



Designation: D2488 – 17

## Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)<sup>1</sup>

This standard is issued under the fixed designation D2488; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope\*

1.1 This practice covers procedures for the description of soils for engineering purposes.

1.2 This practice also describes a procedure for identifying soils, at the option of the user, based on the classification system described in Test Method D2487. The identification is based on visual examination and manual tests. It shall be clearly stated in reporting, the soil identification is based on visual-manual procedures.

1.2.1 When precise classification of soils for engineering purposes is required, the procedures outlined in Test Method D2487 shall be used.

1.2.2 In this practice, the identification procedures assigning a group symbol and name are limited to soil particles smaller than 3 in. (75 mm).

1.2.3 The identification portion of this practice is limited to naturally occurring soils. Specimens used for identification may be either intact or disturbed.

NOTE 1—This practice may be used as a descriptive system applied to such materials as shale, claystone, shells, crushed rock, etc. (see Appendix X2).

1.3 The descriptive information in this practice may be used with other soil classification systems or for materials other than naturally occurring soils.

1.4 *Units*—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are rationalized conversions to SI units that are provided for information only and are not considered standard. The sieve designations are identified using the “alternative” system in accordance with Practice E11.

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 deter-*

*mine the applicability of regulatory limitations prior to use.*

For specific precautionary statements see Section 8.

1.6 *This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word “Standard” in the title of this document means only that the document has been approved through the ASTM consensus process.*

1.7 *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:*<sup>2</sup>
- D653 Terminology Relating to Soil, Rock, and Contained Fluids
  - D1452 Practice for Soil Exploration and Sampling by Auger Borings
  - D1586 Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils
  - D1587 Practice for Thin-Walled Tube Sampling of Fine-Grained Soils for Geotechnical Purposes
  - D2113 Practice for Rock Core Drilling and Sampling of Rock for Site Exploration
  - D2487 Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
  - D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.07 on Identification and Classification of Soils.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto: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

**D4083 Practice for Description of Frozen Soils (Visual-Manual Procedure)**

**D4427 Classification of Peat Samples by Laboratory Testing**

**E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves**

### 3. Terminology

#### 3.1 Definitions:

3.1.1 For definitions of common technical terms in this standard, refer to Terminology **D653**.

3.1.2 *cobbles*—particles of rock that will pass a 12-in. (300-mm) square opening and be retained on a 3-in. (75-mm) sieve.

3.1.3 *boulders*—particles of rock that will not pass a 12-in. (300-mm) square opening.

3.1.4 *clay*—soil passing a No. 200 (75- $\mu$ m) sieve that can be made to exhibit plasticity (putty-like properties) within a range of water contents, and that exhibits considerable strength when air-dried. For classification, a clay is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index equal to or greater than 4, and the plot of plasticity index versus liquid limit falls on or above the “A” line (see Fig. 4 of Test Method **D2487**).

3.1.5 *gravel*—particles of rock that will pass a 3-in. (75-mm) sieve and be retained on a No. 4 (4.75-mm) sieve with the following subdivisions:

3.1.5.1 *coarse*—passes a 3-in. (75-mm) sieve and is retained on a 3/4-in. (19-mm) sieve.

3.1.5.2 *fine*—passes a 3/4-in. (19-mm) sieve and is retained on a No. 4 (4.75-mm) sieve.

3.1.6 *organic clay*—a clay with sufficient organic content to influence the soil properties. For classification, an organic clay is a soil that would be classified as a clay, except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

3.1.7 *organic silt*—a silt with sufficient organic content to influence the soil properties. For classification, an organic silt is a soil that would be classified as a silt except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

3.1.8 *peat*—a soil composed primarily of vegetable tissue in various stages of decomposition usually with an organic odor, a dark brown to black color, a spongy consistency, and a texture ranging from fibrous to amorphous.

3.1.9 *sand*—particles of rock that will pass a No. 4 (4.75-mm) sieve and be retained on a No. 200 (75- $\mu$ m) sieve with the following subdivisions:

3.1.9.1 *coarse*—passes a No. 4 (4.75-mm) sieve and is retained on a No. 10 (2.00-mm) sieve.

