Designation: D560/D560M – 16

Standard Test Methods for Freezing and Thawing Compacted Soil-Cement Mixtures [1]

This standard is issued under the fixed designation D560/D560M; 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 These test methods cover procedures for determining the soil-cement losses, water content changes, and volume changes (swell and shrinkage) produced by repeated freezing and thawing of hardened soil-cement specimens. The specimens are compacted in a mold, before cement hydration, to maximum density at optimum water content using the compaction procedure described in Test Methods D558.

1.2 Two test methods, depending on soil gradation, are covered for preparation of material for molding specimens and for molding specimens as follows:

	Sections
Test Method A, using soil material passing a 4.75-mm [No. 4] sieve. This method shall be used when 100 % of the soil sample passes the 4.75-mm [No. 4] sieve.	7
Test Method B, using soil material passing a [0.75-in.] 19.0-mm sieve. This method shall be used when part of the soil sample is retained on the 4.75-mm [No. 4] sieve. This test method may be used only on those materials that have 30 % or less retained on the 19.0 mm [0.75-in.] sieve	8

1.3 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026, unless superseded by this test method.

1.3.1 The procedures used to specify how data are collected /recorded and calculated in the standard are regarded as the industry standard. In addition, they are representative of the significant digits that generally should be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user's objectives; and it is common practice to increase or reduce significant digits of reported data to be commensurate with these considerations. It is beyond the scope of these test methods to consider significant digits used in analysis methods for engineering data.

1.4 *Units*—The values stated in either SI units or inch-pound units [presented in brackets] are to be regarded separately as standard. The values stated in each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard. Sieve size is identified by its standard designation in Specification E11. The alternative designation given in parentheses is for information only and does not represent a different standard sieve size.

1.4.1 The gravitational system of inch-pound units is used when dealing with inch-pound units. In this system, the pound (lbf) represents a unit of force (weight), while the unit for mass is slugs. The rationalized slug unit is not given, unless dynamic (F = ma) calculations are involved.

1.4.2 It is common practice in the engineering/construction profession to use pounds to represent both a unit of mass (lbm) and of force (lbf). This implicitly combines two separate systems of unit; that is, the absolute system and the gravitational system. It is scientifically undesirable to combine the use of two separate sets of inch-pound units within a single standard. As stated, this standard includes the gravitational system of inch-pound units and does not use/present the slug unit for mass. However, the use of balances or scales recording pounds of mass (lbm) or recording density in lbm/ft^3 shall not be regarded as nonconformance with this standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C150/C150M Specification for Portland Cement

C595/C595M Specification for Blended Hydraulic Cements

D558 Test Methods for Moisture-Density (Unit Weight) Relations of Soil-Cement Mixtures

D559/D559M Test Methods for Wetting and Drying Compacted Soil-Cement Mixtures

D653 Terminology Relating to Soil, Rock, and Contained Fluids

[1] These test methods are under the jurisdiction of ASTM Committee D18 on Soil and Rock and are the direct responsibility of Subcommittee D18.15 on Stabilization With Admixtures.

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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.

***A Summary of Changes section appears at the end of this standard**

D698 Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
D2168 Practices for Calibration of Laboratory Mechanical-Rammer Soil Compactors
D2216 Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
D3282 Practice for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
D4753 Guide for Evaluating, Selecting, and Specifying Balances and Standard Masses for Use in Soil, Rock, and Construction Materials Testing
D6026 Practice for Using Significant Digits in Geotechnical Data
E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves
E145 Specification for Gravity-Convection and Forced-Ventilation Ovens

2.2 *AASHTO Standards:*[3]

M 145 Classifications of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes

3. Terminology

3.1 For common definitions of technical terms used in this standard, refer to Terminology D653.

4. Significance and Use

4.1 These test methods are used to determine the resistance of compacted soil-cement specimens to repeated freezing and thawing. These test methods were developed to be used in conjunction with Test Methods D559/D559M and criteria given in the *Soil-Cement Laboratory Handbook*[4] to determine the minimum amount of cement required in soil-cement to achieve a degree of hardness adequate to resist field weathering.

NOTE 1—The quality of the result produced by this standard is dependent on the competence of the personnel performing it and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D3740 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with Practice D3740 does not in itself ensure reliable results. Reliable results depend on many factors; Practice D3740 provides a means of evaluating some of those factors.

