



Designation: C1818 – 22

Standard Specification for Synthetic Fiber Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe¹

This standard is issued under the fixed designation C1818; 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 synthetic fiber reinforced concrete pipe (Syn-FRCP), intended to be used for the conveyance of sewage, industrial wastes, and storm water and for the construction of culverts.

NOTE 1—Experience has shown that the successful performance of this product depends upon the proper selection of the pipe strength, the type of bedding and backfill, the care that the installation conforms to the construction specifications, and provision for adequate inspection at the construction site. This specification does not include requirements for bedding, backfill, the relationship between field load conditions and the strength designation of pipe, or durability under unusual environmental conditions. These requirements should be included in the project specification.

NOTE 2—This product is a rigid pipe and it does not depend upon deflection (pipe stiffness) for additional support from the soil.

NOTE 3—This standard requires long-term testing of Syn-FRCP in accordance with Section 9 that goes above and beyond what is typically required for steel reinforced concrete pipe, in order to evaluate the long-term material strength of the fiber-concrete matrix.

1.2 *Units*—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.

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

C33/C33M Specification for Concrete Aggregates

¹ This test method is under the jurisdiction of ASTM Committee C13 on Concrete Pipe and is the direct responsibility of Subcommittee C13.02 on Reinforced Sewer and Culvert Pipe.

Current edition approved June 1, 2022. Published June 2022. Originally approved in 2015. Last previous edition approved in 2019 as C1818-19. DOI: 10.1520/C1818-22.

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.

C150/C150M Specification for Portland Cement

C260/C260M Specification for Air-Entraining Admixtures for Concrete

C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete

C494/C494M Specification for Chemical Admixtures for Concrete

C497 Test Methods for Concrete Pipe, Concrete Box Sections, Manhole Sections, or Tile

C595/C595M Specification for Blended Hydraulic Cements

C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

C822 Terminology Relating to Concrete Pipe and Related Products

C989/C989M Specification for Slag Cement for Use in Concrete and Mortars

C1017/C1017M Specification for Chemical Admixtures for Use in Producing Flowing Concrete (Withdrawn 2022)³

C1116/C1116M Specification for Fiber-Reinforced Concrete
D7508/D7508M Specification for Polyolefin Chopped Strands for Use in Concrete

E105 Guide for Probability Sampling of Materials

3. Terminology

3.1 *Definitions*—For definitions of terms relating to concrete pipe not defined in this standard, see Terminology C822.

3.2 *Definitions:*

3.2.1 D_p —the $D_{Service}$ load divided by the long-term serviceability factor α as determined in accordance with Section 9 as compared to the peak test load for a range of deflection from 1 % to 2 % of the initial inside diameter.

3.2.2 $D_{Service}$ —the D-Load the pipe is required to sustain while in service.

3.2.3 D_{Ult} —the load the pipe is required to support in the three-edge bearing test expressed as a D-load.

3.2.4 α —long-term serviceability factor to account for possible creep in the pipe over time (unitless).

³ 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

4. Classification

4.1 Pipe furnished under this specification shall be designated as Class I, II, III, IV, or V. The corresponding strength requirements are prescribed in **Table 1**. Special designs for pipe strengths not designated in **Table 1** are permitted provided all other requirements of this specification are met.

4.2 Current industry practices have provided proof testing for sizes and classes shown in **Table 1a** and can be considered commonly available. Additional sizes and classes meeting test requirements of this standard may be possible but must be verified with local producers prior to specification on a project.

Table 1A Commonly Available Sizes / Classes

Class 1 – 12 in. through 48 in.
Class 2 – 12 in. through 48 in.
Class 3 – 12 in. through 42 in.
Class 4 – 12 in. through 36 in.
Class 5 – 12 in. through 36 in.

5. Basis of Acceptance

5.1 The acceptability of the pipe design shall be in accordance with **Section 10**.

5.2 Unless designated by the owner at the time of, or before placing an order, the pipe shall be accepted on the basis of **Sections 11, 12**, and such material tests as are required in **7.2, 7.3**, and **7.5**.

