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**Standard Method of Test for**

**Materials Finer Than 75- $\mu$ m  
(No. 200) Sieve in Mineral  
Aggregates by Washing**

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**AASHTO Designation: T 11-22<sup>1</sup>**

Technically Revised: 2022

**Technical Subcommittee: 1c, Aggregates**

**ASTM Designation: C117-13**



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## Standard Method of Test for

# Materials Finer Than 75- $\mu\text{m}$ (No. 200) Sieve in Mineral Aggregates by Washing

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## 1. SCOPE

- 1.1. This test method covers determination of the amount of material finer than a 75- $\mu\text{m}$  (No. 200) sieve in aggregate by washing. Clay particles and other aggregate particles that are dispersed by the wash water, as well as water-soluble materials, will be removed from the aggregate during the test.
- 1.2. Two procedures are included, one using only water for the washing operation, and the other including a wetting agent to assist the loosening of the material finer than the 75- $\mu\text{m}$  (No. 200) sieve from the coarser material. Unless otherwise specified, Procedure A (water only) shall be used.
- 1.3. The values stated in SI units are to be regarded as the standard.
- 1.4. *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to its use.*
- 1.5. *The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of R 18 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with R 18 alone does not completely assure reliable results. Reliable results depend on many factors; following the suggestions of R 18 or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.*

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## 2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
  - M 231, Weighing Devices Used in the Testing of Materials
  - M 339M/M 339, Thermometers Used in the Testing of Construction Materials
  - R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
  - R 76, Reducing Samples of Aggregate to Testing Size
  - R 90, Sampling Aggregate Products

- T 27, Sieve Analysis of Fine and Coarse Aggregates

2.2. *ASTM Standards:*

- C670, Standard Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
- E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
- E11, Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
- E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
- E2877, Standard Guide for Digital Contact Thermometers

2.3. *International Electrotechnical Commission Standard:*

- IEC 60584-1:2013, Thermocouples - Part 1: EMF Specifications and Tolerances

2.4. *Other Document:*

- NCHRP Research Results Digest 389, Precision Estimates of AASHTO T 304, AASHTO T 96, and AASHTO T 11 and Investigation of the Effect of Manual and Mechanical Methods of Washing on Sieve Analysis of Aggregates, Transportation Research Board, National Research Council, Washington, DC, 2014.

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### 3. SUMMARY OF METHOD

- 3.1. A sample of the aggregate is washed in a prescribed manner, using either plain water or water containing a wetting agent, as specified. The decanted wash water, containing suspended and dissolved material, is passed through a 75- $\mu\text{m}$  (No. 200) sieve. 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- $\mu\text{m}$  (No. 200) sieve by washing.

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### 4. SIGNIFICANCE AND USE

- 4.1. Material finer than the 75- $\mu\text{m}$  (No. 200) sieve can be separated from larger particles much more efficiently and completely by wet sieving than through the use of dry sieving. Therefore, when accurate determinations of material finer than 75  $\mu\text{m}$  in fine or coarse aggregate are desired, this test method is used on the sample prior to dry sieving in accordance with T 27. The results of this test method are included in the calculation in T 27, and the total amount of material finer than 75  $\mu\text{m}$  by washing, plus that obtained by dry sieving the same sample, is reported with the results of T 27. Usually the additional amount of material finer than 75  $\mu\text{m}$  obtained in the dry-sieving process is a small amount. If it is large, the efficiency of the washing operation should be checked. A large amount of material could also be an indication of the degradation of the aggregate.
- 4.2. Plain water is adequate to separate the material finer than 75  $\mu\text{m}$  from the coarser material in most aggregates. In some cases, the finer material is adhered to the larger particles, such as in some clay coatings and coatings on aggregates that have been extracted from bituminous mixtures. In these cases, the fine material will be separated more readily with a wetting agent in the water.

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### 5. APPARATUS AND MATERIALS

- 5.1. *Balance*—The balance shall have sufficient capacity, be readable to 0.1 percent of the sample mass or better, and conform to the requirements of M 231.

