



Designation: C412 – 15

Standard Specification for Concrete Drain Tile¹

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

1. Scope

1.1 This specification covers concrete drain tile with internal diameters from 4 to 36 in. that are intended to be used for surface and subsurface drainage.

1.2 A complete metric companion to Specification C412 has been developed—C412M; 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 condition and the strength classification of drain tile. However, experience has shown that the successful performance of the product depends upon the proper selection of the class of drain tile, 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 drain tile 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
- C494/C494M Specification for Chemical Admixtures for Concrete
- C497 Test Methods for Concrete Pipe, 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

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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.

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

4. Classification

4.1 Drain tile manufactured according to this specification shall be of the following four classes:

4.1.1 *Standard-Quality Concrete Drain Tile*, intended for land drainage of ordinary soils where the tile are laid in trenches of moderate depths and widths. Standard-Quality concrete drain tile are not recommended for use where internal diameters in excess of 12 in. are required.

4.1.2 *Extra-Quality Concrete Drain Tile*, intended for land drainage of ordinary soils where the tile are laid in trenches of considerable depths or widths, or both.

4.1.3 *Heavy-Duty Extra-Quality Concrete Drain Tile*, intended for land drainage of ordinary soils where the tile are laid in trenches of large depths or widths, or both.

4.1.4 *Special-Quality Concrete Drain Tile*, intended for land drainage where special precautions are necessary for concrete tile laid in soils that are markedly acid or contain unusual quantities of sulfates (see Section 7), and where the tile are laid in trenches of considerable depths or widths, or both.

4.1.4.1 Where the calculated loads are in excess of the crushing strengths prescribed in the physical requirements for extra-quality and special-quality concrete drain tile, tile strengths must be specified in advance by the owner.

5. Basis of Acceptance

5.1 The acceptability of drain tile shall be determined by (1) the results of the physical tests as specified in Section 8, and in Test Methods C497, (2) measurements and inspection to ascertain whether the tile conform to the requirements regarding dimensions, shape, and freedom from visible defects, and (3) the manufacturer's certification in writing that the tile have

been made in accordance with any special provisions, such as strength, absorption, permeability, type of cement, admixture, curing conditions, etc.

5.2 The owner shall specify in writing the class or classes of concrete tile to be supplied, whether Standard-Quality, Extra-Quality, Heavy-Duty Extra-Quality, or Special-Quality. Unless Extra-Quality, Heavy-Duty Extra-Quality, or Special-Quality concrete drain tile have been specified, Standard-Quality drain tile shall be accepted.

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 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 *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 the requirements of Specification **C33/C33M**, except that the requirements 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 nonsynthetic 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 nonsynthetic 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 non-potable water that meets the requirements of Specification **C1602/C1602M**.

7. Chemical Requirements

7.1 *Acid and Sulfate Resistance:*

7.1.1 The owner is not prohibited from specifying special requirements in order to increase the durability of the drain tile in cases where the soils, soil waters, or drainage waters are markedly acid or contain moderate or severe quantities of soil sulfates. Without a specific agreement in advance, no drain tile shall be rejected by reason of its composition as determined later by chemical analyses.

7.1.1.1 Soils or drainage waters with a pH of 6.0 or lower shall be considered to be markedly acid.

7.1.1.2 Where the sulfates are chiefly sodium or magnesium, singly or in combination, from 400 to 2000 ppm in the soil or drainage water, samples shall be considered to constitute moderate sulfate quantities, while in excess of 2000 ppm shall be considered to be severe sulfate quantities.

7.1.2 Concrete drain tile that will be installed in markedly acid soils shall meet the physical requirements given in the table for Special-Quality concrete drain tile.

7.1.3 Tile that will be exposed to moderate or severe sulfate quantities (**Note 2**) if required by the owner, shall be specified to meet the physical requirements for Special-Quality concrete drain tile (**8.3.4**). Tile that will be exposed to moderate sulfate quantities (**Note 2**), if required by the owner, shall be specified to be made with Portland Cement (**C150/C150M**) containing not more than 8 % tricalcium aluminate (C3A). Tile that will be exposed to severe sulfate quantities (**Note 2**), if required by the owner, shall be specified to be made with Portland Cement (**C150/C150M**) containing not more than 5 % C3A. If mutually agreed upon between the manufacturer and owner, other cements, as described in Section 6, that have been proven to be adequately sulfate resistant shall be used.

8. Physical Requirements

8.1 *Test Specimens*—The drain tile to be tested shall be selected at random by the owner at the point or points specified in the order. If agreeable to the owner, the tile shall be inspected and tested in advance of shipment. Any additional expense for making tests and inspection in advance of shipment shall be paid by the manufacturer.

8.2 *Standard Sample*—Each standard physical test shall be made on five individual tile of each size ranging from 4-in. through 12-in. diameters; two individual tiles of each size ranging from 14-in. through 24-in. diameters; or on one tile of each size exceeding 24 in. in diameter. The manufacturer shall furnish tile without separate charge up to 0.5 % of each size of the order. The owner shall pay for all the tile in excess of 0.5 % of each size of the order at the same price as paid for other tile of the same size and quality.

