



Designation: D 6572 – 00

Standard Test Methods for Determining Dispersive Characteristics of Clayey Soils by the Crumb Test¹

This standard is issued under the fixed designation D 6572; 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 These test methods provide a qualitative indication of the natural dispersive characteristics of clayey soils.

1.2 These test methods are not applicable for soils with less than 12 % fraction finer than 0.005 mm and with a plasticity index less than or equal to 8.

1.3 The crumb test method has some limitations in its usefulness as an indicator of dispersive clay. A dispersive soil may sometimes give a nondispersive reaction in the crumb test. Soils containing kaolinite with known field dispersion problems have shown nondispersive reactions in the crumb test (1)². However, if the crumb test indicates dispersion, the soil is probably dispersive.

1.4 Oven-dried soil should not be used to prepare crumb test specimens, as irreversible changes could occur to the soil pore-water physicochemical properties responsible for dispersion (2).

1.5 The crumb test method, while a good quick indication of dispersive clay, should usually be run in conjunction with a pinhole test and a double hydrometer test, Test Methods D 4647 and D 4221, respectively.

NOTE 1—In some cases, the results of the pinhole, crumb, and double-hydrometer test methods may disagree. Crumb test methods are a better indicator of dispersive clays than of nondispersive clays (3).

1.6 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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

2. Referenced Documents

2.1 ASTM Standards:

¹ These test methods are under the jurisdiction of ASTM Committee D18 on Soil and Rock and are the direct responsibility of Subcommittee D18.06 on Physical-Chemical Interactions of Soil and Rock.

Current edition approved June 10, 2000. Published August 2000.

² The boldface numbers in parentheses refer to the list of references at the end of this standard.

D 653 Terminology Relating to Soil, Rock, and Contained Fluids³

D 1193 Specification for Reagent Water⁴

D 2216 Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock³

D 3740 Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction³

D 4221 Test Method for Dispersive Characteristics of Clay Soil by Double Hydrometer³

D 4647 Test Method for Identification and Classification of Dispersive Clay Soils by the Pinhole Test³

E 1 Specification for ASTM Thermometers⁵

E 11 Specification for Wire-Cloth Sieves for Testing Purposes⁶

3. Terminology

3.1 Definitions:

3.1.1 *dispersive clays*—soils that disperse (deflocculate) easily and rapidly without significant mechanical assistance in water of low-salt concentration.

3.1.1.1 *Discussion*—Such soils usually have a high proportion of their adsorptive capacity saturated with sodium cations although adsorbed lithium and magnesium may also play a role (4). Such soils also generally have a high shrink-swell potential, have low resistance to erosion, and have low permeability in an intact state.

3.2 For definitions of other terms used in these test methods, refer to Terminology D 653.

4. Summary of Test Method

4.1 A cube of remolded soil approximately 15 mm ($\frac{5}{8}$ in.) on each side (about the size of a single die in a pair of dice) or a natural soil crumb of approximately similar volume is placed on the bottom of a white porcelain dish containing 250 mL of distilled water.

4.2 Temperature of the water is recorded and visual determinations of dispersion grade are made and recorded at 2 min,

³ *Annual Book of ASTM Standards*, Vol 04.08.

⁴ *Annual Book of ASTM Standards*, Vol 11.01.

⁵ *Annual Book of ASTM Standards*, Vol 14.03.

⁶ *Annual Book of ASTM Standards*, Vol 14.02.

1 h, and 6 h. Determination of grade is based on the formation, extent, and turbidity of a dense “cloud” or halo of colloidal-sized particles extending from the soil crumb.

4.3 Determinations consist of: Grade 1 (Nondispersive), Grade 2 (Intermediate), Grade 3 (Dispersive), and Grade 4 (Highly Dispersive).

5. Significance and Use

5.1 The crumb test method provides a simple, quick method for field or laboratory identification of a dispersive clay soil. The internal erosion failures of a number of homogeneous earth dams, erosion along channel or canal banks, and rainfall erosion of earthen structures have been attributed to colloidal erosion along cracks or other flow channels formed in masses of dispersive clay (5).

