



Designation: D7382 – 25

## Standard Test Methods for Determination of Maximum Dry Unit Weight of Granular Soils Using a Vibrating Hammer<sup>1</sup>

This standard is issued under the fixed designation D7382; 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.

### 1. Scope\*

1.1 These test methods cover the determination of the maximum dry unit weight of granular soils. A vibrating hammer is used to impart a surcharge and compactive effort to the soil specimen. Further, an optional calculation is presented to determine the approximate water content range for effective compaction of granular soils based on the measured maximum dry density and specific gravity.

1.2 These test methods apply to primarily granular, free-draining soils for which impact compaction does not yield a clear optimum water content. Specifically, these test methods apply to soils:

1.2.1 with up to 35 %, by dry mass, passing a No. 200 (75- $\mu$ m) sieve if the portion passing the No. 40 (425- $\mu$ m) sieve is nonplastic;

1.2.2 with up to 15 %, by dry mass, passing a No. 200 (75- $\mu$ m) sieve if the portion passing the No. 40 (425- $\mu$ m) sieve exhibits plastic behavior.

1.3 Further, due to limitations of the testing equipment, and the available oversize correction procedures these test methods apply to soils in which:

1.3.1 less than 30 %, by dry mass, is retained on the  $\frac{3}{4}$ -in. (19.0-mm) sieve, or in which

1.3.2 100 %, by dry mass, passes the 2-in. (50-mm) sieve.

1.4 These test methods will typically produce a higher maximum dry unit weight for the soils specified in 1.2.1 and 1.2.2 than that obtained by impact compaction in which a well-defined moisture-density relationship is not apparent. However, for some soils containing more than 15 % fines, the use of impact compaction (Test Methods D698 or D1557) may be useful in evaluating what is an appropriate maximum index unit weight.

1.5 Four alternative test methods are provided, with the variation being in saturated versus dry specimens and mold

size. The method used shall be as indicated in the specification for the material being tested. If no method is specified, the choice is typically based on the maximum particle size of the material.

1.5.1 *Method 1A*—Using saturated material and a 6-in. (152-mm) diameter mold; applicable for materials with maximum particle size of  $\frac{3}{4}$ -in. (19-mm) or less, or with 30 % or less, by dry mass, retained on the  $\frac{3}{4}$ -in. (19-mm) sieve.

1.5.2 *Method 1B*—Using saturated material and an 11-in. (279-mm) diameter mold; applicable for materials with maximum particle size of 2-in. (50-mm) or less

1.5.3 *Method 2A*—Using oven-dry material and a 6-in. (152-mm) diameter mold; applicable for materials with maximum particle size of  $\frac{3}{4}$ -in. (19-mm) or less, or with 30 % or less, by dry mass, retained on the  $\frac{3}{4}$ -in. (19-mm) sieve.

1.5.4 *Method 2B*—Using oven-dry material and an 11-in. (279-mm) diameter mold; applicable for materials with maximum particle size of 2-in. (50-mm) or less.

1.5.5 It is recommended that both the saturated and dry methods (Methods 1A and 2A, or 1B and 2B) be performed when beginning a new job or encountering a change in soil type, as one method or the other may result in a higher value for the maximum dry unit weight. While the dry method is often preferred for convenience and because results can be obtained more quickly, as a general rule, the saturated method is used if it proves to produce a significantly higher value for maximum dry unit weight.

NOTE 1—Results have been found to vary slightly when a material is tested at the same compaction effort in different size molds.

1.6 If the test specimen contains more than 5 % by mass of oversize material (coarse fraction) and the material will not be included in the test, corrections must be made to the unit weight and water content results from the laboratory test or to the appropriate field in-place density test results using Practice D4718/D4718M.

NOTE 2—Methods 1A and 2A (with the correction procedure of Practice D4718/D4718M, if appropriate), have been shown to provide consistent results with Methods 1B and 2B for materials with 30 % or less, by dry mass retained on the  $\frac{3}{4}$ -in. (19-mm) sieve. Therefore, for ease of operations, it is recommended to use Method 1A or 2A, unless Method 1B or 2B is required due to soil gradations having in excess of 30 %, by dry mass, retained on the  $\frac{3}{4}$ -in. (19-mm) sieve.

<sup>1</sup> These test methods are under the jurisdiction of ASTM Committee D18 on Soil and Rock and are the direct responsibility of Subcommittee D18.03 on Texture, Plasticity, and Density Characteristics of Soils.

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1.7 This test method may cause degradation (particle break-down) of the soil. When degradation occurs, typically there is an increase in the maximum unit weight obtained, and comparable test results may not be obtained when different size molds are used to test a given soil. For soils where degradation is suspected, a sieve analysis of the specimen can be performed before and after the compaction test as a tool to determine the amount of degradation.

1.8 *Units*—The values stated in inch-pound units are to be regarded as standard. The SI units given in parentheses are mathematical conversions, which are provided for information purposes only and are not considered standard. Reporting of test results in units other than inch-pound units shall not be regarded as nonconformance with this test method.

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

1.8.2 The slug unit of mass is almost never used in commercial practice; for example as related to density, balances, and the like. Therefore, the standard unit for mass in this standard is either kilogram (kg) or gram (g), or both. Also, the equivalent inch-pound unit (slug) is not given/presented in parentheses.

1.8.3 It is common practice in the engineering/construction profession, in the United States, to concurrently 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<sup>3</sup> shall not be regarded as nonconformance with this standard.

1.8.4 The terms density and unit weight are often used interchangeably. Density is mass per unit volume whereas unit weight is force per unit volume. In this standard, density is given only in SI units. After the density has been determined, the unit weight is calculated in inch-pound or SI units, or both.

1.9 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice **D6026**.

1.9.1 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 limit.

1.9.2 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 analytical methods for engineering design.

1.10 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.11 *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:<sup>2</sup>

- C127** Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
- C136/C136M** Test Method for Sieve Analysis of Fine and Coarse Aggregates
- C702/C702M** Practice for Reducing Samples of Aggregate to Testing Size
- C778** Specification for Standard Sand
- 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<sup>3</sup> (600 kN-m/m<sup>3</sup>))
- D854** Test Methods for Specific Gravity of Soil Solids by the Water Displacement Method
- D1557** Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>))
- 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
- D4220/D4220M** Practices for Preserving and Transporting Soil Samples (Withdrawn 2023)<sup>3</sup>
- D4318** Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- 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
- D6026** Practice for Using Significant Digits and Data Records in Geotechnical Data
- D6913/D6913M** Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [www.astm.org/contact](http://www.astm.org/contact). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).