



Designation: C 412M – 05

METRIC

## Standard Specification for Concrete Drain Tile [Metric]<sup>1</sup>

This standard is issued under the fixed designation C 412M; 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 Department of Defense.*

### 1. Scope

1.1 This specification covers concrete drain tile with internal diameters from 100 to 900 mm, that are intended to be used for surface and subsurface drainage.

1.2 This specification is the metric counterpart of Specification C 412.

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:<sup>2</sup>

- C 33 Specification for Concrete Aggregates
- C 150 Specification for Portland Cement
- C 497M Test Methods for Testing Concrete Pipe, Manhole Sections, or Tile [Metric]
- C 595 Specification for Blended Hydraulic Cements
- C 618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- C 670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
- C 822 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.

Current edition approved Oct. 15, 2005. Published November 2005. Originally approved in 1980. Last previous edition approved in 2004 as C 412M – 04.

<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.

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### 3. Terminology

3.1 *Definitions*—For definitions of terms relating to concrete pipe, see Terminology C 822.

### 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 300 mm 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 C 497M, (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, and water, in which steel has been embedded in such a manner that the steel and concrete act together.

### 6.2 *Cementitious Materials:*

6.2.1 *Cement*—Cement shall conform to the requirements for portland cement of Specification C 150 or shall be portland blast-furnace slag cement, or slag-modified portland cement, or portland-pozzolan cement conforming to the requirements of Specification C 595, 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 C 618, 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 C 989.

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 C 33, 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.

## 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 (C 150) 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 (C 150) 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 100-mm through 300-mm diameters; two individual tiles of each size ranging from 350-mm through 600-mm diameters; or on one tile of each size exceeding 600 mm 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.

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

Internal Designated Diameter, mm	Maximum Wall Thickness for Indicated Strength, <sup>A</sup> mm	Standard-Quality Concrete Drain Tile				
		Three-Edge-Bearing Crushing Strength <sup>B</sup>			Method A Absorption	
		Minimum Average, kN/linear m	Minimum Average, kN/linear m	Minimum for Individual Tile, kN/linear m	Maximum Average, %	Maximum for Individual Tile, %
		A	B			
100	...	...	11.5	10.0	10	11
125	14	13.0	11.5	10.0	10	11
125	16	14.5	11.5	10.0	10	11
150	16	13.0	11.5	10.0	10	11
150	19	14.5	11.5	10.0	10	11
200	19	13.0	11.5	10.0	10	11
200	22	14.5	11.5	10.0	10	11
250	22	13.0	11.5	10.0	10	11
250	25	14.5	11.5	10.0	10	11
300	25	13.0	11.5	10.0	10	11
300 <sup>C</sup>	29	14.5	11.5	10.0	10	11

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

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

<sup>C</sup> Tile with diameters greater than 300 mm 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, mm	Wall Thickness, mm	Maximum Wall Thickness for Indicated Strength, <sup>A</sup> mm	Extra-Quality Concrete Drain Tile				
			Three-Edge-Bearing Crushing Strength <sup>B</sup>			Method A Absorption	
			Minimum Average, kN/linear m	Minimum Average, kN/linear mm	Minimum for Individual Tile, kN/linear m	Maximum Average, %	Maximum for Individual Tile, %
		A	B				
100	13	...	...	16.0	14.5	9	10
125	14	14	17.5	16.0	14.5	9	10
125	14	16	19.0	16.0	14.5	9	10
150	16	16	17.5	16.0	14.5	9	10
150	16	19	19.0	16.0	14.5	9	10
200	19	19	17.5	16.0	14.5	9	10
200	19	22	19.0	16.0	14.5	9	10
250	22	...	...	16.0	14.5	9	10
300	25	...	...	16.0	14.5	9	10
350	29	...	...	16.0	14.5	9	10
375	32	...	...	16.0	14.5	9	10
400	35	...	...	16.0	14.5	9	10
450	38	...	...	17.5	16.0	9	10
500	41	...	...	19.5	17.5	9	10
550	44	...	...	21.5	19.0	9	10
600	50	...	...	23.5	21.0	9	10
650	54	...	...	25.0	23.0	9	10
700	60	...	...	27.5	24.5	9	10
750	63	...	...	29.0	26.5	9	10
800	66	...	...	31.0	28.0	9	10
850	72	...	...	33.0	30.0	9	10
900	75	...	...	35.0	31.5	9	10

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

<sup>B</sup> 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.

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-strength concrete, or reinforcing, or a combination.

8.3.5 *Precision and Bias*—The user of these test methods is advised that the true value for the strength of a concrete pipe cannot be determined because the specimen is tested to destruction and exact duplicate specimen cannot be obtained. Therefore, no calculations of precision and bias are presently capable of being performed. Specifications that include this test method for the various types of concrete pipe shall include a provision for additional tests of one or more specimens.

#### 8.4 Absorption Tests:

NOTE 3—Method A absorption test is recommended for drain tile having diameters of 300 mm 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 C 497M.

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.