



Designation: D4531 – 23

Standard Test Methods for Bulk and Dry Density of Peat and Peat Products¹

This standard is issued under the fixed designation D4531; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope*

1.1 These test methods cover the determination of the bulk and dry density of both peat in its natural state and peat products (**Note 1**). These test methods consist of defining a volume of peat and determining the mass of that specific volume. The difference in the respective methods is in the procedures employed to determine the peat volume.

1.2 The water content of a peat/peat product influences the bulk density. When using the bulk density for quantifying the amount of peat for use as a resource evaluation, the water content value needs to accompany the bulk density value.

NOTE 1—Test Method **D2978** is used for measuring the volume of uncompacted loose peat materials and compacted baled peat materials.

1.3 *Method A*—The core method covers the determination of the bulk density of a core of peat taken with a piston sampler or other suitable core sampler (Sections **7** and **8**).

1.4 *Method B*—The paraffin wax method, covers the determination of the bulk density of clods or irregular pieces of wet peat and compressed peat products (Sections **9** and **10**).

1.5 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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

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

¹ These test methods are under the jurisdiction of ASTM Committee **D18** on Soil and Rock and are the direct responsibility of Subcommittee **D18.22** on Media for Plant Growth.

Current edition approved Nov. 1, 2023. Published November 2023. Originally approved in 1986. Last previous edition approved in 2015 as D4531 – 15. DOI: 10.1520/D4531-23.

1.7 *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.*

1.8 *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

D653 Terminology Relating to Soil, Rock, and Contained Fluids

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

D2978 Test Method for Volume of Peat and Peat-Based Growing Media

D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

D4753 Guide for Evaluating, Selecting, and Specifying Balances and Standard Masses for Use in Soil, Rock, and Construction Materials Testing

D6026 Practice for Using Significant Digits and Data Records in Geotechnical Data

3. Terminology

3.1 *Definitions*—For definitions of common technical terms used in this standard, refer to Terminology **D653**.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *bulk density, ρ , n*—for peat/peat products, the total mass (solids plus water) per unit of total volume of a peat at a given moisture condition.

3.2.2 *dry density, ρ_d , n*—for peat/peat products, mass of dry organic and mineral matter per unit of total volume of a peat at a given moisture condition.

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.

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

NOTE 2—In many peat science applications and publications, the term defined here as “dry density” in accordance with common geotechnical engineering usage is referred to as “bulk density.” Care is necessary to distinguish which definition is being used when such a term is encountered.

4. Summary of Test Method

4.1 *Method A*—A core of peat is obtained and is extruded either in the field or the laboratory. Representative specimens of the sample are taken. The dimensions of the specimen are measured and recorded. The moist and dry masses of the peat are measured and recorded. Using the masses and the dimensions the bulk and dry densities are calculated for a given water content.

4.2 *Method B*—A representative specimen is taken from a representative sample of peat/peat product that is obtained from a bulk sample. The moist mass of the specimen is measured and recorded and is then dipped in paraffin wax. The mass of the specimen plus wax is measured and recorded and is then submerged in water to obtain the volume. The wax is then removed from the specimen and the mass of the remaining specimen is measured and recorded. The dry mass of the specimen is then measured and recorded. The bulk and dry densities are then calculated.

5. Significance and Use

5.1 The bulk density is of use in the calculation of in situ stresses for engineering analysis and in quantifying the amount of material present when considering peat as a resource. In the latter case, it is necessary to consider the moisture condition for which the bulk density was determined; a more useful parameter to consider may well be the dry density, ρ_d .

NOTE 3—The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D3740 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with Practice D3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D3740 provides a evaluating some of those factors.

6. Apparatus

6.1 *Drying Oven*—A thermostatically controlled drying oven maintained at a temperature of $105 \pm 5^\circ\text{C}$.

6.2 *Balances*—Balances shall conform to the requirements of Guide D4753 and be readable to 0.01 g for specimens less than 100 g, readable to 0.1 g for specimens between 100 g and 1000 g, and readable to 1 g for specimens over 1000 g.

6.3 *Moisture Content Containers*—Suitable containers for laboratory moisture content determinations.

6.4 *Plastic Sample Bags or Sampling Jars*.

6.5 *Sampler*—Piston sampler or other suitable coring device which will give a cylindrical sample.

NOTE 4—Samples taken with the Macaulay type peat sampler are semicylindrical in shape. They may also be used in this method of determination.

6.6 *Sharp Knife*—An electric knife or barber’s razor will be best for laboratory work.

6.7 *Paraffin Wax*, maintained at a temperature between 60 and 70°C , for use in Method B only.

6.8 *Graduated Cylinder (Method B)*—A glass or plastic 1000 mL graduated cylinder with 10 mL gradations between the first and last markings on the cylinder.

6.9 *Specimen-Size Measurement Devices (Method A)*—Devices, such as ruler, caliper, tape measure and so on, used to measure the physical dimensions, such as length and diameter, of the specimen to the nearest 0.1 mm.

METHOD A—CORE METHOD

7. Procedure

7.1 Take a representative core of peat with a sampler.

7.2 With a sharp knife, cut specimens at least 50 mm in length from the various layers included in the core. Measure and record the specimen length to the nearest 1 mm. Measure and record the inside diameter of the sampling device for cylindrical shaped samplers or measure the dimensions of the specimen itself to the nearest 1 mm in order to obtain the area, A .

7.3 For specimen extruded in the field, place the specimen into a plastic sampling bag or sampling jar and seal to prevent moisture loss.

7.4 Transfer the whole specimen and any free water to a moisture content container in the laboratory and obtain and record the moist mass of peat, M , to the readability of the balance used.

7.5 Dry the specimen in a drying oven at $105 \pm 5^\circ\text{C}$ until a constant mass is reached. Record the mass of dry peat, M_s .

8. Calculation

8.1 The bulk density, ρ , is calculated as follows:

$$\rho = \frac{M}{A \times L \times 0.001} \quad (1)$$

where:

ρ = bulk density, nearest 0.01 g/cm³,
 M = mass of the wet peat specimen, g,
 L = length of specimen, nearest 1 mm, and
 A = cross-sectional area of specimen, as determined from the diameter and form of the sampling device, mm².

8.2 The moisture content, w_d , by dry mass of the specimen is calculated as follows:

$$w_d = \frac{(M - M_s)}{M_s} \quad (2)$$

where:

w_d = water content by dry mass, nearest 0.1 % and
 M_s = mass of the oven dried peat specimen, g.

8.2.1 The moisture content, w_p , may also be expressed in terms of total mass, and is then calculated as follows:

$$w_{dt} = \frac{(M - M_s)}{M} \quad (3)$$