- 5.2. *Sieves*—A nest of two sieves, the lower being a 75- $\mu$ m (No. 200) sieve and the upper being a sieve with openings in the range of 2.36 mm (No. 8) to 1.18 mm (No. 16), both conforming to the requirement of ASTM E11.
- 5.3. *Container*—A pan or vessel of a size sufficient to contain the sample covered with water and to permit vigorous agitation without loss of any part of the sample or water.
- 5.4. *Oven*—An oven of sufficient size, capable of maintaining a uniform temperature of  $110 \pm 5^\circ\text{C}$  ( $230 \pm 9^\circ\text{F}$ ). Oven(s) for heating and drying shall be capable of operation at the temperatures required, between  $100$  to  $120^\circ\text{C}$  ( $212$  to  $248^\circ\text{F}$ ), within  $\pm 5^\circ\text{C}$  ( $\pm 9^\circ\text{F}$ ), as corrected, if necessary, by standardization. More than one oven may be used, provided each is used within its proper operating temperature range. The thermometer for measuring the temperature shall meet the requirements of M 339 with a temperature range of at least  $90$  to  $130^\circ\text{C}$  ( $194$  to  $266^\circ\text{F}$ ), and an accuracy of  $\pm 1.25^\circ\text{C}$  ( $\pm 2.25^\circ\text{F}$ ) (see Note 1).
- Note 1**—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E2877 digital metal stem thermometer; ASTM E230/E230M thermocouple thermometer, Type J or K, Special Class, Type T any Class; IEC 60584 thermocouple thermometer, Type J or K, Class 1, Type T any Class; or dial gauge metal stem (bi-metal) thermometer.
- 5.5. *Wetting Agent*—Any dispersing agent, such as liquid dishwashing detergents, that will promote separation of the fine materials.
- 5.6. *Mechanical Washing Apparatus (Optional)*—A mechanical apparatus that aids in the washing process.
- Note 2**—A sample shall not be washed for more than 10 minutes when using a mechanical washing apparatus. Wash intervals greater than 10 minutes have been shown to cause significant amounts of degradation depending upon aggregate type (NCHRP RR Digest 389).

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## 6. SAMPLING

- 6.1. Sample the aggregate in accordance with R 90. If the same test sample is to be tested for sieve analysis according to T 27, comply with the applicable requirements of that method.
- 6.2. Thoroughly mix the sample of aggregate to be tested and reduce the quantity to an amount suitable for testing using the applicable methods described in R 76. If the same test sample is to be tested according to T 27, the minimum mass shall be as described in the applicable sections of that method. Otherwise, the mass of the test sample, after drying, shall conform with the following:

Nominal Maximum Size	Minimum Mass, g
4.75 mm (No. 4) or smaller	300
9.5 mm ( $\frac{3}{8}$ in.)	1000
19.0 mm ( $\frac{3}{4}$ in.)	2500
37.5 mm ( $1\frac{1}{2}$ in.) or larger	5000

The test sample shall be the end result of the reduction. Reduction to an exact predetermined mass shall not be permitted. If the nominal maximum size of the aggregate to be tested is not listed above, the next larger size listed shall be used to determine sample size.

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## 7. SELECTION OF PROCEDURE

- 7.1. Procedure A shall be used, unless otherwise specified by the specification with which the test results are to be compared, or when directed by the agency for which the work is performed.

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## 8. PROCEDURE A—WASHING WITH PLAIN WATER

- 8.1. Dry the test sample to constant mass at a temperature of  $110 \pm 5^{\circ}\text{C}$  ( $230 \pm 9^{\circ}\text{F}$ ). Determine the mass to the nearest 0.1 percent of the mass of the test sample.
- 8.2. If the applicable specification requires that the amount passing the 75- $\mu\text{m}$  (No. 200) sieve shall be determined on a portion of the sample passing a sieve smaller than the nominal maximum size of the aggregate, separate the sample on the designated sieve and determine the mass of the material passing the designated sieve to 0.1 percent of the mass of this portion of the test sample. Use this mass as the original dry mass of the test sample in Section 10.1.
- Note 3**—Some specifications for aggregates with a nominal maximum size of 50 mm or greater, for example, provide a limit for material passing the 75- $\mu\text{m}$  (No. 200) sieve determined on that portion of the sample passing the 25.0-mm sieve. Such procedures are necessary because it is impractical to wash samples of the size required when the same test sample is to be used for sieve analysis by T 27.
- 8.3. After drying and determining the mass, place the test sample in the container and add sufficient water to cover it. No detergent, dispersing agent, or other substance shall be added to the water. Agitate the sample with sufficient vigor to result in complete separation of all particles finer than the 75- $\mu\text{m}$  (No. 200) sieve from the coarser particles, and to bring the fine material into suspension. The use of a large spoon or other similar tool to stir and agitate the aggregate in the wash water has been found satisfactory. Immediately pour the wash water containing the suspended and dissolved solids over the nested sieves, arranged with the coarser sieve on top. Take care to avoid, as much as feasible, the decantation of coarser particles of the sample.
- 8.4. Add a second charge of water to the sample in the container, agitate, and decant as before. Repeat this operation until the wash water is clear.
- Note 4**—If mechanical washing equipment is used, the charging of water, agitating, and decanting may be a continuous operation.
- Note 5**—A spray nozzle or a piece of rubber tubing attached to a water faucet may be used to rinse any of the material that may have fallen onto the sieves. The velocity of water, which may be increased by pinching the tubing or by use of a nozzle, should not be sufficient to cause any splashing of the sample over the sides of the sieve.
- 8.5. Return all material retained on the nested sieves by flushing into the container containing the washed sample. Dry the washed aggregate to constant mass at a temperature of  $110 \pm 5^{\circ}\text{C}$  ( $230 \pm 9^{\circ}\text{F}$ ) and determine the mass to the nearest 0.1 percent of the original mass of the sample.
- Note 6**—Following the washing of the sample and flushing any materials retained on the 75- $\mu\text{m}$  (No. 200) sieve back into the container, no water should be decanted from the container except through the 75- $\mu\text{m}$  sieve, to avoid loss of material. Excess water from flushing should be evaporated from the sample in the drying process.

