



Designation: D1556/D1556M – 24

Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method¹

This standard is issued under the fixed designation D1556/D1556M; 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 This test method may be used to determine the in-place density and unit weight of soils using a sand cone apparatus.

1.2 This test method is applicable for soils without appreciable amounts of rock or coarse materials in excess of 1½ in. [38 mm] in diameter.

1.3 This test method may also be used for the determination of the in-place density and unit weight of intact or *in situ* soils, provided the natural void or pore openings in the soil are small enough to prevent the sand used in the test from entering the voids. The soil or other material being tested shall have sufficient cohesion or particle attraction to maintain stable sides on a small hole or excavation, and be firm enough to withstand the minor pressures exerted in digging the hole and placing the apparatus over it, without deforming or sloughing.

1.4 This test method is not suitable for organic, saturated, or highly plastic soils that would deform or compress during the excavation of the test hole. This test method may not be suitable for soils consisting of unbound granular materials that will not maintain stable sides in the test hole, soils containing appreciable amounts of coarse material larger than 1½ in. [38 mm], and granular soils having high void ratios.

1.5 When materials to be tested contain appreciable amounts of particles larger than 1½ in. [38 mm], or when test hole volumes larger than 0.1 ft³ [2830 cm³] are required, Test Method **D4914/D4914M** or **D5030/D5030M** is applicable.

1.6 **Units**—The values stated in either inch-pound units or SI units [presented in brackets] are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

¹ This test method is under the jurisdiction of ASTM Committee **D18** on Soil and Rock and is the direct responsibility of Subcommittee **D18.08** on Special and Construction Control Tests.

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1.6.1 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 units for mass is slugs. The slug unit is not given, unless dynamic ($F = ma$) calculations are involved.

1.6.2 It is common practice in the engineering/construction profession to use, interchangeably, units representing both mass and force unless dynamic calculations ($F = Ma$) are involved. The practice implicitly combines two separate systems of units; the absolute and gravitational systems. It is scientifically undesirable to combine the use of two separate systems within a single standard. As stated, this standard includes the gravitational system of inch-pound units and does not use/present the slug unit of mass. However, the use of balances and scales recording pounds of mass (lbm), or recording density in lbm/ft³ shall not be regarded as nonconformance with this standard.

1.6.3 The sieve designations are identified using the “standard” system in accordance with Specification **E11**, such as 25 mm and 75 μ m, followed by the “alternative” system of 1 in. and No. 200, respectively.

1.7 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.

1.7.1 For purposes of comparing, a measured or calculated value(s) with specified limits, the measured or calculated value(s) shall be rounded to the nearest decimal of significant digits in the specified limits.

1.7.2 The procedures used to specify how data are collected/recorded or calculated in this 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 this standard to consider significant digits used in analysis methods for engineering design.

1.8 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the*

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

responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

1.9 This international standard was developed in accordance with internationally recognized principles on standardization established in the *Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee*.

2. Referenced Documents

2.1 ASTM Standards:²

- C136/C136M Test Method for Sieve Analysis of Fine and Coarse Aggregates
- 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/ft³ (600 kN-m/m³))
- D1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
- D2216 Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
- D4253 Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
- D4254 Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
- D4643 Test Method for Determination of Water Content of Soil and Rock by Microwave Oven Heating
- D4718/D4718M Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles
- D4753 Guide for Evaluating, Selecting, and Specifying Balances and Standard Masses for Use in Soil, Rock, and Construction Materials Testing
- D4914/D4914M Test Methods for Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit
- D4944 Test Method for Field Determination of Water (Moisture) Content of Soil by the Calcium Carbide Gas Pressure Tester
- D4959 Test Method for Determination of Water Content of Soil By Direct Heating
- D5030/D5030M Test Methods for Density of In-Place Soil and Rock Materials by the Water Replacement Method in a Test Pit
- D6026 Practice for Using Significant Digits and Data Records in Geotechnical Data
- E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

3. Terminology

3.1 Definitions:

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

4. Summary of Test Method

4.1 A hole is hand excavated in the soil at the location to be tested and all the material from the hole is saved in a container. The hole is filled with free flowing sand of a known bulk density, and the volume is determined. The in-place wet density of the soil is determined by dividing the wet mass of the removed material by the volume of the hole. The water content of the material from the hole is determined and the dry mass and the dry density of the in-place material are calculated using the wet mass of the soil, the water content, and the volume of the hole.

5. Significance and Use

5.1 This test method is used to determine the density and water content of compacted soils placed during the construction of earth embankments, road fill, and structural backfill. It often is used as a basis of acceptance for soils compacted to a specified density or percentage of a maximum dry density determined by a test method, such as Test Method D698 or D1557.

5.1.1 Test Methods D698 and D1557 require that mass measurements of laboratory compacted test specimens be determined to the nearest 1 g, so that computed water contents and densities can be reported to three and four significant digits, respectively. This standard is a field procedure requiring mass measurements to the nearest 0.01 lbm [5 g]. As such, water content calculations should only be reported to nearest 1 % and density to three significant digits.

5.2 This test method can also be used to determine the in-place density of natural soil deposits, aggregates, soil mixtures, or other similar material.

5.3 The use of this test method is generally limited to soil in an unsaturated condition. This test method is not recommended for soils that are soft or friable (crumble easily) or in moisture conditions such that water seeps into the hand excavated hole. The precision of the test may be affected for soils that deform easily or that may undergo a volume change in the excavated hole from vibration, or from standing or walking near the hole during the test (see Note 1).

NOTE 1—When testing in soft conditions or in soils near saturation, volume changes may occur in the excavated hole as a result of surface loading, personnel performing the test, and the like. This can sometimes be avoided by the use of a platform that is supported some distance from the hole. As it is not always possible to detect when a volume change has taken place, test results should always be compared to the theoretical saturation density, or the zero air voids line on the dry density versus water content plot. Any in-place density test on compacted soils that calculates to be more than 95 % saturation is suspect and an error has probably occurred, or the volume of the hole has changed during testing.

NOTE 2—The quality of the test result produced by this test method 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. Reliable results depend on

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at www.astm.org/contact. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.