3.1.9.2 *medium*—passes a No. 10 (2.00-mm) sieve and is retained on a No. 40 (425- $\mu$ m) sieve.

3.1.9.3 *fine*—passes a No. 40 (425- $\mu$ m) sieve and is retained on a No. 200 (75- $\mu$ m) sieve.

3.1.10 *silt*—soil passing a No. 200 (75- $\mu$ m) sieve that is nonplastic or very slightly plastic and that exhibits little or no

strength when air dry. For classification, a silt is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index less than 4, or the plot of plasticity index versus liquid limit falls below the “A” line (see Fig. 4 of Test Method **D2487**).

3.1.11 *fine-grained soils*—soils that are made up of 50 % or more particles that will pass a No. 200 (75  $\mu$ m) sieve.

3.1.12 *coarse-grained soils*—soils that are made up of more than 50 % particles that will be retained on a No. 200 (75  $\mu$ m) sieve.

### 4. Summary of Practice

4.1 Using visual examination and simple manual tests, this practice gives standardized criteria and procedures for describing and identifying soils.

4.2 The soil can be given an identification by assigning a group symbol(s) and name. The flow charts, **Fig. 1a** and **Fig. 1b** for fine-grained soils, and **Fig. 2**, for coarse-grained soils, can be used to assign the appropriate group symbol(s) and name. If the soil has properties which do not distinctly place it into a specific group, borderline symbols may be used, see **Appendix X3**.

### 5. Significance and Use

5.1 The descriptive information required in this practice can be used to describe a soil to aid in the evaluation of its significant properties for engineering use.

5.2 The descriptive information required in this practice should be used to supplement the classification of a soil as determined by Test Method **D2487**.

5.3 This practice may be used in identifying soils using the classification group symbols and names as prescribed in Test Method **D2487**. Since the names and symbols used in this practice to identify the soils are the same as those used in Test Method **D2487**, it shall be clearly stated in reports and all other appropriate documents, that the classification symbol and name are based on visual-manual procedures.

5.4 This practice is to be used for identification of soils in the field, laboratory, or any other location where soil samples are inspected and described.

5.5 This practice may be used to group similar soil samples to reduce the number of laboratory tests necessary for positive soil classification.

**NOTE 2**—The ability to describe and identify soils correctly is learned more readily under the guidance of experienced personnel, but it may also be acquired systematically by comparing numerical laboratory test results for typical soils of each type with their visual and manual characteristics.

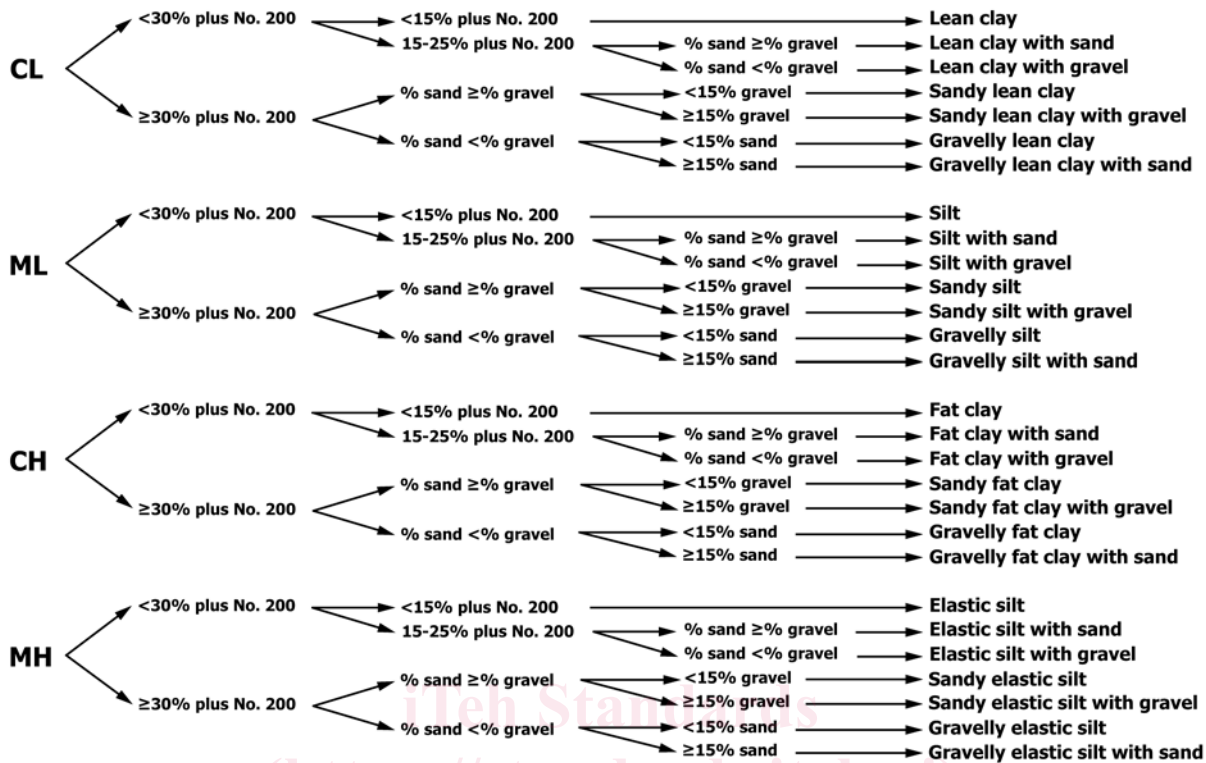
5.6 Soil samples from a given boring, test pit or location which appear to have similar characteristics are not required to follow all of the procedures in this practice, providing at least one sample is completely described and identified. These samples may follow only the necessary procedures to determine they are “similar” and shall be labeled as such.

