurements are performed at a minimum of: **2 locations along the longitudinal axis**

At each longitudinal location: **Minimum 8 circumferential positions**

must be measured.

At every circumferential position, four measurements are made across the corrugation profile:

1. Valley
2. Crest
3. First web
4. Second web

Therefore, the minimum basic measurement program represents: **2 Ã— 8 Ã— 4 = 64 wall-thickness readings**

for a chamber.

The laboratory records:

- Minimum measured thickness
- Average measured thickness

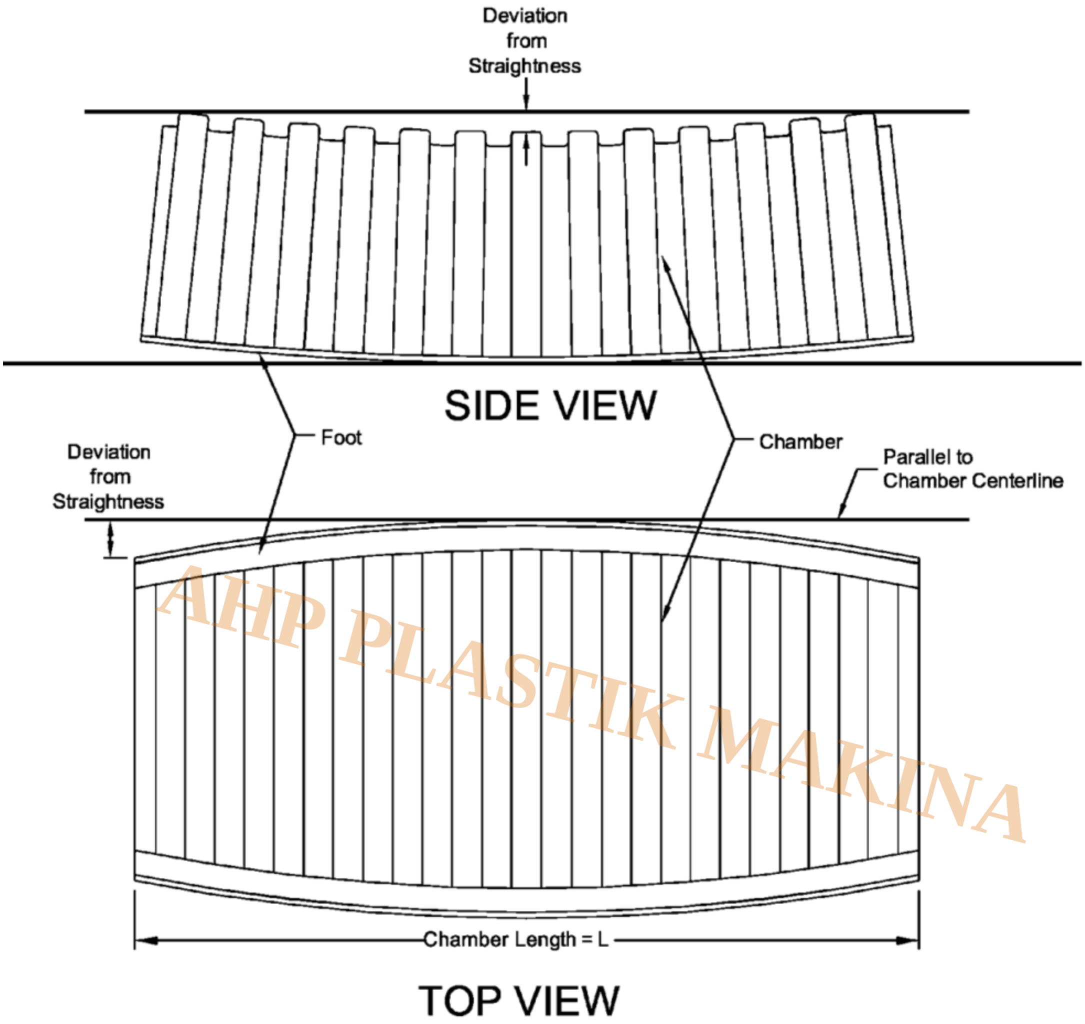


FIG. 3 Measurement of Deviation From Straightness (shape exaggerated for illustration)

11. Wall Thickness Near Mould Flow Channels

Where mould-flow channels cause local variations in chamber wall thickness, these areas are excluded from the standard wall-thickness measurement.

