



Designation: C985M – 04^{ε1}

Standard Specification for Nonreinforced Concrete Specified Strength Culvert, Storm Drain, and Sewer Pipe (Metric)¹

This standard is issued under the fixed designation C985M; 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.

^{ε1} NOTE—Editorial changes were made throughout in March 2005.

1. Scope

1.1 This specification covers nonreinforced concrete pipe designed for specified strengths and intended to be used for the conveyance of sewage, industrial wastes, and storm water and for the construction of culverts.

1.2 This specification is the metric counterpart of Specification C985.

NOTE 1—This specification is a manufacturing and purchase specification only and does not include requirements for bedding, backfill, or the relationship between field load conditions and the designated strength of the pipe. However, experience has shown that the successful performance of this product depends upon the proper selection of the pipe strength, type of bedding and backfill, and care that the installation conforms to the construction specifications. The owner of the concrete pipe specified herein is cautioned that he must correlate the field requirements with the pipe strength specified and provide inspection at the construction site.

2. Referenced Documents

2.1 ASTM Standards:²

- A82/A82M Specification for Steel Wire, Plain, for Concrete Reinforcement
- A185/A185M Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
- A496/A496M Specification for Steel Wire, Deformed, for Concrete Reinforcement
- A497/A497M Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
- A615/A615M Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- C33 Specification for Concrete Aggregates
- C150 Specification for Portland Cement

¹ This specification is under the jurisdiction of ASTM Committee C13 on Concrete Pipe and is the direct responsibility of Subcommittee C13.01 on Non-Reinforced Concrete Sewer, Drain and Irrigation Pipe.

Current edition approved Oct. 1, 2004. Published November 2004. Originally approved in 1983. Last previous edition approved in 2002 as C985M-02. DOI: 10.1520/C0985M-04E01.

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.

- C497M Test Methods for Concrete Pipe, Manhole Sections, or Tile [Metric]
- C595 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 Specification for Slag Cement for Use in Concrete and Mortars
- C1116 Specification for Fiber-Reinforced Concrete and Shotcrete
- E105 Practice for Probability Sampling Of Materials

3. Terminology

3.1 *Definitions*—For definitions of terms relating to concrete pipe, see Terminology C822.

4. Basis of Acceptance

4.1 The acceptability of the pipe design shall be determined in accordance with Section 9. After the pipe design has been accepted, or if the pipe design has been accepted previously in accordance with Section 9, production pipe shall be accepted in accordance with 4.2.

4.2 *Acceptance on the Basis of Pipe Load and Material Tests and Inspection of Manufactured Pipe for Defects*—Determine in accordance with Sections 5, 6, 8, and 11.

NOTE 2—It is necessary that samples be selected at random. For guidance, see Practice E105.

4.3 *Age for Acceptance*—Pipe shall be considered ready for acceptance when it conforms to the requirements as indicated by the specified tests.

5. Design and Manufacturing Data

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

- 5.1.1 Basis of acceptance and supporting data,
- 5.1.2 Designated pipe strength,
- 5.1.3 *Physical Characteristics*—Diameter, wall thickness, laying length, and joint details,
- 5.1.4 Admixtures,

5.1.5 Manufacturing and curing process, and

5.1.6 *Handling Reinforcement*:

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

5.1.6.2 Placement, placement tolerance, diameter, spacing and cross-sectional area of circumferential, longitudinal, and special reinforcement.

6. Materials and Manufacture

6.1 *Materials*:

6.1.1 *Concrete*—The concrete shall consist of cementitious materials, mineral aggregates, and water.

6.1.2 *Cementitious Materials*:

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

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

6.1.2.3 *Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars (GGBFS)*—GGBFS shall conform to the requirements of Grade 100 or 120 of Specification **C989**.