5.7 This practice may be used in combination with Practice **D4083** when working with frozen soils.

**NOTE 3**—The quality of the result produced by this standard is

**GROUP SYMBOL**

**GROUP NAME**

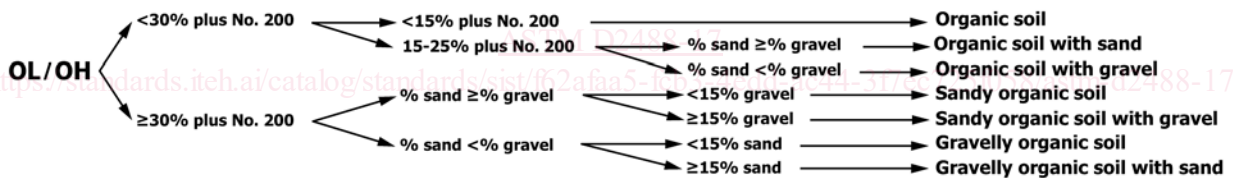


NOTE—Percentages are based on estimating amounts of fines, sand, and gravel to the closest 5 %.

FIG. 1a Flow Chart for Identifying Inorganic Fine-Grained Soil (50 % or more fines)

**GROUP SYMBOL**

**GROUP NAME**



NOTE—Percentages are based on estimating amounts of fines, sand, and gravel to the closest 5 %.

FIG. 1 b Flow Chart for Identifying Organic Fine-Grained Soil (50 % or more fines)

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 means of evaluating some of those factors.

**6. Apparatus**

- 6.1 Small Knife or Spatula
- 6.2 Test Tube and Stopper (optional)
- 6.3 Jar with Lid (optional)
- 6.4 Hand Lens (optional)
- 6.5 Shallow Pan (optional)