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## 9. PROCEDURE B—WASHING USING A WETTING AGENT

- 9.1. Prepare the sample in the same manner as for Procedure A.
- 9.2. After drying and determining the mass, place the test sample in the container. Add sufficient water to cover the sample, and add wetting agent to the water (Note 7). Agitate the sample with sufficient vigor to result in complete separation of all particles finer than the 75- $\mu\text{m}$  (No. 200) sieve from the coarser particles, and to bring the fine material into suspension. The use of a large spoon or other similar tool to stir and agitate the aggregate in the wash water has been found satisfactory. Immediately pour the wash water containing the suspended and dissolved solids over

the nested sieves, arranged with the coarser sieve on top. Take care to avoid, as much as feasible, the decantation of coarser particles of the sample.

**Note 7**—There should be enough wetting agent to produce a small amount of suds when the sample is agitated. The quantity will depend on the hardness of the water and the quality of the detergent. Excessive suds may overflow the sieves and carry some material with them.

- 9.3. Add a second charge of water (without wetting agent) to the sample in the container, agitate, and decant as before. Repeat this operation until the wash water is clear.
- 9.4. Complete the test as for Procedure A.

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## 10. CALCULATION

- 10.1. Calculate the amount of material passing a 75- $\mu\text{m}$  (No. 200) sieve by washing as follows:

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

where:

- $A$  = percentage of material finer than a 75- $\mu\text{m}$  (No. 200) sieve by washing;  
 $B$  = original dry mass of sample, g; and  
 $C$  = dry mass of sample after washing, g.

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## 11. REPORT

- 11.1. Report the percentage of material finer than the 75- $\mu\text{m}$  (No. 200) sieve by washing to the nearest 0.1 percent, except if the result is 10 percent or more, report the percentage to the nearest whole number.
- 11.2. Include a statement as to which procedure was used.

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## 12. PRECISION AND BIAS

- 12.1. *Precision*—The estimates of precision of this test method listed in Table 1 are based on results from the AASHTO Materials Reference Laboratory Proficiency Sample Program, with testing conducted by this test method and ASTM C117. The significant differences between the methods at the time the data were acquired is that T 11 required, and ASTM C117 prohibited, the use of a wetting agent. The data are based on the analyses of more than 100 paired test results from 40 to 100 laboratories.

**Table 1**—Precision

	Standard Deviation (1s), <sup>a</sup> %	Acceptable Range of Two Results (d2s), <sup>a</sup> %
Coarse aggregate: <sup>b</sup>		
Single-operator precision	0.10	0.28
Multilaboratory precision	0.22	0.62
Fine aggregate: <sup>c</sup>		
Single-operator precision	0.15	0.43
Multilaboratory precision	0.29	0.82

<sup>a</sup> These numbers represent the (1s) and (d2s) limits as described in ASTM C670.

<sup>b</sup> Precision estimates are based on aggregates having a nominal maximum size of 19.0 mm (¾ in.) with less than 1.5 percent finer than the 75-µm (No. 200) sieve.

<sup>c</sup> Precision estimates are based on fine aggregates having 1.0 to 3.0 percent finer than the 75-µm (No. 200) sieve.

12.1.1. The precision values for fine aggregate in Table 1 are based on nominal 500-g test samples. Revision of this test method in 1996 permits the fine aggregate test sample size to be 300 g minimum. Analysis of results of testing of 300-g and 500-g test samples from Aggregate Proficiency Test Samples 99 and 100 (Samples 99 and 100 were essentially identical) produced the precision values in Table 2, which indicates only minor differences due to test sample size.

**Table 2**—Precision Data for 300-g and 500-g Test Samples

Fine Aggregate Proficiency Sample	Test Result	Sample Size	No. Labs	Avg	Within Laboratory		Between Laboratory	
					1s	d2s	1s	d2s
AASHTO T 11/ASTM C117 (Total material passing the No. 200 sieve by washing, %)		500 g	270	1.23	0.08	0.24	0.23	0.66
		300 g	264	1.20	0.10	0.29	0.24	0.68

**Note 8**—The values for fine aggregate in Table 1 will be revised to reflect the 300-g test sample size when a sufficient number of Aggregate Proficiency Tests have been conducted using that sample size to provide reliable data.

12.2. *Bias*—Because there is no accepted reference material suitable for determining the bias for the procedure in this test method, no statement on bias is made.

## 13. KEYWORDS

13.1. Aggregate; size analysis; wash loss; 75-µm (No. 200) sieve.

<sup>1</sup> Except for Sections 5.1 and 6.2, and Note 5, this test method is identical to ASTM C117-13.