5. Apparatus

5.1 *Mold, Rammer, and Sample Extruder*—Refer to Test Methods D698 for detailed specifications.

5.2 *Balances*—A balance or scale conforming to the requirements of Class GP5 with a readability of 1 g in Specification D4753, except that a Class GP2 balance of 0.1 g readability is required for water content determination.

5.3 *Drying Oven*—Thermostatically controlled, preferably of the forced-draft type, meeting the requirements of Specification E145 and capable of maintaining a uniform temperature of 110 ± 5°C [230 ± 9°F] throughout the drying chamber.

5.4 *Freezing Cabinet*—A freezing cabinet capable of maintaining temperatures of −23°C [−10°F] or lower.

5.5 *Moist Room*—A moist room, or curing environment, capable of maintaining a temperature of 23 ± 2°C [73.5 ± 3.5°F] and a relative humidity of 100 % for seven-day storage of compacted specimens and for thawing frozen specimens.

5.6 *Wire Scratch Brush*—A wire scratch brush made of 50-mm [2-in.] long by 1.6-mm [0.06 in.] wide by 0.5-mm [No. 26 gage] thick flat wire bristles assembled in 50 groups of 10 bristles each and mounted to form five longitudinal rows and ten transverse rows of bristles on a 190 by 65-mm [7.5- by 2.5-in.] hardwood block.

5.7 *Straightedge*—A stiff metal straightedge of any convenient length but not less than 250 mm [10-in.]. The total length of the straightedge shall be machined straight to a tolerance of ± 0.1-mm [±0.004-in.]. The scraping edge shall be beveled if it is thicker than 3-mm [0.12-in.].

5.8 *Sieves*—75-mm [3-in.], 19.0-mm [0.75-in.], and 4.75-mm [No. 4] sieves conforming to the requirements of Specification E11.

5.9 *Mixing Tools*—Miscellaneous tools such as mixing pan, and trowel, or a suitable mechanical device for thoroughly mixing the soil with cement and water.

5.10 *Butcher Knife*—A butcher knife approximately 250 mm [10 in.] in length for trimming the top of the specimens.

5.11 *Scarifier*—A six-pronged ice pick or similar apparatus to remove the smooth compaction plane at the top of the first and second layers of the specimen.

5.12 *Container*—A flat, round pan, for initial preparation of heavy textured clayey material to facilitate moisture absorption by the soil-cement mixtures, about 300 mm [12 in.] in diameter and at least 50 mm [2 in.] deep.

5.13 *Measuring Device*—A measuring device suitable for accurately measuring the heights and diameters of test specimens to the nearest 0.25 mm [0.01 in.].

5.14 *Pans and Carriers*—Suitable pans for handling materials and carriers or trays for handling test specimens.

5.15 *Absorptive Pads*—6-mm [0.25-in.] thick felt pads, blotters, or similar absorptive material for placing between specimens and specimen carriers.

5.16 *Graduate*—A graduated cylinder of 250-mL [8.4 oz] capacity for measuring water.

5.17 *Water Content Containers*—Suitable containers made of material resistant to corrosion and change in mass upon repeated heating, cooling, exposure to materials of varying pH, and cleaning. Unless a desiccator is used, containers with close filling lids shall be used for testing specimens having a mass of about 200 g [0.4 lbf]; while for specimens having a mass

[3] Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, http://www.transportation.org.

[4] *Soil-Cement Laboratory Handbook*, Portland Cement Assn., 1992.

greater than about 200 g, containers without lids may be used. One container is needed for each water content determination.

6. Standardization/Verification

6.1 Perform verifications of molds and rammers in accordance with Test Method D698 before initial use, after repairs or other occurrences that might affect the test results, at intervals not exceeding 500 test specimens, or annually, whichever occurs first.

6.1.1 *Balance*—Evaluate in accordance with Guide D4753 as required by Test Method D698.

7. Test Method A—Using Soil Material Passing a 4.75-mm [No. 4] Sieve

7.1 *Preparation of Material for Molding Specimens:*

7.1.1 Collect a soil sample that is visually representative of the project material.

7.1.2 Prepare the soil sample in accordance with Test Method A of Test Methods D558.

7.1.3 Select a sufficient quantity of the soil prepared as described in 7.1.2 to provide two (Note 2) compacted specimens and required water content samples.