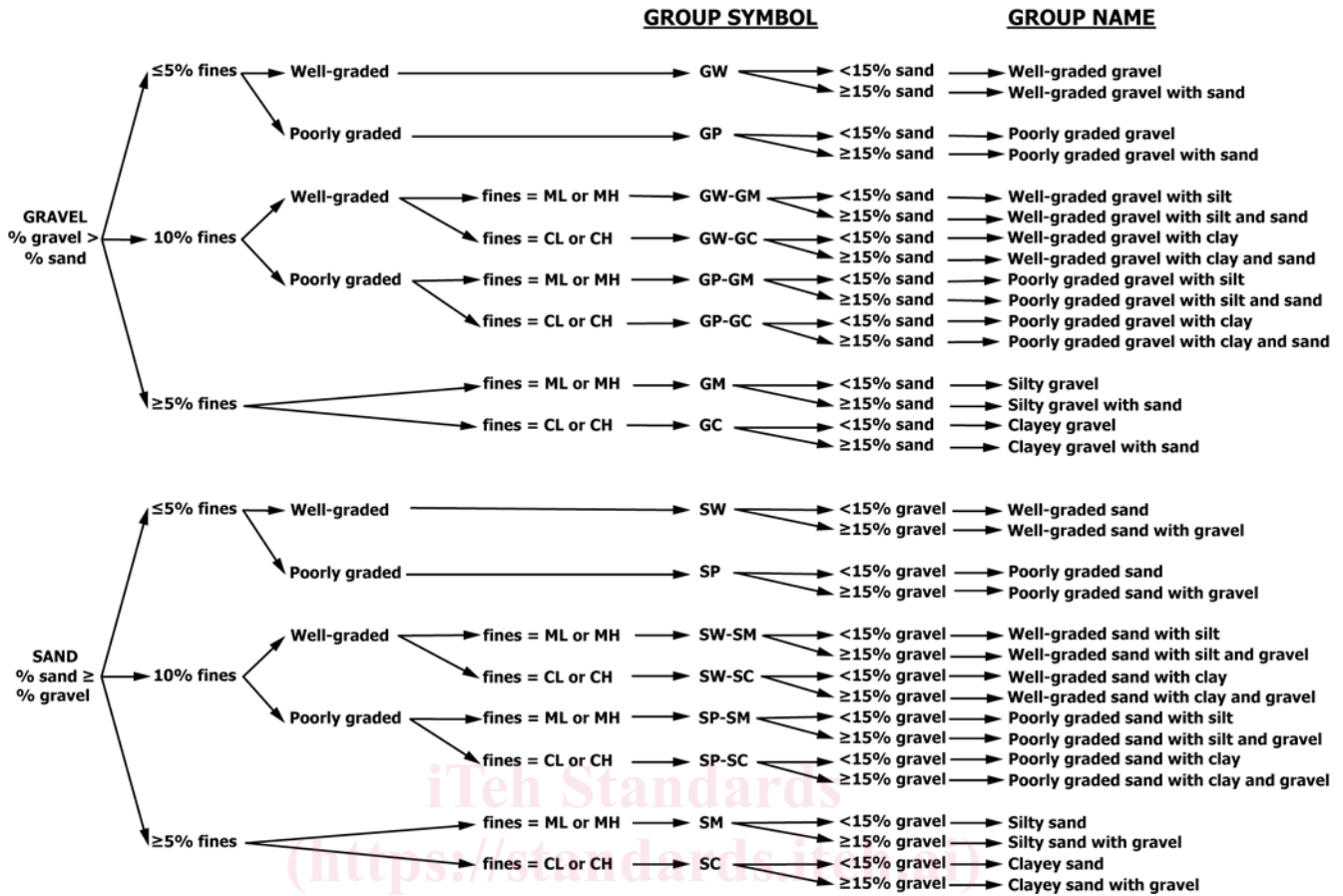
**7. Reagents**

7.1 Purity of Water—Unless otherwise indicated, references to water shall be understood to mean water from a city water supply or natural source, including non-potable water.

7.2 Hydrochloric Acid—A small bottle of dilute hydrochloric acid (HCl) one part HCl (10 N) to three parts distilled water (This reagent is optional for use with this practice). See Section 8.

**8. Safety Precautions**

8.1 When preparing the dilute HCl solution of one part concentrated hydrochloric acid (10 N) to three parts of distilled water, slowly add acid into water following necessary safety



NOTE—Percentages are based on estimating amounts of fines, sand, and gravel to the closest 5 %.

NOTE—It is suggested that a distinction be made between *dual symbols* and *borderline symbols*.

**Dual Symbol**—A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC, CL-ML used to indicate that the soil has been identified as having the properties of a classification in accordance with Test Method D2487 where two symbols are required. Two symbols are required when the soil has between 5 and 12 % fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart.

