Designation: D559/D559M – 15

Standard Test Methods for Wetting and Drying Compacted Soil-Cement Mixtures[1]

This standard is issued under the fixed designation D559/D559M; 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 wetting and drying 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 19.0 mm [0.75-in.] 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 materials with 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values shall conform to the guidelines for significant digits and rounding established in Practice D6026, unless superseded by this test method.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 units; 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 Specification for Portland Cement

C595 Specification for Blended Hydraulic Cements

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

[1] These test methods are under the jurisdiction of the 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**

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D560/D560M Test Methods for Freezing and Thawing Compacted Soil-Cement Mixtures
D653 Terminology Relating to Soil, Rock, and Contained Fluids
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 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 wetting and drying. These test methods were developed to be used in conjunction with Test Methods D560/D560M 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 Ovens*—Thermostatically controlled, preferably 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 chamber for the water content specimens, and a temperature of 71 ± 3°C [160 ± 5°F] throughout the drying chamber for drying compacted soil-cement specimens.

5.4 *Moist Room*—A moist room or suitable covered container capable of maintaining a temperature of 21 ± 2°C [70 ± 3°F] and a relative humidity of 100 % for seven-day storage of compacted specimens.

5.5 *Water Bath*—Suitable tank for submerging compacted specimens in water at room temperature.

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

5.16 *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,

[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.