Designation: F3013 – 13 (Reapproved 2018)

Standard Test Method for Density of Topsoil and Blended Soils In-place by the Core Displacement Method[1]

This standard is issued under the fixed designation F3013; 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 may be used to determine the undisturbed (in-situ) in-place bulk-density, moisture content and unit weight of topsoil and blended soil growing mediums using the Core Displacement Method.

1.2 This test method is applicable for soils without appreciable amounts of rock or coarse material exceeding 1 inch in size. Further it is only suitable for soils in-which the natural void or pore openings in the soil are small enough to prevent the sand used in the test from entering the voids and impacting the test results. Unlike Test Method D1556, this test method is suitable for organic and plastic soils due to the use of a core apparatus, and not hand excavation methods. The material shall have adequate cohesive material or particle attraction to provide a stable core (core hole) for the duration of the test without deforming or sloughing. Therefore this method is not suitable for unbound granular soils that cannot maintain stable sides. This test method is applicable for assessing compaction of surface layers of topsoil (or blended soils) using a soil small core unlike Test Methods D4914, which uses a large volume soil pit excavation.

1.3 This test method is intended for soil typical of growing mediums suitable for sports fields, golf courses and lawn areas that may include organic material, silts, clays and sand.

1.4 This test method is not applicable for soil conditions in-which the root mass is excessive or in-which the root mass includes woody roots.

1.5 *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.*

1.6 *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:*[2]

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

D4914 Test Methods for Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit

F1815 Test Methods for Saturated Hydraulic Conductivity, Water Retention, Porosity, and Bulk Density of Athletic Field Rootzones

3. Terminology

3.1 *Definitions:*

3.1.1 *bulk density of soil, D_b*—mass of dry soil per unit bulk volume, (Mg m^{-3}).

3.1.2 *density, D*—mass per unit volume, (Mg m^{-3}).

3.1.3 *density of water, D_w*—mass per volume of water, (Mg m^{-3}).

3.1.4 *particle density of soil, D_p*—density of the soil particles, the dry mass of the particles being divided by the solid (not bulk) volume of the particles, in contrast with bulk density, (Mg m^{-3}).

4. Summary of Test Method

4.1 A test hole is cored using a hole-cutter into the soil to be tested and the hole-cutter is retracted to remove all soil and saved in a container. The depth of the hole is measured at four points around the diameter of the core. Points shall be at approximately 90° apart. The hole is then filled with a free flowing sand of know volume to determine the volume of the soil removed. The volume of the soil removed is adjusted to account for the volume of the hole-cutter. The removed soil is weight in the laboratory and the in-place wet density of the sample is calculated by dividing the initial moist sample mass

[1] This test method is under the jurisdiction of ASTM Committee F08 on Sports Equipment, Playing Surfaces, and Facilities and is the direct responsibility of Subcommittee F08.64 on Natural Playing Surfaces.

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[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.

divided by the volume of hole (adjusted for the volume of the coring apparatus) from which the sample is removed as determined by the volume of free flowing sand. The sample is then dried and weight to determine the in-place dry bulk-density of the soil.

5. Significance and Use

5.1 This test method can be used to determine in-place density of topsoil and blended soils prior to planting or in the development of a maintenance programs for natural turf sports fields, planting areas, lawns and golf courses.

5.2 This test method can provide builders and maintenance staff with a quick assessment of the turf growing medium density without the delays associated with formal lab testing programs. During construction and prior to seeding or sodding having a method to quantify in-place soil density will assist the builder in providing an appropriate soil density at the time of planting thus improving overall turf establishment.

5.3 The use of this test method is generally limited to soil in an unsaturated condition. This test method is not recommended for soils that are soft or friable (crumble easily) or in a moisture condition such that water seeps into the hand excavated hole. The accuracy of this test can be affected by stones or other material that can create grooves or loose material along the side walls or bottom of the test core. Test core locations within areas subject to vehicle travel may result in higher densities and such locations should be noted in the report.

6. Apparatus

6.1 The testing apparatus consists of a coring device (Hole Corer or Hole cutter), a uniform (free flowing) testing sand, graduated cylinder, and a rule. A drying oven capable of maintaining a temperature of 100°C (212°F) 12 h for preparation of an oven-dried sample.

6.1.1 *Hole-Cutter*—A 10.8 cm diameter (4-¼ in.) hot-rolled steel tubing with steel shaft and sturdy handle. Tubing shall consist of a non-scalloped shell sharpened outsides to allow clean uniform coring into soil. Tubing shall be capable of coring to depths of approximately 20 cm (8 in.). Hole-cutter shall be equipped with a core removal plate that will allow clean uniform removal of core sample.

