Designation: D 425 – 88 (Reapproved 2001)

Standard Test Method for Centrifuge Moisture Equivalent of Soils[1]

This standard is issued under the fixed designation D 425; 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 covers the determination of the moisture equivalent of soil in the laboratory by means of a centrifuge technique.

1.2 This test method is limited to disturbed specimens of coarse-grained soils having fines of low plasticity such as SP, SW, SC-SM, or SM soils. The test is limited to soils passing the 2.00-mm sieve or that fraction of a soil passing a 2.00-mm sieve.

NOTE 1—Test Method D 3152 or Test Method D 2325 should be used to evaluate the capillary-moisture relations of fine-grained soils and coarse-grained soils having fines of medium to high plasticity, undisturbed soils, and soils at specific desired units weights.

1.3 The test method is temperature-dependent, and consistent comparable results can be obtained only if the tests are performed under a constant-temperature condition.

1.4 The values stated in SI units are to be regarded as the standard.

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

2. Referenced Documents

2.1 *ASTM Standards:*

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[2]

D 2216 Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass[2]

D 2325 Test Method for Capillary-Moisture Relationships for Coarse- and Medium-Textured Soils by Porous-Plate Apparatus[2]

D 3152 Test Method for Capillary-Moisture Relationships for Fine-Textured Soils by Pressure-Membrane Apparatus[2]

D 4753 Specification for Evaluating, Selecting, and Specifying Balances and Scales for Use in Soil, Rock, and Construction Materials Testing[2]

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

3. Terminology

3.1 All definitions are in accordance with Terminology D 653. Terms of particular significance are as follows:

3.2 *capillary fringe zone*—the zone above the free water elevation in which water is held by capillary action.

3.3 *centrifuge moisture equivalent*—the water content of a soil after it has been saturated with water and then subjected for one hour to a centrifugal force equal to 1000 times that of gravity.

3.4 *specific retention*—the ratio of the volume of water that cannot be drained from a saturated soil under the action of force of gravity to the total volume of voids.

3.5 *water-holding capacity*—the smallest value to which the water content of soil or rock can be reduced by gravity drainage.

4. Summary of Test Method

4.1 The centrifuge moisture equivalent of soils is determined by initially air-drying the soil, selecting two 5-g test specimens, thoroughly soaking each test specimen, and then determining the water content of each specimen after it has been centrifuged for 1 h at a force equal to 1000 times that of gravity at a controlled temperature of 20 ± 1°C.

5. Significance and Use

5.1 Not all water contained in a saturated soil can be removed by gravity drainage. The amount of water retained after gravity drainage is usually expressed as water holding capacity or specific retention. It varies with time, and with the particle-size distribution and plasticity of the soil (in general, increasing in value with increasing plasticity index).

5.2 In general, the centrifuge moisture equivalent is based on the theory of applying a centrifugal force great enough to reduce the capillary fringe zone enough that it can be ignored without introducing much error, even in small specimens, and yet not so great as to withdraw a large proportion of the water that is held securely above the capillary fringe. For example, if a soil will hold water 100 mm by capillarity acting against

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

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

gravity, the soil will theoretically be able to hold the water only 0.1 mm against a centrifugal force that is 1000 times greater than the force of gravity. It has been determined that for at least medium-textured soils (sandy to silty particle-size distribution) the centrifuge moisture equivalent approximates the water holding capacity and when combined with the bulk density can be used to calculate an approximate specific retention and specific yield. These properties when combined with porosity can be used to estimate aquifer storage coefficient.

6. Apparatus

6.1 *Centrifuge*—A centrifuge of such a size and so driven that a force equal to 1000 times the force of gravity may be exerted on the center of gravity of the soil specimen for 1 h. The centrifuge chamber shall be capable of maintaining a controlled temperature of 20 ± 1°C. The revolutions per minute, *N*, required to provide a centrifugal force of 1000 times gravity is determined from the equation:

$$N = \sqrt{\frac{RCF}{0.0000111\ rm}} \tag{1}$$

where:

N = revolutions per minute,
RCF = relative centrifugal force (1000),
r = radius of rotation to center of gravity of the test specimen, cm, and
m = mass of the body, taken as unity.