Instead, thickness is measured in the adjacent flat region.

This avoids treating intentional mould-flow geometry as representative structural wall thickness.

12. End Corrugation Exception

At end corrugations where adjacent chambers or end caps overlap, the required local wall thickness may be reduced.

The allowable thickness can be:

75% of the Table 1 wall-thickness requirement

because these regions form part of an overlapping connection.

This exception applies specifically to the overlap region and should not be generalized to the main chamber wall.

---

13. Ultrasonic Wall Thickness Measurement

ASTM F2418 permits nondestructive wall-thickness measurement using a:

Properly calibrated ultrasonic thickness gauge

This can be advantageous when destructive sectioning of large chambers is undesirable.

The ultrasonic system should be calibrated using:

- Reference specimens
- Known PP wall thickness
- Appropriate sound velocity setting

Surface coupling and geometry must be carefully controlled.

---

14. Minimum Chamber Wall Thickness

The measured wall thickness must not be less than the minimum applicable value specified for the corresponding chamber classification.

The standard defines classifications such as:

- 16 Ã— 33
- 30 Ã— 51
- 45 Ã— 76
- 60 Ã— 101

The required values depend on chamber size.

16 Ã— 33 Chamber

Average wall thickness: **3.3 mm**

Minimum wall thickness: **3.0 mm**

30 Ã— 51 Chamber

Average wall thickness: **4.6 mm**

Minimum wall thickness: **4.2 mm**

45 Ã— 76 Chamber

Average wall thickness: **5.7 mm**

Minimum wall thickness: **5.2 mm**

60 Ã— 101 Chamber

Average wall thickness: **6.2 mm**

Minimum wall thickness: **5.7 mm**

Failure to satisfy the minimum wall-thickness requirement constitutes product non-conformance.

15. Foot Width Measurement

Each chamber foot is measured at three locations:

1. One end
2. Mid-length
3. Opposite end

The laboratory reports:

- Minimum foot width
- Average foot width

The minimum measured foot width must satisfy the classification requirement.

16. Minimum Foot Width Requirements

16 Ã— 33 Chamber

Minimum foot width: **100 mm**

30 Ã— 51 Chamber

Minimum foot width: **100 mm**

45 Ã— 76 Chamber

Minimum foot width: **127 mm**

60 Ã— 101 Chamber

Minimum foot width: **203 mm**

The chamber foot is structurally important because loads are transmitted from the arch into the bedding through this area.

17. Rise Measurement

The chamber is placed on: **A flat and level surface**

No external load is applied except the chamberâ€™s own weight. Rise is measured as the vertical distance from the reference surface to the inside face of the valley at the chamber crown.

Measurements are made at:

- First end
- Mid-length
- Second end

The three measurements are averaged.

18. Rise Requirements

Typical average rise requirements specified by ASTM F2418 include:

16 Ã— 33

Average rise: **333 mm**

Tolerance: **Â±10 mm**

30 Ã— 51

Average rise: **678 mm**

Tolerance: **Â±10 mm**

45 Ã— 76

Average rise: **1041 mm**

Tolerance: **Â±25 mm**

60 Ã— 101

Average rise: **1389 mm**

Tolerance: **Â±25 mm**

The measured average must remain within the specified tolerance.

---

19. Span Measurement

Span is measured with the chamber on a: **Flat level surface**

under self-weight only.

The measurement is taken horizontally between the inside surfaces of the opposing valley elements near the chamber feet.

Measurements are taken at:

- First end
- Mid-length
- Second end

The three values are averaged.

---

20. Span Requirements

16 Ã— 33 Chamber

Average span: **617 mm**

Tolerance: **Â±10 mm**

30 Ã— 51 Chamber

Average span: **1082 mm**

Tolerance: **Â±10 mm**

45 Ã— 76 Chamber

Average span: **1702 mm**

Tolerance: **Â±51 mm**

60 Ã— 101 Chamber

Average span: **2159 mm**

Tolerance: **approximately Â±51 mm**

The average span must satisfy the limits applicable to the chamber classification.