5.3 *Age for Acceptance*—Pipe shall be considered ready for acceptance when they conform to the requirements of this specification.

6. Design and Manufacturing Data

6.1 The manufacturer shall provide the following information regarding the pipe unless waived by the owner:

6.1.1 Pipe design strength ($D_{Service}$).

6.1.2 *Physical Characteristics*—Diameter, wall thickness, laying length, and joint details.

6.1.3 *Synthetic Fiber Concrete Compressive Strength*—Minimum synthetic fiber concrete compressive strength equal to 4,000 psi.

6.1.4 Admixtures.

6.1.5 *Reinforcement*:

6.1.5.1 Type of reinforcement, applicable reinforcement specification, and grade.

6.1.5.2 Amount of fiber used in pounds per cubic yard.

6.1.6 Manufacturing and curing process.

7. Materials and Manufacture

7.1 *Materials*:

7.1.1 *Synthetic Fiber Reinforced Concrete*—The synthetic fiber reinforced concrete shall consist of cementitious materials, mineral aggregates, admixtures, and water, in which

synthetic fibers have been mixed in such a manner that the fibers and concrete act together to resist stresses.

7.2 *Cementitious Materials*:

7.2.1 *Cement*—Cement shall conform to the requirements for portland cement of Specification **C150/C150M** or shall be portland blast-furnace slag cement, or portland-pozzolan cement conforming to the requirements of Specification **C595/C595M**, except that the pozzolan constituent in the portland-pozzolan cement shall be fly ash.

7.2.2 *Fly Ash*—Fly ash shall conform to the requirements of Class F or Class C of Specification **C618**.

7.2.3 *Slag Cement*—Slag cement shall conform to the requirements of Grade 100 or 120 of Specification **C989/C989M**.

7.2.4 *Allowable Combinations of Cementitious Materials*—The combination of cementitious materials used in the cement shall be one of the following:

7.2.4.1 Portland cement only,

7.2.4.2 Portland blast furnace slag cement only,

7.2.4.3 Portland pozzolan cement only,

7.2.4.4 A combination of portland cement and fly ash,

7.2.4.5 A combination of portland cement and slag cement,

7.2.4.6 A combination of portland cement, slag cement, and fly ash,

7.2.4.7 A combination of portland-pozzolan cement and slag cement, and

7.2.4.8 A combination of portland blast-furnace slag cement and fly ash,

7.3 *Aggregates*—Aggregates shall conform to the requirements of Specification **C33/C33M**, except that the requirement for gradation shall not apply.

7.4 *Admixtures*—The following admixtures and blends are allowable:

7.4.1 Air-entraining admixture conforming to Specification **C260/C260M**;

7.4.2 Chemical admixture conforming to Specification **C494/C494M**;

7.4.3 Chemical admixture for use in producing flowing concrete conforming to Specification **C1017/C1017M**; and

7.4.4 Chemical admixture or blend approved by the owner.

7.5 *Synthetic Fiber Reinforcement*—Reinforcement shall consist of synthetic fibers conforming to Specifications **C1116/C1116M** and **D7508/D7508M**.

7.6 *Manufacture*:

7.6.1 *Mixture*—The aggregates shall be sized, graded, proportioned, and mixed with such proportions of cementitious materials, synthetic fibers, admixtures, and water as will produce a thoroughly mixed synthetic fiber concrete of such quality that the pipe will conform to the test and design

TABLE 1 Strength Requirements

Pipe Class	$D_{Service}$ (lb/linear foot/foot of diameter)	D_{Ult} (lb/linear foot/foot of diameter)	D_P (lb/linear foot/foot of diameter)
I	800	1200	$D_{Service}/\alpha$ where: α = long-term serviceability factor as determined per Section 9 of this standard
II	1000	1500	
III	1350	2025	
IV	2000	3000	
V	3000	4500	