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

- (1) Portland cement only,
- (2) Portland blast furnace slag cement only,
- (3) Slag modified portland cement only,
- (4) Portland pozzolan cement only,
- (5) A combination of portland cement and fly ash, or
- (6) A combination of portland cement and ground granulated blast-furnace slag.
- (7) A combination of Portland Cement, Ground Granulated Blast Furnace Slag (not to exceed 25% of the total cementitious weight), and Fly Ash (not to exceed 25% of the total cementitious weight).

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

6.1.4 *Admixtures and Blends*—Admixtures and blends shall be allowed to be used unless prohibited by the owner.

6.1.5 *Steel Reinforcement*—Reinforcement shall consist of wire conforming to Specification **A82/A82M** or Specification **A496/A496M**, or of wire fabric conforming to Specifications **A185/A185M** or Specification **A497/A497M**, or of bars of Grade 300 steel conforming to Specification **A615/A615M**.

6.2 *Manufacture*:

6.2.1 *Mixture*—The aggregates shall be sized, graded, proportioned, and mixed with cementitious materials, water, and admixtures, if any, to produce a homogeneous concrete mixture of such quality that the pipe will conform to the design and test requirements of this specification.

6.2.2 *Handling Reinforcement*—Circumferential handling reinforcement shall be provided in all pipe larger than 900 mm in diameter.

6.2.2.1 *Placement*—Where one line of circular reinforcement is used, it shall be placed between 30 and 50 % of the

wall thickness from the inside surface. Where two lines of circular reinforcement are used, each line shall be so placed that the protective covering over the circumferential reinforcement in the wall of the section shall be 25 mm.

6.2.2.2 *Splices*—If the splices are not welded, the reinforcement shall be lapped not less than 20 diameters for deformed bars, and 40 diameters for plain bars and cold-drawn wire. When splices are welded and are not lapped to the minimum requirements above, there shall be a minimum lap of 50 mm and pull tests of representative specimens shall develop at least 50 % of the minimum specified strength of the steel.

6.2.2.3 *Spacing*—Handling reinforcements shall be individual hoops or shall be formed into a cage or cages. It shall be distributed along the length of the pipe section, or one half of the minimum reinforcement shall be allowed to be placed in each of the extreme quarters of the length of a 2.4-m or less pipe section, or one third of the minimum reinforcement shall be allowed to be placed in each third of the length of a longer than 2.4-m pipe section. Additionally, at least 75 % of the minimum area shall be located not less than one fifteenth of the length of the pipe section from any portion of the joint.

6.2.2.4 *Area*—The minimum area of circumferential handling reinforcement shall be equal to $0.06 (D + t)^2$ in square mm per m of pipe, where “*D*” equals the designated diameter in mm and “*t*” equals the wall thickness in mm.

6.2.2.5 *Special Designs*—The manufacturer shall be allowed to submit special designs to the owner for approval. Approval shall be based on structural calculations or on load tests. The minimum ultimate three-edge bearing load shall be equal to the weight of the pipe and shall be sustained by the pipe after cracking at the top, bottom and sides the full length of the pipe. The pipe shall also meet the strength requirements of Section 7 and Section 10 or 11, or both.

6.2.3 *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 from appreciable irregularities in the flowline, all compatible with the permissible variations given in Section 8.

6.2.4 *Lift Holes*—When agreed upon by the owner, lift eyes or holes shall be allowed to be provided in each pipe for the purpose of handling.

6.3 *Synthetic Fibers*—Collated fibrillated virgin polypropylene fibers shall be allowed to be used, at the manufacturer’s option, in concrete pipe as a nonstructural manufacturing material. Only Type III synthetic fibers designed and manufactured specifically for use in concrete and conforming to the requirements of Specification **C1116** shall be accepted.

7. Physical Properties

7.1 *Pipe Strength*—Pipe strength may be either a designated strength or a cracking strength. The designated strength is that specified as the minimum load required to produce the cracking strength when tested in three-edge bearing in accordance with Test Methods **C497M**. The cracking strength is the actual maximum load observed in the three-edge bearing test, and shall be assumed to have been reached when any continuous visible crack caused by the test load exceeds 300 mm in length measured parallel to the longitudinal axis of the pipe.