---

21. Straightness Test

The chamber is positioned on a flat and level reference surface under its own weight.

Three straightness measurements are required:

- One along the crown
- One along the first foot
- One along the second foot

A straight reference line is established between the two ends of the component being measured.

The maximum deviation between the chamber surface and the theoretical straight line is determined.

---

22. Acceptance Criterion for Straightness

Maximum permissible deviation is: **L / 100**

where: **L = chamber length**

Example

For a chamber length of: **2000 mm**

Maximum permissible deviation is: **2000 / 100 = 20 mm**

Therefore:

Deviation â‰¤ L/100 â†’ PASS

Deviation > L/100 â†’ FAIL

This requirement helps prevent chambers with significant manufacturing deformation from being accepted before installation.

23. Long-Term Creep Rupture Strength

Polypropylene is a viscoelastic material. Consequently, material strength under long-duration loading is lower than short-term strength.

ASTM F2418 therefore requires determination of: **50-Year Tensile Creep Rupture Strength**

The specimen must be manufactured in the same manner and consist of the same material formulation, including additives, as the finished chamber.

24. Creep Rupture Test Standard

Creep rupture strength is determined using: **ASTM D2990**

at: **23 Â°C**

The testing program must include an additional stress level selected to produce rupture at approximately:

10,000 hours

An alternative accelerated approach using: **Time-Temperature Superposition**

may also be used. ASTM D6992 is specifically referenced as a possible TTS method.

25. Creep Rupture Testing Equipment

A suitable creep rupture test system should include:

- Multiple tensile creep stations
- Constant-load mechanism
- Dead weights or lever system
- Temperature-controlled environment
- High-stability grips
- Individual specimen timers
- Failure detection
- Data acquisition system

Because a test point may extend to approximately: **10,000 h â‰ˆ 417 days** the equipment must be designed for continuous long-term operation.

26. 50-Year Creep Rupture Acceptance Criterion

The predicted 50-year tensile creep rupture strength at 23 Â°C must be at least: **4.8 MPa**

or: **700 psi**

Therefore:

50-Year Creep Rupture Strength â‰¥ 4.8 MPa â†’ PASS

50-Year Creep Rupture Strength < 4.8 MPa â†’ FAIL

27. Tensile Creep Modulus

The long-term tensile creep modulus is also determined.

The specimens must represent:

- The same material
- The same manufacturing method
- The same additives

as the finished chamber. Test temperature: **23 Â°C**

28. Creep Modulus Test Stress

Creep modulus testing is conducted at stress levels up to: **3.5 MPa**

or: **the design service stress**

whichever is greater.

Therefore: **Maximum Required Test Stress = max(3.5 MPa, Design Service Stress)**

The standard specifies a minimum of: **5 stress levels**

approximately evenly distributed up to the required maximum stress.

29. Creep Modulus Test Duration

The creep modulus test duration is: **10,000 hours**

unless the permitted time-temperature superposition approach is used.

This corresponds to approximately: **417 days**

of conventional continuous testing.

30. Creep Modulus Calculation

For tensile creep:

Îµ(t) = Î”L(t) / Lâ‚€

where:

- Îµ(t) = strain at time t
- Î”L(t) = elongation
- Lâ‚€ = initial gauge length

The creep modulus is:

Eâ‚•câ‚Ž(t) = Ïƒ / Îµ(t)

where:

- Eâ‚•câ‚Ž(t) = creep modulus
- Ïƒ = applied tensile stress
- Îµ(t) = time-dependent strain

Regression analysis is then used to obtain the long-term material behaviour.

31. 50-Year Creep Modulus Acceptance Criterion

The 50-year tensile creep modulus must be:

â‰¥ 165 MPa

or: **â‰¥ 24,000 psi**

Therefore:

Eâ‚ â‚€ â‰¥ 165 MPa â†’ PASS

Eâ‚ â‚€ < 165 MPa â†’ FAIL

The actual creep modulus derived from the test must be used in chamber structural design. Passing the minimum 165 MPa requirement alone does not automatically prove that every chamber geometry is structurally adequate.