8.3 *External Load Crushing Strength Test Requirements:*

8.3.1 For Standard-Quality concrete drain tile, the three-edge-bearing crushing strength shall meet the requirements given in **Table 1**, Column A, where no absorption test is required, or the three-edge-bearing crushing strength shall meet the requirements given in **Table 1**, Column B, where an absorption test is required of the limits noted in **Table 1**.

8.3.2 For Extra-Quality concrete drain tile, the three-edge-bearing crushing strength shall meet the requirements given in **Table 2**, Column A, where no absorption test is required, or the three-edge-bearing crushing strength shall meet the requirements given in **Table 2**, Column B, where an absorption test is required of the limits noted in **Table 2**.

8.3.3 For Heavy-Duty Extra-Quality concrete drain tile, the three-edge-bearing crushing strength shall meet the requirements given in **Table 3**.

8.3.4 For Special-Quality concrete drain tile, the three-edge-bearing crushing strength shall meet the requirements given in **Table 4**, or the higher specified load.

NOTE 2—To meet the crushing strength requirements shown in the tables, it is not prohibited to supply tile designed with increased wall thickness, high compressive strength concrete, or reinforcing, or a combination.

8.4 Absorption Tests:

NOTE 3—Method A absorption test is recommended for drain tile having diameters of 12 in. or less. When Method B absorption test is used, the absorption requirements shall be 0.5 % less than the Method A absorption requirements, as shown in **Table 1**, **Table 2**, **Table 3**, or **Table 4**. Method B absorption procedure is described in Test Methods **C497**.

8.4.1 For Standard-Quality concrete drain tile, the Method A absorption test shall meet the requirements given in **Table 1**. No absorption tests are required if the strength requirements of **Table 1**, Column A, are met.

8.4.2 For Extra-Quality concrete drain tile, the Method A absorption test shall meet the requirements given in **Table 2**. No absorption tests are required if the strength requirements of **Table 2**, Column A, are met.

8.4.3 For Heavy-Duty Extra-Quality concrete drain tile, the Method A absorption test shall meet the requirements given in **Table 3**.

8.4.4 For Special-Quality concrete drain tile the Method A absorption test shall meet the requirements given in **Table 4**.

8.4.5 Specimens for the Method A absorption tests shall be selected in accordance with the following provisions:

8.4.5.1 For the tile with inside diameters of 12 in. or less, and lengths of 12 in., the absorption test shall be made on one full-length quarter segment taken from each of the five tile broken in the strength test, constituting a standard sample as defined in **8.2**. By quarter segment is meant one of the four pieces into which a tile usually breaks in the strength test. If a tile breaks in such a manner that a satisfactory quarter segment cannot be obtained, then the absorption test shall be made of two or more pieces that approximate the area of a quarter tile of that size selected so that both ends and the center portion of the tile are represented. The average absorption of the pieces so selected shall be considered the absorption for that tile.

8.4.5.2 For nonreinforced tile with inside diameters or lengths in excess of 12 in., the absorption test shall be made on three specimens: one of the specimens shall be taken from one end of the tile, another specimen from the opposite end, and the third specimen from near the center. The average absorption of the three specimens shall be considered the absorption for that tile.

8.4.5.3 For reinforced tile, the absorption test shall be made on one specimen taken from each test tile.

8.4.5.4 The specimens shall be the full thickness of the tile, as broken or cut from segments that result from the strength test. Each specimen shall have a minimum area of not less than 25 in.² as measured on one wall surface.

8.4.5.5 The average absorption for Standard-Quality, Extra-Quality, and Heavy-Duty Extra-Quality tile shall be the average of the absorption tests for the standard sample as defined in **8.2** or the average of the absorption tests for the strongest and the weakest tile as measured by the crushing strength of the standard sample. When drain tile fail to meet the absorption test requirement as computed by averaging the absorptions from the weakest and the strongest tile of a standard sample, then the average absorption test shall be computed by averaging the absorption tests from all the tile from the standard

TABLE 1 Physical Test Requirements for Standard-Quality Concrete Drain Tile

Internal Designated Diameter, in.	Maximum Wall Thickness for Indicated Strength, ^A in.	Standard-Quality Concrete Drain Tile			Method A Absorption	
		Three-Edge Bearing Crushing Strength ^B			Maximum Average, %	Maximum for Individual Tile, %
		Minimum Average, lbf/linear ft	Minimum Average, lbf/linear ft	Minimum for Individual Tile, lbf/linear ft		
A	B					
4	800	700	10	11
5	9/16	900	800	700	10	11
5	5/8	1000	800	700	10	11
6	5/8	900	800	700	10	11
6	3/4	1000	800	700	10	11
8	3/4	900	800	700	10	11
8	7/8	1000	800	700	10	11
10	7/8	900	800	700	10	11
10	1	1000	800	700	10	11
12	1	900	800	700	10	11
12 ^C	1 1/8	1000	800	700	10	11

^A Maximum wall thickness for the indicated minimum average crushing strength, Column A, when no absorption test is required.

^B Drain tile meeting the above strength requirements are not necessarily safe against cracking in deep and wide trenches.

^C Tile with diameters greater than 12 in., shall meet the requirements specified in **Table 2** for Extra-Quality, **Table 3** for Heavy-Duty Extra-Quality, or **Table 4** for Special-Quality concrete drain tile.