NOTE 2—(*Optional*)—Usually only one specimen (identified as No. 2) is required for routine testing. The other specimen (identified as No. 1) is made for research work and for testing unusual soils.

7.1.4 Add to the soil the required amount of cement conforming to Specification C150/C150M or Specification C595/C595M. Mix the cement and soil thoroughly to a uniform color.

7.1.5 Add sufficient potable water to raise the soil-cement mixture to optimum water content at time of compaction and mix thoroughly.

7.1.6 When the soil used is a heavy textured clayey material transfer the mixture to the flat round pan and lightly tamp the mixture until firm using the rammer described in 5.1 or a cylinder about 50-mm [2-in.] in diameter. Cover the mixture and allow to stand for not less than 5 min, but not more than 10 min, to aid dispersion of the moisture and to permit more complete absorption by the soil-cement.

7.1.7 After the absorption period, thoroughly break up the mixture, without reducing the natural size of individual particles, until it will pass a 4.75-mm [No. 4] sieve, as judged by eye, and then remix.

7.2 *Molding Specimens:*

7.2.1 Form a specimen by immediately compacting the soil-cement mixture in the mold, with the collar attached, and later trimming the specimen in the same manner as directed for Test Method A of Test Methods D558, and in addition scarify the tops of the first and second layers to remove smooth compaction planes before placing and compacting the succeeding layers. This scarification shall form grooves at right angles to each other, approximately 3 mm [0.12 in.] in width and 3 mm [0.12 in.] in depth and approximately 6 mm [0.2 in.] apart.

7.2.2 During compaction, take a representative sample from the batch of soil-cement mixture, that has a mass of at least 100 g. Determine and record the mass. Immediately, dry the specimen in a drying oven at 110 ± 5°C [230 ± 9°F] for at least 12 h or to a constant mass. Determine and record the oven-dry mass of the specimen to four significant digits. Calculate the water content in accordance with Test Methods D2216 and D698, and check against design water content. (Note 6)

7.2.3 Determine and record the mass of the compacted specimen to four significant digits and remove it from the mold. Calculate the dry unit weight in kg/m^3 [lbf/ft^3] in accordance with Test Methods D558 to check against the design dry density. (Note 6).

7.2.3.1 If the dry unit weight obtained is within the design tolerances specified, identify the specimen with a metal tag (or other suitable device) as No. 1, together with any other needed identification marks. This specimen will be used to obtain data on water content and volume changes during the test.

7.2.3.2 If the dry unit weight obtained does not meet the tolerances specified, then another specimen will need to be compacted.

7.2.4 Form a second specimen as rapidly as possible and determine the water content and oven-dry mass as described in 7.2.1 – 7.2.3. Identify this specimen as No. 2, together with other needed identification marks and use to obtain data on soil-cement losses during the test.

7.2.5 Determine the average diameter and height of the No. 1 specimen and calculate its volume.

7.2.6 Place the specimens on suitable carriers in the moist room and protect them from free water for a period of seven days.

7.2.7 Determine and record the mass and measurement of the No. 1 specimen at the end of the seven-day storage period to provide data for calculating its water content and volume.

7.2.8 It is important that all height and diameter measurements be accurate to within 0.25 mm [0.01 in.] and be taken at the same points on the specimen at all times.

7.3 *Procedure:*

7.3.1 At the end of storage in the moist room, place water-saturated felt pads about 6 mm [0.25 in.] thick, blotters, or similar absorptive material between the specimens and the carriers, and place the assembly in a freezing cabinet having a constant temperature not warmer than −23°C [−10°F] for 24 h and remove. Determine and record the mass and measurements of the No. 1 specimen (water content and volume change specimen).

7.3.2 Place the assembly in the moist room, or curing environment, having a temperature of 23 ± 2°C [73.5 ± 3.5°F] and a relative humidity of 100 % for 23 h and remove. Free potable water shall be made available to the absorbent pads under the specimens to permit the specimens to absorb water by capillary action during the thawing period. Determine and record the mass and measurements of the No. 1 specimen.