A separate structural analysis is still required.

32. Meaning of the 50-Year Creep Values

The 50-year creep rupture strength and 50-year creep modulus are material-design properties obtained using logarithmic regression.

They must not be interpreted to mean:

â€œThe chamber will fail after exactly 50 years.â€•

They are long-term material properties used in structural design.

Actual chamber performance also depends upon:

- Chamber geometry
- Soil condition
- Backfill
- Cover depth
- Traffic loading
- Installation quality
- Chamber spacing
- Bedding
- Temperature
- Structural safety factors

33. Arch Stiffness Constant â€“ ASC Test

The **Arch Stiffness Constant (ASC)** evaluates the short-term structural stiffness of the chamber arch.

Testing is based on: **ASTM D2412**

with specific modifications defined by ASTM F2418.

The specimen consists of a section of the actual chamber.

34. ASC Test Machine

The apparatus should be a calibrated compression testing machine capable of:

- Constant crosshead movement
- Measuring vertical load
- Measuring vertical displacement
- Supporting large chamber specimens
- Using a rigid top loading plate

The test setup consists of:

- Lower rigid base
- Chamber specimen
- Foot restraints
- Upper load plate
- Load fixture
- Load cell
- Displacement measurement system

35. ASC Specimen Length

The specimen must contain at least: **2 complete corrugation periods**

The specimen ends must be: **Squarely cut**

An irregular or angled cut can cause nonuniform loading and should not be accepted.

36. Selection of Worst-Case ASC Specimen

If chamber stiffness varies because of:

- Perforations
- Inspection ports
- Geometry changes
- Wall profile variations

the test specimen must represent the:

Lowest chamber stiffness condition

This is an important worst-case qualification requirement.

A manufacturer should not select only the structurally strongest chamber region for ASC testing.

37. Chamber Foot Restraint

During ASC testing, the outer edge of each chamber foot is restrained against: **Lateral movement**

However, the foot must remain: **Free to rotate**

This boundary condition is important because excessive clamping can artificially increase measured stiffness.

The fixture must therefore prevent horizontal translation without rigidly fixing foot rotation.

---

38. ASC Crosshead Speed

Crosshead motion must be constant at:

2.0 Â± 0.2% of average chamber rise per minute

This speed is calculated individually from chamber rise.

Example

For chamber rise: **678 mm**

Nominal speed: **0.02 Ã— 678 = 13.56 mm/min**

Permissible range:

1.8 to 2.2% of rise/min

approximately: **12.2 to 14.9 mm/min**

Therefore the test machine must allow programmable crosshead speed.

---

39. ASC Measurement Point

The compression test continues until: **2% vertical deflection**

of chamber rise is reached.

The corresponding plate load is recorded.

If: **R = original rise**

then: **Î”Râ‚‚% = 0.02 Ã— R**

Example

Original rise: **678 mm**

2% deflection: **13.56 mm**

The load at this displacement is used to calculate ASC.

40. ASC Formula

The Arch Stiffness Constant is calculated from:

ASC = F / (Î"y Ã— L)

where:

- **F** = plate load at 2% vertical deflection
- **Î"y** = percentage deflection = 2
- **L** = specimen length

In the original ASTM formulation, ASC is expressed as: **lb/ft/% deflection**

ASC should not be confused with conventional pipe stiffness.

41. Minimum ASC Requirements

ASTM F2418 specifies different minimum ASC values depending upon chamber classification.

16 Ã— 33

Minimum ASC:

300 lb/ft/%

30 Ã— 51

Minimum ASC:

300 lb/ft/%

45 Ã— 76

Minimum ASC:

250 lb/ft/%

60 Ã— 101

Minimum ASC: **250 lb/ft/%**

Therefore: **Measured ASC â‰¥ Applicable Table 1 Minimum â†’ PASS**

42. Flattening Test

The flattening test is performed immediately following the ASC test.

