Designation: D1140 – 00 (Reapproved 2006)

Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75-μm) Sieve[1]

This standard is issued under the fixed designation D1140; 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 These test methods cover determination of the amount of material finer than a 75-μm (No. 200) sieve by washing.

1.2 Two methods for determining the amount of material finer than the No. 200 sieve are provided. The method to be used shall be specified by the requesting authority. If no method is specified, the choice should be based on the guidance given in 4.2 and 7.3

1.2.1 *Method A*—Test specimen is not dispersed prior to wash sieving.

1.2.2 *Method B*—Test specimen is dispersed by soaking in water containing a deflocculating agent prior to wash sieving.

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

1.4 *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:*[2]

C702 Practice for Reducing Samples of Aggregate to Testing Size

D75 Practice for Sampling Aggregates

D422 Test Method for Particle-Size Analysis of Soils

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

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

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 in Geotechnical Data

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

E145 Specification for Gravity-Convection and Forced-Ventilation Ovens

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Summary of Test Method

3.1 A specimen of the soil is washed over a 75-μm (No. 200) sieve. Clay and other particles that are dispersed by the wash water, as well as water-soluble materials, are removed from the soil during the test. The loss in mass resulting from the wash treatment is calculated as mass percent of the original sample and is reported as the percentage of material finer than a 75-μm (No. 200) sieve by washing.

4. Significance and Use

4.1 Material finer than the 75-μm (No. 200) sieve can be separated from larger particles much more efficiently and completely by wet sieving than with dry sieving. Therefore, when accurate determinations of material finer than 75-μm sieve in soil are desired, this test method is used on the test specimen prior to dry sieving. Usually the additional amount of material finer than 75-μm sieve obtained in the dry sieving process is a small amount. If it is large, the efficiency of the washing operation should be checked, as it could be an indication of degradation of the soil.

4.2 With some soils, particularly clayey soils, in order to keep the finer material from adhering to the larger particles, it will be necessary to soak the soil prior to washing it through

[1] These test methods are under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.03 on Texture, Plasticity and Density Characteristics of Soils.

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[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.

the sieve. A deflocculating agent (dispersing agent) should be added to the soil when it is soaked.

NOTE 1—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 means of evaluating some of those factors.

5. Apparatus

5.1 *Balance*—A balance or scale conforming to the requirements of Specification D4753, readable (with no estimation) to 0.1 % of the test mass, or better. To determine the balance needed, multiply your test mass by 0.001 and check Table 1 of Specification D4753 for the class of balance readable to the number observed.

5.2 *Sieves*—A minimum nest of two sieves is recommended, the lower must be a 75-µm (No. 200) sieve and the upper may be a 425-µm (No. 40) or larger sieve. Chose a sieve with a diameter sufficient to handle the size of specimen required by 6.2. The 75-µm sieve should have a backing to prevent damage. The sieves shall conform to the requirements of Specification E11. Stainless sieve mesh is preferred, as it is less prone to damage or wear.

5.3 *Oven*—An oven of sufficient size, capable of maintaining a uniform temperature of 100 ± 5°C (230 ± 9°F) and which meets the criteria of Specification E145.

5.4 *Deflocculating Agent*—A solution of Sodium Hexametaphosphate of any concentration sufficient to cause particle separation can be used. A common amount is 40 g per 1000 mL of water.

6. Sampling

6.1 Sample the soil in accordance with Practice D75.

6.2 Thoroughly mix the soil sample and reduce the quantity to an amount suitable for testing using the applicable method described in Practice C702. The test specimen shall be the end result of the reduction. Reduction to an exact predetermined mass is not permitted. The mass of the test specimen, after drying, shall conform with the following except as noted (6.2.1 and Note 2):

Maximum Particle Size (100 % Passing)	Standard Sieve Size	Recommended Minimum Mass of Test Specimens
2 mm or less	No. 10	20 g
4.75 mm	No. 4	100 g
9.5 mm	⅜ ″	500 g
19.0 mm	¾ ″	2.5 kg
37.5 mm	1½ ″	10 kg
75.0 mm	3″	50 kg

6.2.1 If the same specimen is to be tested for sieve analysis according to Test Method D422, comply with the applicable mass requirements of that Test Method.

NOTE 2—When a minimum mass is not available (split spoon sample, and the like), a smaller mass can be used. The report shall indicate the mass used.

7. Procedure

7.1 Dry the test specimen to a constant mass at a temperature of 110 ± 5°C (230 ± 9°F) and determine its mass to the nearest 0.1 g. To determine the balance needed, multiply the mass by 0.001, check the resultant number with Table 1 of Specification D4753 for the required balance.