6.1.1.1 A steel sharpened core cutting device with an outside diameter of 10.8 cm (4.25 in.) and an inside diameter, d_i, of 10.16 cm (4.00 in.).

6.1.1.2 A handle positioned at approximately waist level suitable for twisting the core into the soil while maintaining vertical alignment.

6.1.1.3 A core with a depth, h_c, of at least 10.16 cm (4 in.) and not more than 20.32 cm (8 in.). The core shall be marked on the outside to indicate a 10 cm depth.

6.1.1.4 A soil removal piston or other device that allows complete removal of the cored sample.

6.1.1.5 Details of the apparatus are shown in Fig. 1.

6.1.2 *Free Flowing Sand*—Clean, dry sand, uniform in density and grading, uncemented, durable, and free-flowing. Any gradation may be used that has a uniformity coefficient (Cu 5 D60/D10) less than 2.0, a maximum particle size smaller than 2.0 mm (No. 10 sieve), and less than 3 % by weight passing 250 µm (No. 60 sieve).). Sand shall be uniformly graded to prevent segregation during handling, storage and use. Sand must be free flowing and therefore non-compacting.

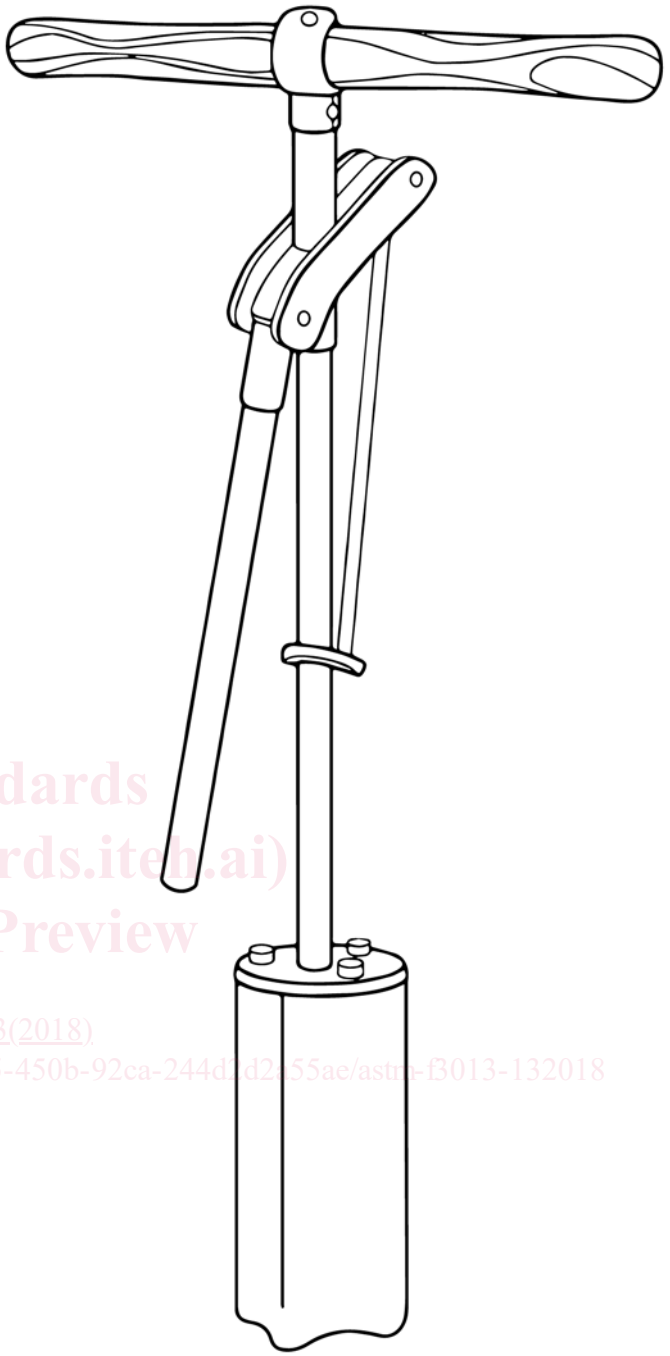

FIG. 1 Hole Cutter

NOTE 1—Uniformly graded sand is needed to prevent segregation during handling, storage, and use. Sand free of fines (and fine sand particles) is required to avoid significant bulk-density changes which can occur due to normal daily changes in atmospheric humidity. Sand comprised of durable, natural sub-angular, sub-rounded, or rounded particles is desirable. Crushed sand or sand having angular particles may not be free-flowing, a condition that can cause bridging resulting in inaccurate density determinations. Likewise, sands containing significant amounts of micaceous grains (which tend to be plate-shaped) should be avoided. In selecting sand from a potential source, bulk-density variation