After recording the load at: **2% deflection**

loading continues at the: **Same crosshead speed**

until vertical deflection reaches: **7% of the original rise**

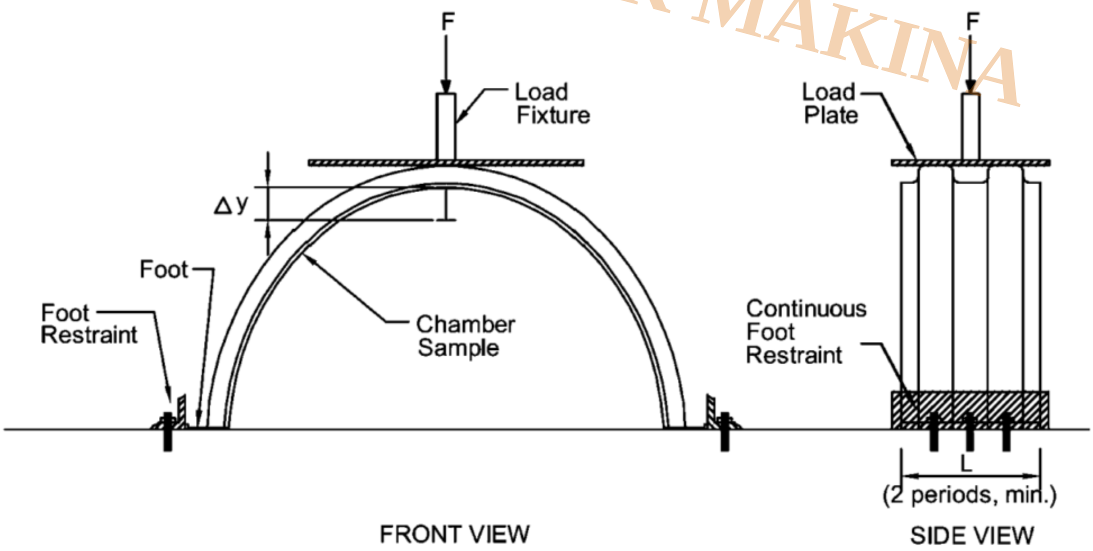


FIG. 4 Arch Stiffness and Flattening Test Model Configuration

43. Flattening Test Displacement

Required displacement:

Î”Râ‚‡% = 0.07 Ã— Original Rise

Example

For a chamber with rise: **678 mm**

7% deflection: **47.46 mm**

The chamber is then visually inspected.

---

44. Flattening Acceptance Criteria

During the test, the chamber must demonstrate no loss of load-carrying capacity. At 7% deflection, examination under:

- Normal light
- Unaided eye

must show no:

- Splitting
- Cracking
- Breaking

Therefore the chamber passes when:

No splitting + No cracking + No breaking + No loss of load-carrying capacity

are observed.

Any of these conditions constitutes failure.

---

45. Why ASC and Flattening Are Separate Evaluations

The two evaluations assess different behaviours.

ASC

Measures stiffness at relatively small deformation: **2% vertical deflection**

Flattening

Assesses structural integrity at a larger deformation: **7% vertical deflection**

A chamber can therefore possess sufficient initial stiffness but still fail the flattening requirement through:

- Local buckling
- Cracking

- Splitting
- Structural instability

Both requirements must be satisfied.

46. Accelerated Weathering Test

Material specimens representative of finished chambers must undergo accelerated weathering.

The test is conducted according to: **ASTM D4329 â€“ Cycle A**

Minimum exposure time: **500 hours**

After weathering, the material must continue to satisfy all material requirements specified by ASTM F2418.

47. Accelerated Weathering Equipment

Suitable equipment consists of a fluorescent UV weathering chamber capable of controlling the conditions required by ASTM D4329.

Typical equipment includes:

- Fluorescent UV lamps
- Temperature control
- Condensation or moisture system
- Exposure timer
- Specimen racks
- Irradiance monitoring where applicable

After the required exposure, specimens are retested for the relevant material properties.

48. Acceptance After Weathering

Weathered specimens must continue to meet the applicable material requirements.

This means accelerated UV exposure must not reduce the relevant properties below their minimum limits.

The chamber material cannot be accepted solely because it passed the tests before weathering.

49. Structural Design Requirement

Physical laboratory testing alone does not constitute complete chamber qualification.