7.1.1 For example: Minimum readability = 276 g (mass) × 0.001 = 0.3 g. A GP-2 with a readability of 0.1 g would be suitable. A more sensitive balance could also be used.

7.1.2 As an alternative, select an auxiliary water content specimen and determine the water content (nearest 0.1 %) in accordance with Test Method D2216. Calculate the oven-dry mass of the test specimen from the moist mass (nearest 0.1 % of its mass, or better (see 5.1)) and the water content.

7.2 *Method A:*

7.2.1 After preparing the specimen in accordance with 7.1, place the specimen on on the uppermost (coarsest) sieve. Wash the specimen (material) on the sieve(s) by means of a stream of water from a faucet (Note 3). The material may be lightly manipulated by hand, to facilitate the washing process, taking care not to lose any of the retained material. No downward pressure should be exerted on the retained material or sieve to avoid the forcing of particles through the sieve or damage to the sieve. Continue the washing until the water coming through the sieve(s) is clear (Note 4).

NOTE 3—A spray nozzle or a piece of rubber tubing attached to a water faucet may be used for the washing. The velocity of the water, which may be increased by pinching the tubing, shall not cause any splashing of the material over the sides of the sieve. The water temperature should not exceed 32°C (90°F) to avoid expanding the sieve fabric.

NOTE 4—Care should be taken not to let water accumulate on the 75-µm (No. 200) sieve due to clogging of the screen. The clogging can cause overflow of the sieve and loss of material. Lightly hand tapping the sides of the sieve or the bottom of the screen with a fingertip(s) should prevent clogging. Directing a stream of water up from below the screen is another method to unplug the sieve without physically damaging it. Be careful not to overload the screen by sieving too large a specimen, or portion of a specimen, at any one time.

7.3 *Method B:*

7.3.1 As an alternative, particularly for very cohesive soils; after preparing the specimen in accordance with 7.1, place the specimen in a container, cover with water containing a deflocculating agent, and soak for a minimum of 2 h (preferably overnight) (Note 5). The specimen should be periodically agitated manually or by mechanical means to facilitate the complete separation of the particles.

NOTE 5—It will also be easier to separate the particles if the specimen is not dried prior to soaking. The moist mass can be adjusted to a dry mass by using the water content determination procedure from 7.1.2.

7.3.2 After the soaking period is completed, agitate the contents of the container vigorously and immediately pour into the nested sieves. Wash any remaining material into the sieve(s) to make sure all of the material is transferred. Then finish the washing procedure as specified in 7.2.

7.4 When the washing by Method A or B is completed, the material retained on the 75-µm (No. 200) sieve can be dried either in the sieve, or by flushing (transferring) the contents of the sieve into another container. If the soil is transferred, excess

water can be removed by decanting or suctioning to speed drying time. Take care not to lose any particles by removing only clear water.

7.4.1 Dry the residue from each sieve to a constant mass using a temperature of 110 ± 5°C (230 ± 9°F) and determine the mass using the same balance as used in 7.1.

NOTE 6—As mentioned in 4.1, if the sample is dry sieved after washing, some material will pass the 75-µm (No. 200) sieve that did not pass during washing operations. This can be a significant amount for samples with a high percent of very fine sand or coarse silt.

8. Calculation

8.1 Calculate the amount of material passing the 75-µm (No. 200) sieve by washing using the following formula:

$$A = [(B - C)/B] \times 100 \quad (1)$$

where:

A = percentage of material finer than the 75-µm sieve by washing, nearest 0.1 %
B = original dry mass of sample, g, and
C = dry mass of specimen retained on the 75-µm sieve including the amount retained on an upper sieve after washing, g.

9. Report

9.1 Report the percentage of material finer than the 75-µm (No. 200) sieve by washing to the nearest 0.1 %.

9.2 Indicate whether the specimen was soaked and length of time.

9.3 Indicate method used (A or B).

9.4 Sample identification.

9.5 Size of initial dry mass used.

9.6 State whether the dry mass was determined directly or using the water content of the specimen as directed in 7.1.2. If so, note the water content.

10. Precision and Bias

10.1 *Precision*—Criteria for judging the acceptability of test results obtained by these test methods on a range of soil types using Method B are given in Tables 1 and 2. These estimates of precision are based on the results of the interlaboratory program conducted by the ASTM Reference Soils and Testing Program[3]. In this program, some laboratories performed three replicate tests per soil type (triplicate test laboratory), while other laboratories performed a single test per soil type (single test laboratory). A description of the soils tested is given in 10.1.4. The precision estimates may vary with soil type and method used (Method A or B). Judgment is required when applying these estimates to another soil or method.