**Borderline Symbol**—A borderline symbol is two symbols separated by a slash, for example, CL/CH, GM/SM, CL/ML. A borderline symbol should be used to indicate that the soil has been identified as having properties that do not distinctly place the soil into a specific group (see Appendix X3).

FIG. 2 Flow Chart for Identifying Coarse-Grained Soils (less than 50 % fines)

precautions. Handle with caution, utilize personal protective equipment and store safely. If solution comes into contact with the skin or eyes, rinse thoroughly with water.

8.2 **Caution**—Acid shall be added to the water. Do not add water to the acid as this may cause an adverse reaction.

## 9. Sampling

9.1 The sample shall be considered to be representative of the stratum from which it was obtained by an appropriate, accepted, or standard procedure.

NOTE 4—Preferably, the sampling procedure should be identified as having been conducted in accordance with Practices D1452, D1587, or D2113, or Test Method D1586.

9.2 The sample shall be carefully identified as to origin.

NOTE 5—Remarks as to the origin may take the form of a boring number and sample number in conjunction with a project number, a geologic stratum, a pedologic horizon or a location description with respect to a permanent monument, a grid system or a station number and offset with respect to a stated centerline and a depth or elevation.

9.3 For accurate description and identification, the minimum amount of the specimen to be examined shall be in accordance with Table 1.

NOTE 6—If random isolated particles are encountered that are significantly larger than the particles in the soil matrix, the soil matrix can be accurately described and identified in accordance with the preceding table.

9.4 If the sample or specimen being examined is smaller than the minimum recommended specimen size, the report shall include a remark stating as such.

TABLE 1 Minimum Specimen Dry Mass Requirements

Maximum Particle Size, Sieve Opening	Minimum Specimen Size, by Dry Mass
No. 4 (4.75 mm)	0.25 lb (110 g)
3/8 in. (9.5 mm)	0.5 lb (220 g)
3/4 in. (19.0 mm)	2.2 lb (1.0 kg)
1 1/2 in. (38.1 mm)	18 lb (8.0 kg)
3 in. (75.0 mm)	132 lb (60.0 kg)

## 10. Descriptive Information for Soils

10.1 *Angularity*—Describe the angularity of the sand (coarse sizes only), gravel, cobbles, and boulders, as angular, subangular, subrounded, or rounded in accordance with the criteria in [Table 2](#) and [Fig. 3](#). A range of angularity may be stated, such as: subrounded to rounded.

10.2 *Shape*—Describe the shape of the gravel, cobbles, and boulders as flat, elongated, or flat and elongated if they meet the criteria in [Table 3](#) and [Fig. 4](#). Otherwise, do not mention the shape. Indicate the fraction of the particles that have the shape, such as: one-third of the gravel particles are flat.

10.3 *Color*—Describe the color. Color is an important property in identifying organic soils, and within a given locality it may also be useful in identifying materials of similar geologic origin. If the sample contains layers or patches of varying colors, this shall be noted and all representative colors shall be described. The color shall be described for moist samples. If the color represents a dry condition, this shall be stated in the report.

10.4 *Odor*—Describe the odor if organic or unusual.

10.4.1 Soils containing a significant amount of organic material usually have a distinctive odor of decaying vegetation. This is especially apparent in fresh samples.

10.4.2 If the samples are dried, the odor may often be revived by moistening the sample and slightly heating it.

10.4.3 Odors from petroleum products, chemicals or other substances shall be described.

10.4.4 Some fumes emitting from soil samples, especially of a chemical nature, may pose a health risk. Proper safety protocols which may include the use of personal protective equipment must be followed in these instances. It is the responsibility of the user to determine the extent of the health risk and the correct protocols to follow.

10.5 *Moisture Condition*—Describe the moisture condition as dry, moist, or wet, in accordance with the criteria in [Table 4](#).

10.6 *HCl Reaction*—Describe the reaction with HCl as none, weak, or strong, in accordance with the criteria in [Table 5](#). Since calcium carbonate is a common cementing agent, a comment of its presence on the basis of the reaction with dilute hydrochloric acid is important.

10.7 *Consistency*—For intact fine-grained soil, describe the consistency as very soft, soft, firm, hard, or very hard, in accordance with the criteria in [Table 6](#). This observation is inappropriate for soils with significant amounts of gravel.

