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.

Designation: D8167/D8167M – 18a

Standard Test Method for In-Place Bulk Density of Soil and Soil-Aggregate by a Low-Activity Nuclear Method (Shallow Depth)[1]

This standard is issued under the fixed designation D8167/D8167M; 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 This test method describes the procedures for measuring in-place bulk density of soil and soil-aggregate using nuclear equipment with radioactive sources (hereafter referred to simply as "gauges.") These gauges are distinct from those described in Test Method D6938 insofar as:

1.1.1 These gauges do not contain a system (nuclear or otherwise) for the determination of the water content of the material under measurement.

1.1.2 These gauges have photon yields sufficiently low as to require the inclusion of background radiation effects on the response during normal operation.

1.1.2.1 For the devices described in Test Method D6938, the contribution of gamma rays detected from the naturally-occurring radioisotopes in most soils (hereafter referred to as "background") compared to the contribution of gamma rays used by the device to measure in-place bulk density is typically small enough to be negligible in terms of their effect on measurement accuracy. However, for these low-activity gauges, the gamma ray yield from the gauge is low enough that the background contribution from most soils compared to the contribution of gamma gays from the gauge is no longer negligible, and changes in this background can adversely affect the accuracy of the bulk density reading.

1.1.2.2 In order to compensate for potentially differing background contribution to low-activity gauge measurements at different test sites, a background reading must be taken in conjunction with gauge measurements obtained at a given test site. This background reading is utilized in the bulk density calculation performed by the gauge with the goal of minimizing these background effects on the density measurement accuracy.

1.2 For limitations see Section 5 on Interferences.

1.3 The bulk density of soil and soil-aggregate is measured by the attenuation of gamma radiation where the source is placed at a known depth up to 200 mm [8 in.] and the detector(s) remains on the surface (some gauges may reverse this orientation).

1.3.1 The bulk density of the test sample in mass per unit volume is calculated by comparing the detected rate of gamma radiation with previously established calibration data.

1.3.2 Neither the dry density nor the water content of the test sample is measured by this device. However, the results of this test can be used with the water content or water mass per unit volume value determined by alternative methods to determine the dry density of the test sample.

1.4 The gauge is calibrated to read the bulk density of soil or soil-aggregate.

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

1.5.1 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 or significant digits in the specified limits.

1.5.2 The procedures used to specify how data are collected/recorded and calculated in this standard are regarded as the industry standard. In addition, they are representative of the significant digits that should generally 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 commensurate with these considerations. It is beyond the scope of this standard to consider significant digits used in analysis methods for engineering design.

1.6 *Units*—The values stated in either SI units or inch-pound units 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 nonconformance with the standard. Reporting test results in units other than SI shall not be regarded as nonconformance with this standard.

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

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

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