10.1.1 The data in Table 1 are based on three replicate tests performed by each triplicate test laboratory on each soil type. The single operator and multilaboratory standard deviation shown in Table 1, Column 4 were obtained in accordance with Practice E691, which recommends each testing laboratory perform a minimum of three replicate tests. Results of two properly conducted tests performed by the same operator on the same material, using the same equipment, and in the shortest practical period of time should not differ by more than the single-operator d2*s* limits shown in Table 1, Column 5. For definition of d2*s* see Footnote C in Table 2. Results of two properly conducted tests performed by different operators and on different days should not differ by more than the multilaboratory d2*s* limits shown in Table 1, Column 5.

10.1.2 In the ASTM Reference Soils and Testing Program, many of the laboratories performed only a single test on each soil type. This is common practice in the design and construction industry. The data for each soil type in Table 2 are based upon the first test results from the triplicate test laboratories and the single test results from the other laboratories. Results of two properly conducted tests performed by two different laboratories with different operators using different equipment and on different days should not vary by more than the d2s

TABLE 1 Summary of Test Results from Triplicate Test Laboratories (Percent of Fines)

(1) Soil Type	(2) Number of Triplicate Test Laboratories	(3) Average Value[A] (Percentage Points)	(4) Standard Deviation[B] (Percentage Points)	(5) Acceptable Range of Two Results[C] (Percentage Points)
Single-Operator Results (Within- Laboratory Repeatability):				
CH	13	98.83	0.15	0.4
CL	13	88.55	0.14	0.4
ML	14	99.00	0.12	0.3
SP	13	2.47	0.20	0.5
Multilaboratory Results (Between- Laboratory Reproducibility): :				
CH	13	98.83	0.22	0.6
CL	13	88.55	0.40	1.1
ML	14	99.00	0.13	0.4
SP	13	2.47	0.36	1.0

[A]The number of significant digits and decimal places presented are representative of the input data. In accordance with Practice D6026, the standard deviation and acceptable range of results can not have more decimal places than the input data.

[B]Standard deviation is calculated in accordance with Practice E691 and is referred to as the 1s limit.

[C]Acceptable range of two results is referred to as the d2s limit. It is calculated as $1.960\sqrt{2}\cdot 1s$, as defined by Practice E177. The difference between two properly conducted tests should not exceed this limit. The number of significant digits/decimal places presented is equal to that prescribed by this test method or Practice D6026. In addition, the value presented can have the same number of decimal places as the standard deviation, even if that result has more significant digits than the standard deviation.

TABLE 2 Summary of Single-Test Result from Each Laboratory (Percent of Fines)[A]

(1) Soil Type	(2) Number of Test Laboratories	(3) Average Value (Percentage Points)	(4) Standard Deviation (Percentage Points)	(5) Acceptable Range of Two Results (Percentage Points)
Multilaboratory Results (Single Test Performed by Each Laboratory):				
CH	25	98.74	0.22	0.6
CL	24	88.41	0.52	1.4
ML	25	99.00	0.18	0.5
SP	25	2.647	0.60	1.7

[A]See footnotes in the Table 1.

[3] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D18-1010.

limits shown in Table 2, Column 5. The results in Table 1 and Table 2 are dissimilar because the data sets are different.

10.1.3 Table 1 presents a rigorous interpretation of triplicate test data in accordance with Practice E691 from pre-qualified laboratories. Table 2 is derived from test data that represents common practice.

10.1.4 *Soil Types*—Based on the multilaboratory test results, the soils used in the program are described below in accordance with Practice D2487. In addition, the local names of the soils are given.

CH—Fat clay, CH, 99 % fines, LL=60, PI=39, grayish brown, soil had been air dried and pulverized. Local name—Vicksburg Buckshot Clay

CL—Lean clay, CL, 89 % fines, LL=33, PI=13, gray, soil had been air dried and pulverized. Local name—Annapolis Clay

ML—Silt, ML, 99 % fines, LL=27, PI=4, light brown, soil had been air dried and pulverized. Local name—Vicksburg Silt

SP—Poorly graded sand; SP, 20 % coarse sand, 48 % medium sand, 30 % fine sand, 2 % fines, yellowish brown. Local name—Frederick sand

11. Keywords

11.1 fines; particle sizes; sieve analysis; washing