10.8 *Cementation*—Describe the cementation of intact coarse-grained soils as weak, moderate, or strong, in accordance with the criteria in [Table 7](#).

10.9 *Structure*—Describe the structure of intact soils in accordance with the criteria in [Table 8](#).

10.10 *Range of Particle Sizes*—For gravel and sand components, describe the range of particle sizes within each component as defined in 3.1.5 and 3.1.9. For example, about 20 % fine to coarse gravel, about 40 % fine to coarse sand.

10.11 *Maximum Particle Size*—Describe the maximum particle size found in the sample in accordance with the following information:

10.11.1 *Sand Size*—If the maximum particle size is a sand size, describe as fine, medium, or coarse as defined in 3.1.9. For example: maximum particle size, medium sand.

10.11.2 *Gravel Size*—If the maximum particle size is a gravel size, describe the maximum particle size as the smallest sieve opening that the particle will pass. For example, maximum particle size, 1½ in. will pass a 1½-in. (square opening) but not a ¾-in. (square opening).

10.11.3 *Cobble or Boulder Size*—If the maximum particle size is a cobble or boulder size, describe the maximum dimension of the largest particle. For example: maximum dimension, 18 in. (450 mm).

10.12 *Hardness*—Describe the hardness of coarse sand and larger particles as hard, or state what happens when the particles are hit by a hammer, for example, gravel-size particles fracture with considerable hammer blow, some gravel-size particles crumble with hammer blow. “Hard” means particles do not crack, fracture, or crumble under a hammer blow.

10.13 Additional comments shall be noted, such as the presence of roots or root holes, difficulty in drilling or augering the hole, caving of the trench or hole, or the presence of mica.

10.14 A local or commercial name or a geologic interpretation of the soil, or both, may be added if identified as such.

10.15 A classification or identification of the soil in accordance with other classification systems may be added if identified as such.

## 11. Identification of Peat

11.1 A sample composed primarily of vegetative tissue in various stages of decomposition that has a fibrous to amorphous texture, usually a dark brown to black color, and an organic odor, shall be designated as highly organic and shall be identified as peat, PT. Peat samples shall not be subjected to the identification procedures described hereafter. Refer to [D4427](#) for procedures on classifying peat.

## 12. Preparation for Identification

12.1 The soil identification portion of this practice is based on the portion of the soil sample that will pass a 3-in. (75-mm) sieve. The larger than 3-in. (75-mm) particles must be removed, manually for a loose sample, or ignored for an intact sample before classifying the soil.

**TABLE 2 Criteria for Describing Angularity of Coarse-Grained Particles (see Fig. 3)**

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges



FIG. 3 Typical Angularity of Bulky Grains

TABLE 3 Criteria for Describing Particle Shape (see Fig. 4)

The particle shape shall be described as follows where length, width, and thickness refer to the greatest, intermediate, and least dimensions of a particle, respectively.

Flat	Particles with width/thickness > 3
Elongated	Particles with length/width > 3
Flat and elongated	Particles meet criteria for both flat and elongated

12.2 Estimate and note the percentage of cobbles and the percentage of boulders. Visual estimates will be based on the percentage by volume.

NOTE 7—Since the percentages of the particle-size distribution in Test Method D2487 are by dry mass, and the estimates of percentages for gravel, sand, and fines in this practice are by dry mass, it is recommended

that the report state that the percentages of cobbles and boulders are by volume.

12.3 Of the fraction of the soil smaller than 3 in. (75 mm), estimate and note the percentage, by dry mass, of the gravel, sand, and fines (see Appendix X4 for suggested procedures).

NOTE 8—Since the particle-size components appear visually on the basis of volume, considerable experience is required to estimate the percentages on the basis of dry mass. Frequent comparisons with laboratory particle-size analyses should be made.

12.3.1 The percentages shall be estimated to the closest 5%. The percentages of gravel, sand, and fines must add up to 100%.

12.3.2 If one of the components is present but not in sufficient quantity to be considered 5% of the smaller than 3-in. (75-mm) portion, indicate its presence by the term *trace*,