7.3.3 Give specimen No. 2 (soil-cement loss specimen) two firm strokes on all areas with the wire scratch brush. The brush shall be held with the long axis of the brush parallel to the longitudinal axis of the specimen or parallel to the ends as required to cover all areas of the specimen. Apply these strokes to the full height and width of the specimen with a firm stroke corresponding to approximately 13-N [3-lbf] force (Note 3).

Eighteen to twenty vertical brush strokes are required to cover the sides of the specimen twice and four strokes are required on each end.

NOTE 3—This pressure can be measured as follows: clamp a specimen in a vertical position on the edge of a platform scale and zero the scale. Apply vertical brushing strokes to the specimen and note the force necessary to register approximately 13 N [3 lbf].

7.3.4 After being brushed, the specimens shall be turned over end for end before they are replaced on the water-saturated pads.

7.3.5 The procedures described in 7.3.1 – 7.3.4 constitute one cycle (48 h) of freezing and thawing. Again place the specimens in the freezing cabinet and continue the procedure for 12 cycles.

NOTE 4—Mass determinations of specimen No. 2 before and after brushing are usually made at the end of each cycle when conducting research and making special investigations. Some specimens made of silty and clayey soils tend to scale on sides and ends particularly after about the sixth cycle of test. This scale shall be removed with a sharp-pointed instrument such as an ice pick, since the regular brushing may not be effective.

7.3.6 The No. 1 specimen may be discontinued prior to 12 cycles should measurements become inaccurate due to soil-cement loss of the specimen.

NOTE 5—If it is not possible to run the cycles continuously the specimens may be held in the freezing cabinet during the layover period.

7.3.7 After 12 cycles of test, dry the specimens to constant mass or until there is less than 0.1 % change in mass after one hour of oven drying at 110 ± 5°C [230 ± 9°F]. Determine and record the oven-dry mass of the specimens to four significant digits.

7.3.8 The data collected will permit calculations of volume and water content changes of specimen No. 1 and the soil-cement losses of specimen No. 2 after the prescribed 12 cycles of test.

NOTE 6—Unless otherwise specified, normal laboratory practice permits the following tolerances between design factors and those obtained in the molded specimens:

Water content	±1 percentage point
Dry Unit Weight	± 48 kg/m^3 [3 lbf/ft^3]

8. Test Method B—Using Soil Material Passing a 19.0-mm [0.75-in.] Sieve

8.1 *Preparation of Material for Molding Specimens:*

8.1.1 Collect a soil sample that is visually representative of the project material.

8.1.2 Prepare the soil sample in accordance with Test Method B of Test Methods D558.

8.1.3 Select and maintain separate representative samples of soil passing the 4.75-mm [No. 4] sieve and of saturated, surface-dry aggregate passing the 19.0-mm [0.75-in.] sieve and retained on the 4.75-mm [No. 4] sieve so that the total sample will be enough to provide two (Note 2) compacted specimens and required water content samples. The percentage, by oven-dry mass, of aggregate passing the 19.0-mm [0.75-in.] sieve and retained on the 4.75-mm [No. 4] sieve shall be the same as the percentage passing the 75-mm [3-in.] sieve and retained on the 4.75-mm [No. 4] sieve in the original sample.

8.1.4 Add to the sample passing the 4.75-mm [No. 4] sieve, the amount of cement conforming to Specification C150/C150M, or Specification C595/C595M, required for the total sample described in 8.1.3. Mix the cement and soil thoroughly to a uniform color.

8.1.5 Add to the sample passing the 4.75-mm [No. 4] sieve, sufficient water to raise the total soil-cement mixture specified in 8.1.3 to optimum water content at time of compaction and facilitate moisture dispersion as described for Test Method A in 7.1.5 – 7.1.7.

8.1.6 After preparation of the mixture as described in 8.1.2 – 8.1.5, add the saturated, surface-dry aggregate to the mixture and mix thoroughly.

8.2 *Molding Specimens:*

8.2.1 Form a specimen by immediately compacting the soil-cement mixture in the mold (with the collar attached) and later trimming the specimen in accordance with Test Method B of Test Methods D558, and in addition as the mixture for each layer is placed in the mold, spade along the inside of the mold with a butcher knife before compaction to obtain uniform distribution of the material retained on the 4.75-mm [No. 4] sieve and scarify the tops of the first and second layers as described for Test Method A of these test methods.

