



Standard Test Methods for Saturated Hydraulic Conductivity, Water Retention, Porosity, and Bulk Density of Athletic Field Rootzones¹

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1. Scope

1.1 These test methods cover the measurements of saturated hydraulic conductivity, water retention, porosity (including distribution of capillary and air-filled porosity at a known soil suction), and bulk density on sand-based root zone mixes to be used for construction and topdressing of golf course putting greens including United States Golf Association (USGA) recommended greens, golf course tees, sand-based sports fields, or other highly trafficked turfgrass areas. These test methods are designed for sand-based mixes and are not intended for use with fine or medium textured soils, for example, sandy loams and loams.

1.2 The values stated in SI units are to be regarded as the standard. The inch-pound units given in parentheses are for information only.

1.3 *This standard does not purport to address all of the safety concerns 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 its use.*

2. Referenced Documents

2.1 ASTM Standards:²

D854 Test Methods for Specific Gravity of Soil Solids by Water Pycnometer

D2216 Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

D2974 Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

D4643 Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating

D4959 Test Method for Determination of Water (Moisture)

Content of Soil By Direct Heating

D5550 Test Method for Specific Gravity of Soil Solids by Gas Pycnometer

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

F1647 Test Methods for Organic Matter Content of Athletic Field Rootzone Mixes

3. Summary of Test Method

3.1 *Test Method A*—Saturated hydraulic conductivity is determined on compacted, saturated mix or sand soil cores. Water flow through the core is maintained at a constant hydraulic head until a steady flow rate is achieved, at which time aliquots of the outflow are collected.

3.2 *Test Method B*—Water retention is obtained at a soil suction as defined by the design architect or engineer in the specifications. In lieu of a specification, or if testing for USGA greens, the water retention shall be determined at a soil suction of 30 cm. The water shall be extracted from a prepared core by means of a tension table or other water extraction apparatus. When equilibrium is achieved, the weight is recorded. The core is oven dried at 105°C until a constant weight is obtained. Water retention is calculated on an oven dried basis. Bulk density is calculated from the mix or sand dry weight and volume.

3.3 *Test Method C*—Total porosity is calculated from the bulk density and particle density.

3.4 *Test Method D*—Capillary porosity is calculated from the bulk density and water retention information. Air-filled or aeration porosity is calculated from the difference of total and capillary porosity.

4. Apparatus

4.1 *Cylinders*, made of metal, PVC, or similar rigid materials shall have an inside diameter of 51 or 76 + 2 mm (2 or 3 + 0.08 in.), and a height of 76 + 2 mm (3 + 0.08 in.).

4.2 *Compactor*, shall be such as to exert a total potential energy of 3.03 J/cm² (14.3 ft-lb/in.²) across the cross-sectional area of the core. Fig. 1 shows an example of such a device where a weighted hammer is dropped 15 times from a height of 305 + 2 mm (12 + 0.08 in.). A 51 mm (2 in.) diameter core will

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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.