For normal equipment installation, N will equal approximately 2300 rpm.

6.2 *Gooch Crucible*—A procelain Gooch crucible having a perforated bottom, a capacity of approximately 25 mL, and a diameter at bottom of about 20 mm (Fig. 1). Crucibles should be numbered and paired in such a way that their masses meet the requirements of the manufacturer of the centrifuge.

6.3 *Babcock Trunnion Cups*—At least one pair of centrifuge cups with caps and with a crucible holder for supporting the Gooch crucible above the bottom of the cup (Fig. 1). The holder shall have sufficient clearance to fit fully within the cup and short support the cup in such a manner that the water ejected during the centrifuging operation does not come in contact with the crucible and soil. Cups and crucible holders should be balanced in pairs opposite each other in the centrifuge and should be numbered in pairs (for example, 1, 1A, 2, 2A, etc.).

6.4 *Filter Paper*—A circular piece of filter paper just large enough to cover the inside bottom of the Gooch crucible.

NOTE 2—Filter papers may be purchased already cut to size from a scientific supply company. A medium speed, high wet strength (hardened) paper is recommended.

6.5 *Balance*—A balance having a readability of 0.01 g, and accurate to ±0.03 g.

NOTE 3—For additional information on balances refer to Specification D 4753.

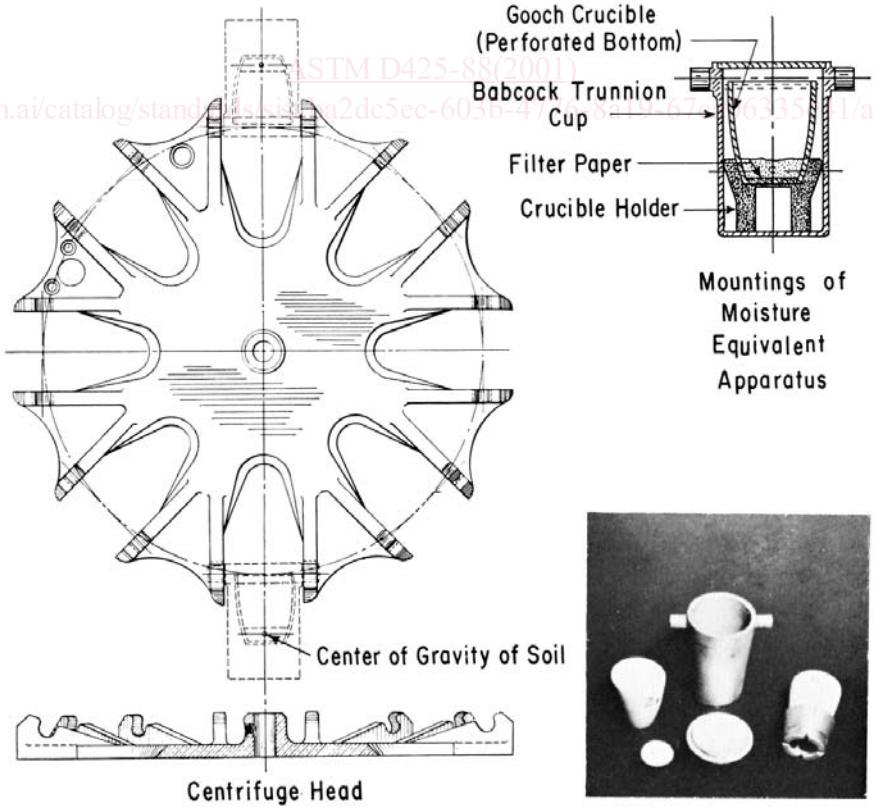

FIG. 1 Crucible, Trunnion Cup, and Cup Holder