8.2.2 During compaction take from the batch a representative sample of the soil-cement mixture with a mass of at least 500 g [1 lbf]. Determine and record the moist mass immediately to four significant digits, and dry in an oven at 110 ± 5°C [230 ± 9°F] at least 12 h or to constant mass to determine the water content to check against design water content.

8.2.3 Form a second specimen as rapidly as possible in the same manner.

8.2.4 Determine and record the mass of each compacted specimen, while in the mold, to check against design dry unit weight (Note 6); remove the molds, identify each specimen, measure the No. 1 specimen (Note 2), place both specimens in the moist room, and measure the No. 1 specimen again at the end of the 7-day storage period as described for Test Method A in 7.2.3 – 7.2.7 (7.2.8).

8.3 *Procedure*—Proceed as directed in Test Method A (see 7.3).

9. Calculation

9.1 Calculate the volume and water content changes and the soil-cement losses of the specimens as follows:

9.1.1 Calculate the volume of the mold used to compact the soil-cement mixture in accordance with Test Methods D698, Annex A1, to four significant digits.

9.1.2 Calculate the water content of the soil-cement mixture in accordance with Test Methods D2216 to 0.1%.

9.1.3 Calculate the difference between the volume of specimen No. 1 at the time of molding and subsequent volumes as a percentage of the original volume.

9.1.4 Calculate the water content of specimen No. 1 at the time of molding and subsequent water contents as a percentage of the original oven-dry mass of the specimen.

9.1.5 Correct the oven-dry mass of specimen No. 2 as obtained in 7.3.7 for water that has reacted with the cement and soil during the test and is retained in the specimen at 110°C [230°F] as follows:

$$\text{Corrected oven} - \text{dry mass} = (A/B) \times 100 \quad (1)$$

where:

A = oven-dry mass after drying at 110°C [230°F], and
B = percent by mass of water of hydration retained in specimen plus 100.

The percentage of water retained in specimen No. 2 after drying at 110°C [230°F] for use in the above formula can be assumed to be equal to the water retained in specimen No. 1. When No. 1 specimens are not molded, the foregoing data are not available and the average values prescribed in Table 1 are used.

9.1.6 Calculate the soil-cement loss of specimen No. 2 as a percentage of the original oven-dry mass of the specimen as follows:

$$\text{Soil} - \text{cement loss, \%} = (A/B) \times 100 \quad (2)$$

where:

A = original calculated oven-dry mass minus final corrected oven-dry mass, and
B = original calculated oven-dry mass.

10. Report: Test Data Sheet(s)/Form(s)

10.1 The methodology used to specify how data are recorded on the test data sheet(s)/form(s), as given below, is covered in 1.3.

10.2 Record as a minimum the following general information (data):

10.2.1 Testing date, operator name, location, and unique conditions.

10.2.2 Sample identification (that is, sample number, project, location, depth, etc.).

10.3 Record as a minimum the following test specimen data:

10.3.1 The design optimum water content to the nearest 0.5 %, and maximum dry unit weight of the molded specimens to the nearest 2 N/m^3 [0.5 lbf/ft^3],

10.3.2 The water content and dry unit weight obtained in molded specimens (Note 6),

10.3.3 The design cement content, in percent (include the basis of the percentage calculation), of the molded specimens,

10.3.4 The maximum volume change, in percent, and maximum water content during test of specimen No. 1,

10.3.5 The soil-cement loss, in percent, of specimen No. 2,

10.3.6 Procedure used (Method A or Method B).

TABLE 1 Average Values

Soil Classification (ASTM D3282 or AASHTO M 145)	Average Water Retained After Drying at 110°C [230°F], %
A-1, A-3	1.5
A-2	2.5
A-4, A-5	2.0
A-6, A-7	3.5

11. Precision and Bias

11.1 *Precision*—Only limited data are available from which to judge the variability of results for these test methods. These data are shown in Table 2.

11.1.1 A larger amount of mass loss data is listed in these test methods than in Test Methods D559/D559M. It is expected that variations of results of these tests would be similar to results of Test Methods D559/D559M since the same brushing operation is used in both test methods to achieve the mass loss.

