Designation: C14M – 15a

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

This standard is issued under the fixed designation C14M; 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.

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

1. Scope

1.1 This specification 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 This specification is the metric counterpart of Specification C14.

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 condition 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:*[2]

C33/C33M Specification for Concrete Aggregates
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
C443M Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric)
C494/C494M Specification for Chemical Admixtures for Concrete
C497M Test Methods for Concrete Pipe, Manhole Sections, or Tile (Metric)
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
C1116/C1116M Specification for Fiber-Reinforced Concrete
C1602/C1602M Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

3. Terminology

3.1 *Definitions of Terms Specific to This Standard*—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.

[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.

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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.

TABLE 1 Physical and Dimensional Requirements for Nonreinforced Concrete Pipe[A]

Internal Designated Diameter, mm	Class 1		Class 2		Class 3	
	Minimum Thickness of Wall, mm	Minimum Three-Edge Bearing Strength, kN/linear m	Minimum Thickness of Wall, mm	Minimum Three-Edge Bearing Strength, kN/linear m	Minimum Thickness of Wall, mm	Minimum Three-Edge Bearing Strength, kN/linear m
100	16	22.0	19	29.0	19	35.0
150	16	22.0	19	29.0	22	35.0
200	19	22.0	22	29.0	29	35.0
250	22	23.5	25	29.0	32	35.0
300	25	26.5	35	33.0	44	38.0
375	32	29.0	41	38.0	47	42.0
450	38	32.0	50	44.0	57	48.0
525	44	35.0	57	48.0	69	56.0
600	54	38.0	75	52.5	85	64.0
675	82	41.0	94	57.5	94	67.0
750	88	44.0	107	63.0	107	69.5
825	94	46.0	113	64.0	113	71.0
900	100	48.0	119	65.5	119	73.0

[A]Subject to tolerance in Section 11.

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, admixtures, if used, and water.

6.2 *Cementitious Materials:*

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

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 Portland-pozzolan cement only,

6.2.4.4 Portland-limestone cement only,

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

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

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

6.2.4.8 A combination of portland-pozzolan cement and fly ash.

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

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

6.4.1 Air-entraining admixture conforming to Specification C260/C260M;

6.4.2 Chemical admixture conforming to Specification C494/C494M;

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

6.4.4 Chemical admixture or blend approved by the owner.

6.5 *Fibers*—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/C1116M shall be accepted.

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

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, water, and admixtures, if any, to produce a thoroughly mixed 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 6.2 and shall be added to the mix in a proportion not less than 280 kg/m^3 unless mix designs with a lower cementitious materials 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 through 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 prescribed 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 perforated pipes, mechanical sprinklers, porous hose, or by any other approved method that will keep the pipe moist during the specified curing period.

9.2.3 The manufacturer is not prohibited from combining the methods described in 9.2.1 and 9.2.2 provided the specified strength is attained.

9.2.4 *Membrane Curing*—A sealing membrane conforming to the requirements of Specification C309 is not prohibited from being applied and left intact until the specified strength requirements are met. The concrete at the time of application shall be within 6°C of the atmospheric temperature. All surfaces shall be kept moist prior to the application of the compounds and shall be damp when the compound is applied.

9.3 *Specials:*

9.3.1 *General Requirements*—Special shapes or fittings such as wyes, tees, bends, and adapters for use with concrete pipe conforming to this specification shall conform to the applicable requirements for concrete pipe of corresponding class and internal diameter. Joints shall be compatible with those used in adjoining concrete pipes.

9.3.2 *Fabricated Branches*—Fabricated branches for wyes and tees shall be securely attached to the wall of the pipe in such a manner as not to restrict or otherwise interfere with the flow characteristics of the pipe.

10. Physical Requirements

10.1 *Test Specimen*—The specified number of pipe required for the tests shall be furnished by the manufacturer and shall be selected at random by the owner, and shall be pipe that would not otherwise be rejected under this specification. The selection shall be made at the point or points designated by the owner when placing the order. The test pipe shall first be freed from all visible moisture. When dry, each pipe shall be measured and inspected. The results of these observations shall be recorded.