5.2 The crumb test method, as originally developed by Emerson (6), was called the aggregate coherence test and had seven different categories of soil-water reactions. Sherard (5) later simplified the test by combining some soil-water reactions so that only four categories, or grades, of soil dispersion are observed during the test. The crumb test is a relatively accurate positive indicator of the presence of dispersive properties in a soil. The crumb test, however, is not a completely reliable negative indicator that soils are not dispersive. The crumb test, can seldom be relied upon as a sole test method for determining the presence of dispersive clays. The double-hydrometer test (Test Method D 4221) and pinhole test (Test Method D 4647) are test methods that provide valuable additional insight into the probable dispersive behavior of clay soils.

NOTE 2—The quality of the result produced by these test methods 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 D 3740 are generally considered capable of competent and objective testing. Users of these test methods are cautioned that compliance with Practice D 3740 does not in itself ensure reliable testing. Reliable testing depends on several factors; Practice D 3740 provides a means of evaluating some of those factors.

6. Interferences

6.1 Oven-dried soil shall not be used in performing the crumb test as irreversible changes could occur to the soil pore-water physicochemical properties responsible for dispersion (2).

6.2 Using other than Type IV water in accordance with Specification D 1193, can interfere with dispersion of the colloidal clay particles.

6.3 Carefully place the cube or crumb directly on the bottom of the dish when submerging the crumb. Dropping the crumb from the water surface can cause excessive slaking and may result in erroneous interpretation of the dispersion grade.

6.4 Jarring or moving the soil specimen or porcelain dish once the test method has begun can cause excessive turbidity and may result in erroneous interpretation of the dispersion grade.

6.5 The use of natural, irregular-shaped soil crumbs may result in a specimen that is not representative of the total sample. Therefore, several crumb test specimens should be selected to ensure that representative test results are obtained. The total number of test specimens should be determined

during the test program and will depend on the degree of agreement of individual test results.

6.6 These test methods are not applicable to soils with less than 12 % fraction finer than 0.005 mm and with a plasticity index less than or equal to 8.

7. Apparatus

7.1 *Specimen Container*—Dish, porcelain, evaporating, 300-mL capacity.

NOTE 3—Plastic bowls or cups can also be used but they should be white or clear to help in distinguishing the colloidal cloud. The container should be at least 85 mm (3 in.) across the bottom if flat-bottomed.

7.2 *Thermometer*—0 to 50°C range, 0.1°C divisions, conforming to the requirements of Specification E 1.

7.3 *Sieve*, 4.75-mm (No. 4) and 2-mm (No. 10) sieve, in accordance with Specification E 11.

8. Reagents and Materials

8.1 *Purity of Water*—Type IV of Specification D 1193 with a pH between 5.5 and 7.0 shall be used for conducting the test method and preparing remolded specimens. Distilled water is preferred.

9. Sampling, Test Specimens, and Test Units

9.1 *Sampling*—Obtain a representative soil sample of -4.75 -mm (No. 4) soil. Depending on the percentage of coarse sand in the material, approximately 25 to 75 g of material is needed to perform a crumb test method and approximately 400 to 500 g of material is needed to perform the crumb, pinhole, and double-hydrometer tests.

NOTE 4—Do not use oven-dried material for the crumb test method because irreversible changes may occur to the soil pore-water physicochemical properties responsible for dispersion. Soil at natural moisture or at specified compaction moisture is preferred.

9.2 Test Specimens:

9.2.1 Test specimens may be from natural, irregularly shaped soil crumbs (Test Method A) or may be remolded from material passing a 2-mm (No. 10) sieve (Test Method B). Material for the crumb test method should be selected as soon as possible after obtaining the soil sample.

9.2.2 Test Method A—Natural Soil Crumbs:

9.2.2.1 A natural, irregularly shaped soil crumb is selected that has been preserved at natural moisture or only allowed to air-dry. This soil crumb should be approximately the same volume as a cube 15 mm ($\frac{5}{8}$ in.) on each side (about the size of a single die of a pair of dice). Smaller soil crumbs down to a volume equivalent to a cube 7 mm ($\frac{1}{4}$ in.) on each side may be used if larger ones are unavailable.

9.2.2.2 Use of natural soil crumbs may result in a specimen that is not representative of the total sample. Therefore, it is recommended that several crumb specimens be tested to ensure the total sample is represented. The number chosen is dependent on the homogeneity of the total sample.

9.2.3 Test Method B—Remolded Specimens:

9.2.3.1 A cube, approximately 15 mm ($\frac{5}{8}$ in.) on each side, is prepared from moist soil which has passed a 2-mm (No. 10) sieve.