11.1.2 Experience indicates that the variations in test results are greater for high mass losses and less for low mass losses. The degree of variation of most interest is that at the allowable mass loss criteria. Suggested allowable mass loss criteria are given in the literature.[4]

TABLE 2 Weight Loss of Replicate Specimens in the Freezing-and-Thawing Test[A]

Soil No.	Soil Class (ASTM D3282 or AASHTO M 145)	Cement Content, %	Weight Losses Replicate Specimens, %
8295[B]	A-4 (5)	3	14, 14
		5	6, 8
		7	3, 3
8939[B]	A-1-b (0)	2	29, 26
		3	3, 3
8942[B]	A-6 (10)	5	19, 23
		7	10, 9
		10	2, 2
9069[B]	A-4 (8)	8	34, 38
		10	15, 18
		12	8, 7
9247[B]	A-4 (8)	7	9, 7
9248[B]	A-1-b (0)	4	66, 40
		6	4, 7
9263[B]	A-2-4 (0)	2	31, 30
		3	10, 6
9268[B]	A-2-4 (0)	4	20, 17
		5	9, 10
9271[B]	A-2-4 (0)	3.5	17, 16
9287[B]	A-1-a (0)	5	3, 3
9295[B]	A-2-4 (0)	6	76, 34
9296[B]	A-1-b (0)	4	44, 100
9307[B]	A-3 (0)	9	10, 10
9312[B]	A-4 (7)	8	6, 5
9319[B]	A-2-4 (0)	5	4, 4
9423[C]	A-3 (0)	8	19, 17
		10	11, 8
		12	7, 5
9427[C]	A-3 (0)	8	15, 12
		10	9, 7
		12	6, 7
9429[C]	A-4 (6)	7.8	6, 4, 5, 5
9433[C]	A-6 (10)	14	2, 2, 2, 2
9443[C]	A-4 (2)	4	9, 6
		5	5, 4
9444[C]	A-1-a (0)	5	1, 4, 1
9465[C]	A-2-4 (0)	6	12, 10
		8	5, 6
9468[C]	A-3 (0)	12	6, 8

[A] Data condensed from Packard, R. G., and Chapman, G. A., "Developments in Durability Testing of Soil-Cement Mixtures," *Highway Research Record*, No. 36, 1963. Additional information given in Packard, R. G., "Alternate Methods for Measuring Freeze-Thaw and Wet-Dry Resistance of Soil-Cement Mixtures," *Highway Research Board Bulletin*, No. 353, 1962.
[B] Molded from same batch by same operator.
[C] Molded from separate batches at different times by different operators; from unpublished data of Portland Cement Association.

11.2 *Bias*—Since there is no accepted reference material suited for determining the bias for the procedure for measuring mass loss, no statement on bias is being made.

12. Keywords

12.1 durability; freeze-thaw; soil-cement; soil-cement mixtures; soil stabilization

SUMMARY OF CHANGES

In accordance with Committee D18 policy, this section identifies the location of changes to this standard since the last edition (2015) that may impact the use of this standard. (November 1, 2016)

(1) Revised 5.5 and 7.3.2 to clarify the intent of the curing environment requirement and make the curing environment temperature range consistent that required by concrete Standard Practices.

In accordance with Committee D18 policy, this section identifies the location of changes to this standard since the last edition (2003) that may impact the use of this standard. (November 15, 2015)

(1) Section 1.4 Units – Substituted combined SI and inch-pound units, and corrected references throughout standard.
(2) Inserted D18 policy statement on significant digits.
(3) Section 2 Referenced Documents – Added reference to D698 Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft^3 (600 kN-m/m^3). and AASHTO M 145 Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
(4) Section 4.1 – Updated publication date of Soil-Cement Laboratory Handbook.
(5) Added standard language on units and sieve sizes.
(6) Section 5 – Apparatus – Eliminated detailed description of compaction equipment and replaced with reference to D698 (e.g. 5.1 Mold, 5.2 Rammer, 5.3 Sample Extruder.).
(7) Section 6.1 – Combined 6.1.2, 6.1.3, and 6.1.4 into 6.1 with reference to D698.
(8) Section 7.1 and 8.1 – Added guidance on sample collection
(9) Revised notes.
(10) Added guidance on significant digits.
(11) Updated the Reports section per D18.91 special memorandum.
(12) Adjusted and clarified syntax where appropriate.
(13) Renumbered sections and notes as appropriate.
(14) Updated the Summary of Changes.