The chamber must also be structurally designed according to: **ASTM F2787**

Structural design considers factors such as:

- Earth loads
- Vehicle loads
- Chamber geometry
- Soil-structure interaction
- Long-term material modulus
- Long-term strain capacity
- Cover depth
- Installation configuration

---

50. Minimum and Maximum Cover

The manufacturer must provide the purchaser with:

- Minimum allowable cover height
- Maximum allowable cover height

for:

- Traffic conditions
- Non-traffic conditions

These values must be based upon the structural requirements of ASTM F2787.

---

51. Full-Scale Installation Qualification

The manufacturerâ€™s installation assumptions and structural design basis must be verified using representative full-scale chamber testing.

Testing must consider:

- Design earth load
- Design live load
- Representative chamber geometry
- Representative installation configuration

This ensures that analytical design assumptions correspond reasonably with actual chamber behaviour.

---

52. Sampling Requirements

Sampling is normally established by agreement between:

- Purchaser
- Manufacturer

Unless otherwise specified: **Minimum 5 randomly selected chamber samples**

must be tested.

Random selection is important to avoid intentionally selecting unusually strong or dimensionally ideal units.

53. Sample Acceptance

A chamber sample submitted for testing should represent the production lot and satisfy identification and traceability requirements.

The following should be recorded:

- Manufacturer
- Product name
- Chamber classification
- Material classification
- Lot number
- Production code
- Manufacturing date
- Mould or cavity where applicable
- Sample selection date
- Sampling personnel

54. Retesting Procedure

ASTM F2418 contains a clear procedure for failed tests.

If any test result does not satisfy the specification:

the test is repeated using samples from the same lot.

During retesting:

- Minimum requirements must not be reduced.
- Test limits must not be changed.

- The specified test method must not be replaced.
- The test procedure must not be modified merely to obtain a passing result.

55. Rejection after Retest

If failure occurs again during retesting:

The quantity of product represented by that test does not comply with ASTM F2418.

Therefore:

Initial Failure â†’ Retest Same Lot

Retest Pass â†’ Evaluate according to applicable acceptance procedure

Retest Failure â†’ Lot represented by test is NON-COMPLIANT

This is an important product acceptance requirement.

56. Certification

When required by the purchase order or contract, the manufacturer must provide certification that the material and chamber were:

- Designed
- Manufactured
- Sampled
- Tested
- Inspected

according to ASTM F2418. When requested, the manufacturer must also provide the test results.

Certification should be signed by an authorized representative.

57. Required Product Marking

Compliant chambers must be marked with: ASTM Identification

The letters: **ASTM**

followed by the specification designation.

Material Identification

PP

followed by the applicable material classification.

Product Identification

Product name identifying the specific chamber geometry.

Manufacturer Identification

Manufacturer name or trademark.

Production Code

A production code allowing identification of:

- Manufacturing location
- Manufacturing date

Traceable marking is essential for quality control and lot identification.

---

58. Recommended Complete Test Equipment Package

A laboratory intended to perform comprehensive ASTM F2418 qualification should have access to the following equipment.

Universal Testing Machine

For:

- Tensile testing
- Flexural testing
- Arch stiffness
- Flattening

Required characteristics should include:

- Calibrated load cell
- Programmable crosshead speed
- Large compression test space
- Data acquisition
- Displacement measurement

Large Chamber Compression Fixture

Including:

- Rigid upper load plate
- Lower support platform
- Continuous foot restraints
- Adjustable chamber positioning
- Load introduction fixture

The restraint system must prevent lateral foot movement while allowing rotation.

Tensile Creep Testing System

For ASTM D2990:

- Multiple independent stations
- Constant load application
- Long-term temperature stability
- Automatic failure detection
- Displacement measurement
- Long-duration data acquisition

Tensile Testing Grips

Suitable for polypropylene tensile specimens and ASTM D638.

Flexural Test Fixture

Three-point flexural fixture suitable for ASTM D790.

Izod Impact Tester

Including:

- Appropriate pendulum
- Specimen fixture
- Notching machine
- Energy measurement system

UV Weathering Chamber

Suitable for ASTM D4329 Cycle A testing.

