Designation: D5030/D5030M – 13a

Standard Test Methods for Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit[1]

This standard is issued under the fixed designation D5030/D5030M; 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.

1. Scope*

1.1 These test methods cover the determination of the in-place density of soil and rock using water to fill a lined test pit to determine the volume of the test pit. The use of the word "rock" in these test methods is used to imply that the material being tested will typically contain particles larger than 3 in. [75 mm].

1.2 These test methods are best suited for test pits with a volume between approximately 3 and 100 ft^3 [0.08 and 2.83 m^3]. In general, the materials tested would have maximum particle sizes over 5 in. [125 mm]. These test methods may be used for larger sized excavations if desirable.

1.2.1 This procedure is usually performed using circular metal templates with inside diameters of 3 ft [0.9 m] or more. Other shapes or materials may be used providing they meet the requirements of these test methods and the guidelines given in Annex A1 for the minimum volume of the test pit.

1.2.2 Test Method D4914 may be used as an alternative method. Its use, however, is usually only practical for volume determination of test pits between approximately 1 and 6 ft^3 [0.03 and 0.17 m^3].

1.2.3 Test Method D1556 or Test Method D2167 is usually used to determine the volume of test holes smaller than 1 ft^3 [0.03 m^3].

1.3 The two procedures are described as follows:

1.3.1 *Procedure A*—In-Place Density and Density of Total Material (Section 12).

1.3.2 *Procedure B*—In-Place Density and Density of Control Fraction (Section 13).

1.4 *Selection of Procedure:*

1.4.1 Procedure A is used when the in-place density of total material is to be determined. Procedure A can also be used to determine percent compaction or percent relative density when the maximum particle size present in the in-place material being tested does not exceed the maximum particle size allowed in the laboratory compaction test (Test Methods D698, D1557, D4253, D4254, D4564, and D7382). For Test Methods D698 and D1557 only, the density determined in the laboratory compaction test may be corrected for larger particle sizes in accordance with, and subject to the limitations of, Practice D4718.

1.4.2 Procedure B is used when percent compaction or percent relative density is to be determined and the in-place material contains particles larger than the maximum particle size allowed in the laboratory compaction test or when Practice D4718 is not applicable for the laboratory compaction test. Then the material is considered to consist of two fractions, or portions. The material from the in-place density test is physically divided into a control fraction and an oversize fraction based on a designated sieve size. The density of the control fraction is calculated and compared with the density(ies) established by the laboratory compaction test(s).

1.4.3 Normally, the control fraction is the minus No. 4 [4.75-mm] sieve size material for cohesive or nonfree-draining materials and the minus 3-in. [75-mm] sieve size material for cohesionless, free-draining materials. While other sizes are used for the control fraction ⅜, ¾-in. [9.5, 19-mm], these test methods have been prepared using only the No. 4 [4.75-mm] and the 3-in. [75-mm] sieve sizes for clarity.

1.5 Any material can be tested, provided the material being tested has sufficient cohesion or particle attraction to maintain stable sides during excavation of the test pit and through completion of this test. It should also be firm enough not to deform or slough due to the minor pressures exerted in digging the hole and filling with water.

1.6 These test methods are generally limited to material in an unsaturated condition and is not recommended for materials that are soft or friable (crumble easily) or in a moisture condition such that water seeps into the excavated hole. The accuracy of the test may be affected for materials that deform easily or that may undergo volume change in the excavated hole from standing or walking near the hole during the test.

1.7 *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

[1] These test methods are 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.

Current edition approved Nov. 15, 2013. Published December 2013. Originally approved in 1989. Last previous edition approved in 2013 as D5030 – 13. DOI: 10.1520/D5030_D5030M-13A.

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

of the other. Combining values from the two systems may result in non-conformance with the standard.

1.7.1 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 slug unit is not given, unless dynamic (F = ma) calculations are involved.

1.7.2 In the engineering profession, it is customary practice to use, interchangeably, units representing both mass and force, unless dynamic calculations (F = Ma) are involved. This implicitly combines two separate systems of units, that is, the absolute system and the gravimetric system. It is scientifically undesirable to combine the use of two separate systems within a single standard. These test methods have been written using inch-pound units (gravimetric system) where the pound (lbf) represents a unit of force (weight); however, conversions are given in the SI system. The use of balances or scales recording pounds of mass (lbm), or the recording of density in lbm/ft^3 should not be regarded as nonconformance with this standard.

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

1.8.1 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; 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.

1.9 *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.* For a specific hazard statement, see Section 9.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C127 Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate

C138/C138M Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete

C566 Test Method for Total Evaporable Moisture Content of Aggregate by Drying

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))

D1556 Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method

D1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))

D2167 Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method

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

D4564 Test Method for Density and Unit Weight of Soil in Place by the Sleeve Method (Withdrawn 2013)[3]

D4718 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 Test Methods for Density and Unit Weight of Soil and Rock in Place by the Sand Replacement Method in a Test Pit

D6026 Practice for Using Significant Digits in Geotechnical Data

D7382 Test Methods for Determination of Maximum Dry Unit Weight and Water Content Range for Effective Compaction of Granular Soils Using a Vibrating Hammer

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

F2362 Specification for Temperature Monitoring Equipment

3. Terminology

3.1 *Definitions*—Except as follows in 3.2, all definitions are in accordance with Terminology D653.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *control fraction*—the portion of a soil sample consisting of particles smaller than a designated sieve size.

3.2.1.1 *Discussion*—This fraction is used to compare in-place densities with densities obtained from standard laboratory tests. The control sieve size depends on the laboratory test used.

3.2.2 *oversize particles*—the portion of a soil sample consisting of the particles larger than a designated sieve size.

4. Summary of Test Method

4.1 The ground surface at the test location is prepared and a template (metal ring) is placed and fixed into position. A liner is laid in the template and the volume of the space between a selected level within the template and the ground surface is determined by filling the space with water. The mass or the volume of the water required to fill the template to the selected

[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.

[3] The last approved version of this historical standard is referenced on www.astm.org.