



Standard Test Methods for Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit¹

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1. Scope *

1.1 These test methods cover the determination of the in-place density and unit weight of soil and rock using a pouring device and calibrated sand to determine the volume of a test pit. 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 of from 1 to 6 ft³ (0.03 and 0.17 m³). In general, the materials tested would have a maximum particle size of 3 to 5 in. (75 to 125 mm).

1.2.1 These test methods may be used for larger sized excavations if desirable. However, for larger sized excavations, Test Method D 5030 is preferred.

1.2.2 Test Method D 1556 or D 2167 are usually used to determine the volume of test holes smaller than 1 ft³ (0.03 m³). While the equipment illustrated in these test methods is used for volumes less than 1 ft³ (0.03 m³), the test methods allow larger versions of the equipment to be used when necessary.

1.3 Two test methods are provided as follows:

1.3.1 *Test Method A—In-Place Density and Unit Weight of Total Material* (Section 9).

1.3.2 *Test Method B—In-Place Density and Unit Weight of Control Fraction* (Section 10).

1.4 *Selection of Test Methods:*

1.4.1 Test Method A is used when the in-place unit weight of total material is to be determined. Test Method 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 (refer to Test Methods D 698, D 1557, D 4253, and D 4254). For Test Methods D 698 and D 1557 only, the unit weight determined in the laboratory compaction test may be corrected for larger particle sizes in accordance with, and subject to the limitations of Practice D 4718.

1.4.2 Test Method 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 D 4718 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 unit weight test is physically divided into a control fraction and an oversize fraction based on a designated sieve size. The unit weight of the control fraction is calculated and compared with the unit weight(s) established by the laboratory compaction test(s).

1.4.2.1 Because of possible lower densities created when there is particle interference (see Practice D 4718), the percent compaction of the control fraction should not be assumed to represent the percent compaction of the total material in the field.

1.4.3 Normally, the control fraction is the minus No. 4 sieve size material for cohesive or nonfree draining materials and the minus 3-in. sieve size material for cohesionless, free-draining materials. While other sizes are used for the control fraction ($\frac{3}{8}$, $\frac{3}{4}$ -in.), these test methods have been prepared using only the No. 4 and the 3-in. sieve sizes for clarity.

1.5 Any materials that can be excavated with handtools can be tested provided that the void or pore openings in the mass are small enough (or a liner is used) to prevent the calibrated sand used in the test from entering the natural voids. The material being tested should have sufficient cohesion or particle interlocking 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 pouring the sand.

1.6 These test methods are generally limited to material in an unsaturated condition and are not recommended for materials that are soft or friable (crumble easily) or in a moisture condition such that water seeps into the hand-excavated hole. The accuracy of the test methods 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 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.7.1 In the engineering profession it is customary to use units representing both mass and force interchangeably, unless dynamic calculations ($F = Ma$) are involved. This implicitly

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