Designation: D 2217 – 85 (Reapproved 1998)

AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Practice for Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants[1]

This standard is issued under the fixed designation D 2217; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This practice covers the wet preparation of soil samples as received from the field for particle-size analysis and determination of soil constants.

1.2 Procedure A provides for drying the field sample at a temperature not exceeding 140°F (60°C), making a wet separation on the No. 10 (2.00-mm) sieve, or No. 40 (425-µm) sieve, or both, as needed, and finally drying at a temperature not exceeding 140°F. Procedure B provides that the sample shall be kept at a moisture content equal to or greater than the natural water content. The procedure to be used should be indicated in the specification for the material being tested. If no procedure is specified, the provisions of Procedure B shall govern.

1.3 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 421 Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants[2]

D 422 Method for Particle-Size Analysis of Soils[2]

E 11 Specification for Wire-Cloth Sieves for Testing Purposes[3]

3. Significance and Use

3.1 Procedure A is used to prepare soil samples for plasticity tests and particle-size analysis when the coarse-grained particles of a sample are soft and pulverize readily, as in Practice D 421, or when the fine particles are very cohesive and tend to resist removal from the coarse particles.

3.2 Some soils never dry out in nature and may change their characteristics greatly when dried. If the true natural gradation and plasticity characteristics of such soils are desired, these soils should be shipped to the laboratory in sealed containers and processed in accordance with Procedure B of this practice.

3.3 Liquid limit and plasticity index values derived from samples containing their natural moisture are usually, but not always, equal to or higher than values derived from similar samples of the dried soil. In the case of fine-grained organic soil, there is a radical drop in plasticity due to oven drying.

4. Apparatus

4.1 *Balance*, sensitive to 0.1 g.

4.2 *Mortar and Rubber-Covered Pestle*, suitable for breaking up the aggregations of soil particles.

4.3 *Sieves*, No. 10 (2.00-mm) and No. 40 (425-µm), of square mesh woven-wire cloth, conforming to Specification E 11.

4.4 *Sampler*—A riffle sampler or sample splitter for quartering the samples.

4.5 *Drying Apparatus*—Thermostatically controlled drying oven for use at 140°F (60°C) or below and at 230°F (110°C), infrared lamps; air drier; or other suitable device for drying samples.

4.6 *Filter Funnels or Candles*—Büchner funnels 10 in. (254 mm) in diameter and filter paper or filter candles.

4.7 *Miscellaneous Equipment*—Pans 12 in. (304.8 mm) in diameter and 3 in. (76.2 mm) in depth; a suitable container that will prevent loss of moisture during storage of the moist test sample prepared in Procedure B.

PROCEDURE A

5. Sampling

5.1 Dry the soil sample as received from the field, using one of the following methods: (*1*) in air at room temperature, (*2*) in a drying oven at a temperature not exceeding 140°F (60°C), or (*3*) using any warming device that will not raise the temperature of the sample above 140°F. Break up thoroughly any aggregations of particles using the mortar and rubber-covered pestle or other suitable device (Note 1). Select a representative portion by the method of quartering or by use of the sampler. This portion must be sufficient to provide samples for particle-size analyses of material retained on and passing the No. 10

[1] This practice is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.03 on Texture, Plasticity, and Density Characteristics of Soils.

Current edition approved July 26, 1985. Published September 1985. Originally published as D 2217 – 63 T. Last previous edition D 2217 – 66 (1978)ε[1].

[2] *Annual Book of ASTM Standards*, Vol 04.08.

[3] *Annual Book of ASTM Standards*, Vol 14.02.

(2.00-mm) sieve, and to provide an adequate amount of material passing the No. 40 (425-µm) sieve for the tests to determine soil constants. The amounts of material required to perform the individual tests are as follows:

Particle-Size Analysis of Material Retained on No. 10 (2.00-mm) Sieve:	
Gravelly soils, g	4 000 to 10 000
Sandy soils, g	1 500
Silty or clayey soils, g	400
Particle-Size Analysis of Material Passing No. 10 (2.00-mm) Sieve:	
Sandy soils, g	115
Silty or clayey soils, g	65
Tests for Determination of Soil Constants:	
Liquid limit, g	100
Plastic limit, g	15
Centrifuge moisture equivalent, g	10
Shrinkage factors, g	30
Check tests, g	65

NOTE 1—When the sample contains particles of soft shale or sandstone or similar weak material, proper care must be exercised to avoid excessive reduction in the size of the particles.

6. Preparation of Test Samples

6.1 *For Particle-Size Analysis*:

6.1.1 Weigh the portion of the test sample selected for particle-size analysis and record as the weight of test sample uncorrected for hygroscopic moisture. Separate this material into two portions using the No. 10 (2.00-mm) sieve. Set aside the portion passing for later recombination with additional material washed from the portion retained on the No. 10 (2.00-mm) sieve.

6.1.2 Place the material retained on the No. 10 (2.00-mm) sieve in a pan, cover with water, and allow to soak until the particle aggregations become soft. After soaking, wash the material on a No. 10 (2.00-mm) sieve in the following manner: Place an empty No. 10 (2.00-mm) sieve on the bottom of a clean pan and pour the water from the soaked sample into the sieve. Add sufficient water to bring the level approximately ½ in. (12.7 mm) above the mesh of the sieve. Transfer the soaked material to the sieve in increments not exceeding 1 lb (0.45 kg), stirring each increment with the fingers while agitating the sieve up and down. Crumble or mash any lumps that have not slaked, using the thumb and fingers. Raise the sieve above the water in the pan and complete the washing operation using a small amount of clean water. Transfer the washed material on the sieve to a clean pan before placing another increment of soaked material on the sieve.

