Designation: C412 – 05a

Standard Specification for Concrete Drain Tile[1]

This standard is issued under the fixed designation C412; 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 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 Specification for Concrete Aggregates
C150 Specification for Portland Cement
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
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 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

[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.

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, and water.

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, 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 Class F or Class C of Specification C618.

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 requirements for gradation shall not apply.

6.4 *Admixtures and Blends*—Admixtures and blends shall only be used with the approval of the owner.

6.5 *Synthetic Fibers*—At the manufacturer's option, collated fibrillated virgin polypropylene fibers are not prohibited from being used 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 used.

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 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) 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) 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.

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

Internal Designated Diameter, in.	Standard-Quality Concrete Drain Tile					
	Maximum Wall Thickness for Indicated Strength,[A] in.	Three-Edge Bearing Crushing Strength[B]			Method A Absorption	
		Minimum Average, lbf/linear ft	Minimum Average, lbf/linear ft	Minimum for Individual Tile, lbf/linear ft	Maximum Average, %	Maximum for Individual Tile, %
		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.

TABLE 2 Physical Test Requirements for Extra-Quality Concrete Drain Tile

Internal Designated Diameter, in.	Extra-Quality Concrete Drain Tile						
	Wall Thickness, in.	Maximum Wall Thickness for Indicated Strength,[A] in.	Three-Edge-Bearing Crushing Strength[B]			Method A Absorption	
			Minimum Average, lbf/linear ft	Minimum Average, lbf/linear ft	Minimum for Individual Tile, lbf/linear ft	Maximum Average, %	Maximum for Individual Tile, %
			A	B			
4	1/2	...	...	1100	990	9	10
5	9/16	9/16	1200	1100	990	9	10
5	9/16	5/8	1300	1100	990	9	10
6	5/8	5/8	1200	1100	990	9	10
6	5/8	3/4	1300	1100	990	9	10
8	3/4	3/4	1200	1100	990	9	10
8	3/4	7/8	1300	1100	990	9	10
10	7/8	...	...	1100	990	9	10
12	1	...	...	1100	990	9	10
14	1 1/8	...	...	1100	990	9	10
15	1 1/4	...	...	1100	990	9	10
16	1 3/8	...	...	1100	990	9	10
18	1 1/2	...	...	1200	1080	9	10
20	1 5/8	...	...	1330	1200	9	10
22	1 3/4	...	...	1460	1320	9	10
24	2	...	...	1600	1440	9	10
26	2 1/8	...	...	1730	1560	9	10
28	2 3/8	...	...	1870	1680	9	10
30	2 1/2	...	...	2000	1800	9	10
32	2 5/8	...	...	2130	1920	9	10
34	2 7/8	...	...	2270	2040	9	10
36	3	...	...	2400	2160	9	10

[A] Maximum wall thickness for the indicated minimum average crushing strength, Column A, when no absorption test is required.
[B] For crushing strengths greater than or equal to those shown in the above table, it is not prohibited to supply tile designed with increased wall thickness, higher strength concrete, or reinforcing.

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