10.2 *Number and Type of Test Specimens Required*—The manufacturer or seller shall furnish pipe for crushing and absorption tests, up to 0.5 % of the number of pipe of each size included in the order, except that in no case shall less than two pipe be furnished. For the permeability test, 2 % of the number of pipe of each size included in the order, but in no case less than two pipe shall be furnished. For the hydrostatic test, 0.5 % of the number of pipe of each size included in the order, but in no case less than two pipe shall be furnished.

10.3 *External Load Crushing Requirement*—The crushing strength of nonreinforced concrete pipe shall conform to the requirements prescribed in Table 1. The individual results of the various tests for each size of pipe and for each shipment and plant shall be tabulated separately. The crushing strength shall ordinarily be applied to not less than 75 % of the pipe received for purpose of test. All tests shall be made in accordance with Test Method C497M. Pipe shall be acceptable when all test pipe conform to the specified requirement. Should any of the test pipe provided in 10.2 fail to meet the strength requirement, the manufacturer will be allowed to test two pipe for each pipe that failed, and the pipe shall be acceptable only when all of these additional test pipe meet the strength requirement.

10.4 *Absorption Requirement*—When required by the owner, an absorption test shall be performed by either Test Method A or Test Method B in accordance with Test Methods C497M for the boiling absorption test. Absorption shall not exceed 9 % for Test Method A or 8.5 % for Test Method B. The individual results of the various tests for each size of pipe and for each shipment and plant shall be tabulated separately. All tests shall be made in accordance with Test Methods C497M. The number of absorption test specimens shall be equal to the number of pipe provided for crushing strength testing. These specimens shall be obtained from pipe that are acceptable as to strength, and shall be taken from pipe used in making the strength test after the test is made. These specimens shall be marked with the number or identification mark of the pipe from which they were taken. Each Test Method A specimen shall have an area of 77 to 129 cm^2, as measured on one surface of the pipe, and a thickness equal to the pipe wall, and shall be free of visible cracks. Pipe shall be acceptable when all test pipe conform to the specified absorption requirements.

10.5 *Permeability Requirement*—When subjected to the permeability test, as specified in Test Methods C497M, the outer pipe surface of not less than 80 % of the pipe tested shall show no moist or damp spots at the end of the test period due to water passing through the walls of the pipe.

10.6 *Hydrostatic Requirement*—When subjected to the hydrostatic test, as described in Test Methods C497M, the pipe shall show no leakage during 10 min at 70 kPa. Moisture appearing on the surface of the pipe in the form of patches or beads adhering to the surface shall not be considered leakage. The test pipe shall be filled with water and held under 70 kPa pressure for 24 h prior to the test, except that the manufacturer is not prohibited from reducing this presoak time or pressure,

or both. The manufacturer is not prohibited from continuing this test up to 24 h, and the pipe will be considered to have passed when, during any 10-min period, no leakage is observed. When the hydrostatic requirement is used for acceptance of the pipe joint as specified in Section 10 of Specification C443M, it is not prohibited to use the same joint test runs as the basis of acceptance for pipe hydrostatic requirements in accordance with 5.5 and 10.6 of this specification.

10.7 *Retest*—Should more than 20 % of the samples fail to meet the specified requirements for the permeability or not more than 20 % of the samples fail to meet the specified requirement for absorption or hydrostatic requirements of this section, it is not prohibited for the manufacturer to cull his stock and may eliminate whatever any of pipe and must so mark those pipe that will not be shipped. The required tests shall be made on the balance of the order and they are acceptable if they conform to the specified requirements. If the second sample fails to meet the specified requirements, the whole lot is subject to rejection.

11. Dimensions and Permissible Variations

11.1 *Sizes and Dimensions*—Pipe shall be furnished of the sizes, internal diameters, and dimensions prescribed in Table 1.