6.1.3 Dry the material retained on the No. 10 (2.00-mm) sieve at a temperature of 230 ± 9°F (110 ± 5°C), sieve on the No. 10 (2.00-mm) sieve, and add the material passing the sieve to similar material obtained in 6.1.1. Set aside the material retained on the sieve for use in the particle-size analysis.

6.1.4 Set aside the pan containing the washings for a period of several hours or until the water above the particles is clear. Decant, pipet, or siphon off as much of the clear water as possible (Note 2). Dry the soil remaining in the pan at a temperature not exceeding 140°F (60°C). Grind the dried soil in the mortar with the rubber-covered pestle or other suitable device, and combine with similar material obtained in 6.1.1.

6.1.5 Alternatively, after all the soaked material has been washed, remove most of the water by filtering the wash water on one or more Büchner funnels fitted with filter paper or by using filter candles. Remove the moist soil from the filter paper or filter candles, combine with any sediment remaining in the pan, and dry at a temperature not exceeding 140°F (60°C). Grind the dried soil in the mortar with a rubber-covered pestle or other suitable device and combine with similar material obtained in 6.1.1.

NOTE 2—In some instances, the wash water will not become clear in a reasonable length of time; in this case the entire volume must be evaporated.

6.2 *For Determination of Soil Constants*—Proceed in accordance with 6.1, substituting a No. 40 (425-µm) sieve for the No. 10 (2.00-mm) sieve.

NOTE 3—In some areas it is possible that the cations of salts present in the tap water may exchange with the natural cations in the soil and alter significantly the values of the soil constants should tap water be used in the soaking and washing operations. Unless it is known that such cations are not present in the tap water, distilled or demineralized water should be used. The soaking and washing operation will remove soluble salts contained in the soil. When soluble salts are present in the soil, the wash water should be saved and evaporated, and the salts returned to the soil sample.

7. Test Samples

7.1 Keeping each portion separate from the other portion, mix thoroughly the portions of the soil sample passing the No. 10 (2.00-mm) sieve and the No. 40 (425-µm) sieve. By the method of quartering or by the use of the sampler, select and weigh out test samples of the weights indicated in Section 5, as may be needed to make the required tests.

PROCEDURE B

8. Samples

8.1 Samples prepared in accordance with this procedure must be shipped from the field to the laboratory in sealed containers and must contain all their natural moisture. Samples obviously containing only particles passing the No. 10 (2.00-mm) sieve may be tested in the particle-size analysis without first washing on the No. 10 (2.00-mm) sieve. Samples obviously containing only particles passing the No. 40 (425-µm) sieve may be used in the tests to determine soil constants without first washing on the No. 40 (425-µm) sieve.

9. Preparation of Test Samples

9.1 *For Particle-Size Analysis*:

9.1.1 Select and weigh a representative portion of the moist sample estimated to contain 50 g of particles passing the No. 10 (2.00-mm) sieve for silty and clayey soil, or 100 g for sandy soil. For samples containing particles not passing the No. 10 (2.00-mm) sieve for which a particle-size analysis is required, select and weigh a representative sample estimated to contain the required amounts of particles both passing and not passing the No. 10 (2.00-mm) sieve. Determine the moisture content at 230 ± 9°F (110 ± 5°C) using an auxiliary sample, for use in Method D 422.

9.1.2 Soak the moist sample and wash on a No. 10 (2.00-mm) sieve as described in 6.1.2. After washing, dry the material retained on the No. 10 (2.00-mm) sieve in an oven at

a temperature of 230 ± 9°F (110 ± 5°C), weigh, and retain for the particle-size analysis. If the volume of the wash water and soil is too large for use in the sedimentation procedure of the test for particle-size analysis, evaporate excess water by exposure to air at room temperature, by heating in an oven at a temperature not exceeding 230°F (110°C), or by boiling. Regardless of the method of evaporation used, the following precautions must be taken: (*1*) stir the slurry from time to time to prevent a dry soil ring from forming on the walls of the evaporation vessel, and (*2*) return the temperature of the sample to room temperature before testing.

9.2 *For Determination of Soil Constants*—Select a representative portion of the moist sample estimated to contain sufficient particles passing the No. 40 (425-µm) sieve to make the required tests for determination of soil constants. Soak this selected portion of the moist sample and wash on the No. 40 (425-µm) sieve as described in 6.2 (Note 2). Reduce the moisture content of the material passing the No. 40 (425-µm) sieve until the mass reaches a putty-like consistency (such as 30 to 35 drops of the cup in the liquid limit test) but never below the natural moisture content. Reduction of moisture content may be accomplished as follows: by exposure to air at ordinary room temperature, by heating in an oven at a temperature not exceeding 230°F (110°C), by boiling, by filtering on a Büchner funnel, or by use of filter candles. During evaporation and cooling, stir the sample often enough to prevent overdrying of the fringes and soil pinnacles on the surface. Cool the heated samples to normal room temperature before testing. For soil samples containing soluble salts, use a method of water reduction that will not eliminate the soluble salts from the test sample. Protect the prepared sample in a suitable container from further drying until all required tests have been performed.

10. Keywords

10.1 sample treatment; soil preparation; wet preparation