Precision Dimensional Instruments

Including:

- Micrometers
- Calipers
- Height gauges
- Ultrasonic thickness gauge
- Straight edges
- Measuring tape
- Flat reference table

59. Recommended Laboratory Test Sequence

A comprehensive product qualification can be organized in the following order:

Product Identification

â†“

Visual Inspection

â†“

Dimensional Inspection

â†“

Wall Thickness

â†“

Foot Width

â†“

Rise

â†“

Span

â†“

Straightness

â†“

Material Tensile Test

â†“

Flexural Modulus

â†“

Izod Impact

â†“

Creep Rupture

â†“

Creep Modulus

â†“

Arch Stiffness Test

â†“

Flattening Test

â†“

Accelerated Weathering

â†“

Post-Weathering Material Verification

â†“

Structural Design Verification

â†“

Full-Scale Installation Qualification

â†“

Final Compliance Review

60. Principal Acceptance Criteria Summary

Property	ASTM F2418 Requirement
Polypropylene content	â‰¥ 95%
PP classification	PP0330B99945
Tensile yield stress	â‰¥ 21 MPa
Flexural modulus	â‰¥ 1000 MPa
Izod impact at 23 Â°C	â‰¥ 215 J/m
Conditioning temperature	23 Â± 2 Â°C
Conditioning RH	50 Â± 5%
Conditioning time	â‰¥ 4 h
Straightness	â‰¤ L/100
50-year creep rupture strength	â‰¥ 4.8 MPa
50-year creep modulus	â‰¥ 165 MPa
Conventional creep test duration	10,000 h
Creep modulus stress levels	Minimum 5
ASC deflection	2% of rise
ASC crosshead speed	2.0 Â± 0.2% rise/min
Minimum ASC, smaller classes	300 lb/ft/%
Minimum ASC, larger classes	250 lb/ft/%
Flattening deflection	7% of rise
Flattening visual acceptance	No splitting, cracking or breaking
Flattening structural acceptance	No loss of load capacity
UV exposure	â‰¥ 500 h
Default random chamber samples	â‰¥ 5

61. Example ASC Calculation

Assume:

Plate load at 2% deflection: **F = 1800 lb**

Specimen length: **L = 3 ft**

Deflection: **Î”y = 2%**

Then:

ASC = 1800 / (2 Ã— 3)

ASC = 300 lb/ft/%

If the applicable classification requires: **Minimum ASC = 300 lb/ft/%**

then: **Result = 300 â†' PASS**

If the result were: **285 lb/ft/%**

the chamber would fail a 300 lb/ft/% minimum requirement.

62. Example Straightness Calculation

Chamber length: **L = 2400 mm**

Maximum allowable deviation: **L / 100**

Therefore: **2400 / 100 = 24 mm**

If measured deviation is: **18 mm â†' PASS**

If measured deviation is: **29 mm â†' FAIL**

63. Example Flattening Calculation

Original chamber rise: **1041 mm**

Required 7% flattening displacement: **1041 Ã— 0.07 = 72.87 mm**

Therefore the test continues until the chamber has been vertically deflected by approximately: **72.9 mm**

At this point the specimen is visually inspected. The chamber passes only if it shows no splitting, cracking or breaking and has not lost load-carrying capacity.

64. Critical Sources of Testing Error

Several errors can significantly influence ASTM F2418 results.

Incorrect Foot Restraint

Over-clamping may artificially increase chamber stiffness.

Wrong Crosshead Speed

ASC and flattening results depend upon controlled loading rate.

Testing a Non-Worst-Case Specimen

A specimen containing no opening or weak geometry may overestimate actual product stiffness.

Incorrect Rise Reference

The correct inside crown valley geometry must be used.

Unlevel Test Surface

Can distort rise, span and straightness measurements.

Insufficient Conditioning

Mechanical properties can vary if specimens are not temperature-conditioned.

Inadequate Load Calibration

Especially important for structural compression and creep equipment.

Temperature Instability During Creep

Polypropylene creep is highly temperature-sensitive.

Incomplete Wall Thickness Mapping

A few isolated measurements cannot substitute for the prescribed multi-location profile survey.