11.2 *Permissible Variations in Dimensions*—Permissible variations in dimensions shall be limited to the following:

11.2.1 *Internal Diameter*—See Table 2. At the manufacturer's option, the internal diameter shall be one of two alternatives, the Designated Diameter or the Converted English Diameter. Pipe sections that are intended to be jointed to each other shall be furnished with the same internal diameter alternative. The internal diameter of pipe manufactured to the Designated Diameters shall vary from the Designated Diameter not more than ±5 mm for 300 mm pipe and smaller, ±7 mm for 375 mm to 450 mm pipe, ±8 mm for 525 mm pipe, and ±10 mm for 600 mm pipe and larger. The internal diameter of pipe manufactured to the Converted English Diameters shall vary from the Converted English Diameter not more than ±5 mm for 305 mm pipe and smaller, ±7 mm for 381 mm to 457 mm pipe, ±8 mm for 533 mm pipe, and ±10 mm for 610 mm pipe and larger. For pipe manufactured to Converted English Diameters, the corresponding Designated Diameter shown in Table 2 shall apply for all other requirements of this specification.

TABLE 2 Internal Diameters

Designated Diameter, mm	Equivalent English Diameter, in	Converted English Diameter, mm
100	4	102
150	6	152
200	8	203
250	10	254
300	12	305
375	15	381
450	18	457
525	21	533
600	24	610
675	27	686
750	30	762
825	33	838
900	36	914

11.2.2 *Thickness of Wall*—The wall thickness shall be not less than the values shown in Table 1 or the manufacturer's designated thickness if greater than shown in Table 1 by more than 2 mm for pipe 250 mm or less in diameter; by more than 3 mm for pipe 300 to 600 mm in diameter; and by more than 5 mm for pipe more than 600 mm in diameter; or by more than 5 % of the tabulated or designated wall thickness, whichever is greater. Localized variations in wall thickness exceeding those specified above shall be accepted if the physical test requirements specified herein are met.

11.2.3 *Length*—The length of any section of pipe shall vary not more than − 13 mm from a specified or designated design length.

11.2.4 *Length of Two Opposite Sides*—The length of two opposite sides of any section of pipe shall vary not more than 6 mm or 2 % of the designated diameter, whichever is larger.

11.2.5 *Straightness*—Pipe intended to be straight shall not vary in alignment more than 10 mm/m of length.

12. Repairs

12.1 Pipe repaired because of imperfections in manufacture or damage during handling are acceptable if, in the opinion of the owner, the repaired pipe conforms to the requirements of this specification.

13. Inspection

13.1 The quality of all materials and the finished pipe shall be subject to inspection and approval by the owner. Such inspection shall be performed either at the point of manufacture or delivery, or both. The method of marking as to acceptance or rejection of pipe shall be agreed upon, prior to inspection, between the owner and the manufacturer. Rejected pipe shall be replaced by the manufacturer with pipe that meets the requirements of this specification.

14. Rejection

14.1 Pipe shall be subject to rejection on account of failure to conform to any of the specification requirements. This specification is a manufacturing and purchase specification only. Therefore, damage to pipe during installation or caused by field loading in the installed condition shall not be cause for rejection on the basis of not meeting this specification. Individual sections of pipe are subject to rejection because of any of the following:

14.1.1 Fractures or cracks passing through the wall or joints, except that a single crack not exceeding 50 mm in length at either end of a pipe or a single fracture or spall in the joints not exceeding 75 mm around the circumference of the pipe nor 50 mm in length into joint shall not be considered cause for rejection unless these defects exist in more than 5 % of the entire shipment or delivery.

14.1.2 The planes of the ends of the pipe are not perpendicular to the longitudinal axis, subject to the limits of variation as shown in 11.2.4.

14.1.3 Defects that indicate mixing and molding not in accordance with 9.1.

14.1.4 Cracks sufficient to impair the strength, durability, or serviceability of the pipe.

15. Product Marking

15.1 The following information shall be legibly marked on each pipe:

15.1.1 The pipe class and specification designation,

15.1.2 The date of manufacture.

15.1.3 The name or trademark of the manufacturer, and

15.1.4 Identification of the plant.

15.2 Marking shall be indented on the pipe section or painted thereon with waterproof paint.

16. Keywords

16.1 concrete sewer; culvert; nonreinforced; pipe; storm drain