



Designation: C14 – 14

# Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe<sup>1</sup>

This standard is issued under the fixed designation C14; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 1. Scope

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

1.2 A complete metric companion to Specification C14 has been developed—C14M; therefore, no metric equivalents are presented in this specification.

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 strength classification of pipe. However, experience has shown that the successful performance of this product depends upon the proper selection of the class of pipe, type of bedding and backfill, and care that the installation conforms to the construction specifications. The owner is cautioned that he must correlate the field requirements with the class of pipe specified and provide for or require inspection at the construction site.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

- C33 Specification for Concrete Aggregates
- C150 Specification for Portland Cement
- C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- C443 Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- C494 Specification for Chemical Admixtures for Concrete
- C497 Test Methods for Concrete Pipe, Manhole Sections, or Tile
- 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

<sup>1</sup> 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.

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<sup>2</sup> 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.

C989 Specification for Slag Cement for Use in Concrete and Mortars

C1116 Specification for Fiber-Reinforced Concrete and Shotcrete

## 3. Terminology

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

## 4. Classification

4.1 Pipe manufactured according to this specification shall be of three classes identified as “Class 1 Nonreinforced Concrete Pipe,” “Class 2 Nonreinforced Concrete Pipe,” and “Class 3 Nonreinforced Concrete Pipe.” The corresponding strength requirements are prescribed in Table 1.

## 5. Basis of Acceptance

5.1 The acceptability of the pipe shall be determined by the results of the test prescribed in this section, when required, and by inspection to determine whether the pipe conforms to this specification as to design and freedom from defects.

5.2 *Acceptance as to Strength Properties*—Pipe shall be acceptable under the strength tests when they have met the requirements as prescribed in 10.3.

5.3 *Acceptance as to Absorption Properties*—Pipe shall be acceptable under the absorption test when they have met the requirements as prescribed in 10.4.

5.4 *Acceptance as to Permeability Properties*—Pipe shall be acceptable under the permeability test when they have met the requirements as prescribed in 10.5.

NOTE 2—Prior to purchase, the owner has the option to specify the hydrostatic test prescribed in 10.6 instead of the permeability test.

5.5 *Acceptance as to Hydrostatic Properties*—Pipe shall be acceptable under the hydrostatic test when they have met the requirements as prescribed in 10.6.

## 6. Materials

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

**TABLE 1 Physical and Dimensional Requirements for Nonreinforced Concrete Pipe<sup>A</sup>**

| Internal Designated Diameter, in. | Class 1                        |  | Class 2                        |  | Class 3                        |  |
|-----------------------------------|--------------------------------|--|--------------------------------|--|--------------------------------|--|
|                                   | Minimum Thickness of Wall, in. | Minimum Three-Edge Bearing Strength, lbf/linear ft | Minimum Thickness of Wall, in. | Minimum Three-Edge Bearing Strength, lbf/linear ft | Minimum Thickness of Wall, in. | Minimum Three-Edge Bearing Strength, lbf/linear ft |
| 4                                 | 5/8                            | 1500   | 3/4                            | 2000   | 3/4                            | 2400   |
| 6                                 | 5/8                            | 1500   | 3/4                            | 2000   | 7/8                            | 2400   |
| 8                                 | 3/4                            | 1500   | 7/8                            | 2000   | 1 1/8                          | 2400   |
| 10                                | 7/8                            | 1600   | 1                              | 2000   | 1 1/4                          | 2400   |
| 12                                | 1                              | 1800   | 1 3/8                          | 2250   | 1 3/4                          | 2600   |
| 15                                | 1 1/4                          | 2000   | 1 5/8                          | 2600   | 1 7/8                          | 2900   |
| 18                                | 1 1/2                          | 2200   | 2                              | 3000   | 2 1/4                          | 3300   |
| 21                                | 1 3/4                          | 2400   | 2 1/4                          | 3300   | 2 3/4                          | 3850   |
| 24                                | 2 1/8                          | 2600   | 3                              | 3600   | 3 3/8                          | 4400   |
| 27                                | 3 1/4                          | 2800   | 3 3/4                          | 3950   | 3 3/4                          | 4600   |
| 30                                | 3 1/2                          | 3000   | 4 1/4                          | 4300   | 4 1/4                          | 4750   |
| 33                                | 3 3/4                          | 3150   | 4 1/2                          | 4400   | 4 1/2                          | 4875   |
| 36                                | 4                              | 3300   | 4 3/4                          | 4500   | 4 3/4                          | 5000   |

<sup>A</sup> Subject to tolerances in Section 11.

## 6.2 Cementitious Materials:

6.2.1 *Cement*—Cement shall conform to the requirements for portland cement of Specification C150 or shall be portland blast-furnace slag cement or slag modified portland 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.

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

6.2.3 *Ground Granulated Blast Furnace Slag (GGBFS)*—GGBFS shall conform to the requirements of Grade 100 or 120 of Specification C989.

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

6.2.4.1 Portland cement only,

6.2.4.2 Portland blast furnace slag cement only,

6.2.4.3 Slag modified portland cement only,

6.2.4.4 Portland pozzolan cement only,

6.2.4.5 A combination of portland cement and fly ash,

6.2.4.6 A combination of portland cement and ground granulated blast-furnace slag, or

6.2.4.7 A combination of portland cement, fly ash (not to exceed 25 % of the total cementitious weight) and ground granulated blast furnace slag (not to exceed 25 % of the total cementitious weight).

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

6.4 Admixtures and blends shall conform to Specification C494.

6.5 Synthetic fibers and Non-Synthetic fibers shall be allowed to be used, at the manufacturer's option, in concrete pipe as a nonstructural manufacturing material. Synthetic fibers (Type II and Type III) and Non-Synthetic fiber (Type I) designed and manufactured specifically for use in concrete and conforming to the requirements of Specification C1116 shall be accepted.

## 7. Design

7.1 *Design Tables*—Design requirements shall be in accordance with Table 1. Wall thickness used shall be not less than

the value shown, except as affected by the tolerance herein specified and by the provision for modified design.

7.2 *Modified or Special Design*—Manufacturers shall submit to the owner for approval, prior to manufacture, wall thicknesses other than those shown in Table 1. Such pipe shall meet all of the physical requirements listed in Section 10 that are specified by the owner.

## 8. Joints

8.1 The joints shall be of such design and the ends of the concrete pipe sections so formed, that the pipe can be laid together to make a continuous line of pipe compatible with the permissible variations given in Section 11.

## 9. Manufacture

9.1 *Mixture*—The aggregates shall be sized, graded, proportioned, and mixed with such proportions of cementitious materials and water as will produce a homogeneous concrete mixture 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 6.2 and shall be added to the mix in a proportion not less than 470 lb/yd<sup>3</sup> unless mix designs with a lower cementitious material content demonstrate that the quality and performance of the pipe meet the requirements of this specification.

9.2 *Curing*—Pipe shall be subjected to any one of the methods of curing described in 9.2.1, 9.2.2, 9.2.3, 9.2.4, or to any other method or combination of methods approved by the owner that will give satisfactory results. The pipe shall be adequately cured to obtain the strength properties as described in 5.2.

9.2.1 *Steam Curing*—Pipe shall be placed in a curing chamber, free from outside drafts, and cured in a moist atmosphere maintained by the injection of steam for such time and such temperature as needed to enable the pipe to meet the strength requirements. The curing chamber shall be so constructed as to allow full circulation of steam around the entire pipe.

9.2.2 *Water Curing*—Concrete pipe shall be water-cured by covering with water-saturated material or by a system of