---

65. Recommended Test Report

A complete technical report should include:

- ASTM designation and revision
- Manufacturer
- Product model
- Chamber classification
- PP classification
- Production lot
- Production date
- Sample identification
- Visual inspection result
- Wall-thickness readings
- Minimum wall thickness
- Average wall thickness
- Foot-width measurements
- Rise measurements

- Span measurements
- Straightness results
- Tensile yield strength
- Flexural modulus
- Izod impact strength
- Creep test conditions
- Creep rupture regression
- 50-year creep rupture strength
- 50-year creep modulus
- ASC test specimen length
- Original rise
- Crosshead speed
- Load at 2% deflection
- Calculated ASC
- Load-deflection curve
- Flattening result at 7%
- Visual condition after flattening
- Weathering duration
- Post-weathering test results
- Applicable specification limit for each property
- Pass/Fail status
- Instrument identification
- Calibration status
- Test date
- Operator
- Authorized reviewer

66. Final Product Acceptance

Compliance with ASTM F2418 requires more than passing a single mechanical test.

A compliant polypropylene stormwater chamber must satisfy the complete applicable combination of:

- Material requirements
- Visual workmanship requirements
- Dimensional tolerances
- Minimum wall thickness
- Foot width
- Rise
- Span
- Straightness
- Long-term creep rupture strength
- Long-term creep modulus
- Arch stiffness
- Flattening resistance

- Weathering requirements
- Structural design requirements
- Installation qualification
- Sampling and inspection requirements
- Marking requirements

Therefore, product acceptance should be based upon a documented compliance matrix rather than one isolated test result.

Conclusion

ASTM F2418 provides a comprehensive qualification framework for **polypropylene corrugated-wall underground stormwater chambers**.

The specification combines material characterization with dimensional inspection, long-term creep testing and large-scale structural chamber testing.

One of the most important laboratory evaluations is the **Arch Stiffness Constant test**, in which a minimum two-period chamber specimen is compressed at a controlled speed equal to **2.0 Â± 0.2% of chamber rise per minute**.

The load required to generate **2% vertical deflection** is used to calculate ASC.

Loading then continues to: **7% vertical deflection**

for the flattening test.

At this deformation, the chamber must show:

- No splitting
- No cracking
- No breaking
- No loss of load-carrying capacity

Long-term PP performance is verified by creep testing at **23 Â°C**. The minimum predicted 50-year creep rupture tensile strength is: **4.8 MPa**

and the minimum 50-year tensile creep modulus is: **165 MPa**.

The chamber material must additionally demonstrate minimum:

21 MPa tensile yield stress

1000 MPa flexural modulus

and: **215 J/m Izod impact resistance at 23 Â°C**.

A minimum of five randomly selected chambers is specified unless purchaser and manufacturer agree otherwise.

When an initial test fails, ASTM F2418 requires retesting using material from the same lot without changing test methods or lowering specification limits. If the product fails again during retesting, the quantity of product represented by the test is considered non-compliant.

For reliable ASTM F2418 evaluation, the laboratory therefore requires not only a large structural compression tester, but also accurate dimensional inspection equipment, material testing equipment, long-term creep equipment, UV weathering equipment, and a controlled quality and traceability system.

Motorized Notch Making Machine for FNCT Tester

Full Notch Creep Tester (FNCT, 2NCT)-6S-ECO

Full Notch Creep Tester (FNCT, 2NCT)

How To Use Motorized Notch Maker for FNCT Samples According to ISO 16770

ISO 2285 Determination Of Tension Set Under Constant Elongation, and of Tension Set, Elongation and Creep Under Constant Tensile Load- Testing Fixtures

ISO16770 Plastics â€” Determination of Environmental Stress Cracking (ESC) of Polyethylene â€” Full-Notch Creep Test (FNCT)

ISO 18489 â€“ Determination of Resistance to Slow Crack Growth Under Cyclic Loading â€” Cracked Round Bar Test Method â€“ Equipment

Full Notch Creep Tester (FNCT, 2NCT)-30S-ECO

CNC Milling for Tensile Sample Preparation-Max40mm

Laboratory Injection Molding Machine-155mm

Manual Desktop Injection Molding Machine (Sample Preparation Device for Laboratory Instruments)

- Pendulum Impact Tester (Izod, Charpy, Tensile impact)

Category

1. Equipment for Standards
2. Standards