



Designation: D 3017 – 96<sup>ε1</sup>

## Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)<sup>1</sup>

This standard is issued under the fixed designation D 3017; 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 Department of Defense.*

<sup>ε1</sup> NOTE—Table 1 was corrected editorially in December 1997.

### 1. Scope

1.1 This test method covers the determination of water content of soil and rock by the thermalization or slowing of fast neutrons where the neutron source and the thermal neutron detector both remain at the surface.

1.2 The water content in mass per unit volume of the material under test is determined by comparing the detection rate of thermalized or slow neutrons with previously established calibration data.

1.3 The values stated in SI units are to be regarded as the standard. The inch-pound equivalents may be approximate.

1.3.1 It is common practice in the engineering profession to concurrently use pounds to represent both a unit of mass (lbm) and of force (lbf). This implicitly combines two systems of units, that is, the absolute system and the gravitational system. This standard has been written using the absolute system for water content (kilograms per cubic metre) in SI units. Conversion to the gravitational system of unit weight in lbf/ft<sup>3</sup> may be made by multiplying by 0.06243 or in kN/m<sup>3</sup> by multiplying by 9.807. The recording of water content in pound-force per cubic foot should not be regarded as non-conformance with this standard although the use is scientifically incorrect.

1.4 *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:

- D 1556 Test Method for Density of Soil in Place by the Sand-Cone Method<sup>2</sup>
- D 2167 Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method<sup>2</sup>
- D 2216 Test Method for Laboratory Determination of Water

(Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures<sup>2</sup>

D 2922 Test Methods for Density of Soil and Soil Aggregate and Rock in Place by Nuclear Methods (Shallow Depth)<sup>2</sup>

D 2937 Test Method for Density of Soil in Place by the Drive-Cylinder Method<sup>2</sup>

D 4643 Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method<sup>2</sup>

D 4718 Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles<sup>2</sup>

### 3. Significance and Use

3.1 The test method described is useful as a rapid, nondestructive technique for the in-place determination of water content of soil and rock.

3.2 The test method is used for quality control and acceptance testing of compacted soil and rock for construction and for research and development. The non-destructive nature allows repetitive measurements at a single test location and statistical analysis of the results.

3.3 The fundamental assumptions inherent in the test method are that the hydrogen present is in the form of water as defined by Test Method D 2216, and that the material under test is homogeneous.

3.4 Test results may be affected by chemical composition, sample heterogeneity, and, to a lesser degree, material density and the surface texture of the material being tested. The technique also exhibits spatial bias in that the apparatus is more sensitive to water contained in the material in close proximity to the surface and less sensitive to water at deeper levels.

### 4. Interferences

4.1 The chemical composition of the sample may dramatically affect the measurement and adjustments may be necessary. Hydrogen in forms other than water, as defined by Test Method D 2216, and carbon will cause measurements in excess of the true value. Some chemical elements such as boron, chlorine, and minute quantities of cadmium will cause measurements lower than the true value.

4.2 The water content determined by this test method is not

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.08 on Special and Construction Control Tests.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.08.