Designation: C1765 – 19

Standard Specification for Steel Fiber Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe[1]

This standard is issued under the fixed designation C1765; 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 steel fiber reinforced concrete pipe (SFRCP) of internal diameters 12 - 48 in., 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 relation ship 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.

1.2 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this 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]

A820/A820M Specification for Steel Fibers for Fiber-Reinforced Concrete
C33/C33M Specification for Concrete Aggregates
C150/C150M Specification for Portland Cement
C260/C260M Specification for Air-Entraining Admixtures for 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
C1602/C1602M Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
E105 Practice for Probability Sampling of Materials

3. Terminology

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

3.2 $D_{Service}$—the D_{Test} test load divided by a factor of safety of 1.5.

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

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.

5. Basis of Acceptance

5.1 The acceptability of the pipe design shall be in accordance with Section 9.

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 10 and 11, 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.

[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.

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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**

TABLE 1 Pipe Strength Requirements

Pipe Class	$D_{Service}$ (lb/linear foot/foot of diameter)	D_{Test} (lb/linear foot/foot of diameter)
I	800	1200
II	1000	1500
III	1350	2025
IV	2000	3000
V	3000	4500

6. Design and Manufacturing

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 *Steel Fiber Concrete Compressive Strength*—Minimum steel fiber concrete compressive strength equal to 4000 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 Percentage of steel fiber reinforcing by volume.

6.1.6 Manufacturing and curing process.

7. Materials and Manufacture

7.1 *Materials:*

7.1.1 *Steel Fiber Reinforced Concrete*—The steel fiber reinforced concrete shall consist of cementitious materials, mineral aggregates, admixtures, if used, and water, in which steel fibers have been mixed in such a manner that the steel 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, portland-limestone cement, or portland-pozzolan cement conforming to the requirements of Specification C595/C595M, except that the pozzolan constituent in the Type IP 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 Portland-limestone cement only,

7.2.4.5 A combination of portland cement or portland-limestone cement and fly ash,

7.2.4.6 A combination of portland cement or portland-limestone cement and slag cement,

7.2.4.7 A combination of portland cement or portland-limestone, slag cement and fly ash, or

7.2.4.8 A combination of portland pozzolan 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 and Blends*—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 *Steel Reinforcement*—Reinforcement shall consist of steel fibers conforming to Specification A820/A820M.

7.6 *Water*—Water used in the production of concrete shall be potable or nonpotable water that meets the requirements of Specification C1602/C1602M.

7.7 *Manufacture:*

7.7.1 *Mixture*—The aggregates shall be sized, graded, proportioned, and mixed with such proportions of cementitious materials, steel fibers, admixtures, and water as will produce a thoroughly mixed steel fiber concrete of such quality that the pipe will conform to the test and design requirements of this specification. All concrete shall have a water-cementitious materials ratio not exceeding 0.53 by weight. Cementitious materials shall be as specified in 7.2.

7.7.2 *Reinforcement*—Steel reinforcing fibers shall be thoroughly mixed throughout the concrete amalgam. No restriction is placed on the combination or proportion of steel fibers in the finished product, except that pipes manufactured using these materials and mixture shall comply with the performance requirements of this standard.

7.7.3 *Joints*—The joints shall be of such design and the ends of the concrete pipe sections so formed that when the sections are laid together they will make a continuous line of pipe with a smooth interior free of appreciable irregularities in the flow line, all compatible with the permissible variations given in Section 11.

8. Design

8.1 *Design*—The wall thickness, compressive strength of the concrete, and percentage of steel fibers by volume shall be sufficient to pass the D_{Test} requirements in Table 1.

8.2 *Special Classes:*

8.2.1 If permitted by the owner, the manufacturer may request approval by the owner of a special class of pipe having D_{Test} values that differ from those shown in Table 1.

8.2.2 Such special classes of pipe shall be based on the same design/testing requirements as required for those classes found in Table 1.

9. Proof of Design Testing

9.1 *Test Equipment and Facilities*—The manufacturer shall furnish without charge all samples, facilities, and personnel necessary to carry out the tests required by this specification.