Standard Method of Test for

Mechanical Analysis of Extracted Aggregate

AASHTO Designation: T 30-Proposed

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1. SCOPE

1.1. This method covers a procedure for the determination of the particle-size distribution of fine and coarse aggregates extracted from bituminous mixtures, using sieves with square openings.

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

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards*:

- M 92, Wire-Cloth Sieves for Testing Purposes
- M 231, Weighing Devices Used in the Testing of Materials
- T 164, Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
- T 308, Determining the Asphalt Binder Content of Hot-Mix Asphalt (HMA) by the Ignition Method
- T 255, Total Evaporable Moisture Content of Aggregate by Drying

2.2. *ASTM Standard*:

- C 670, Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials

3. SIGNIFICANCE AND USE

3.1. This method is used to determine the grading of aggregates extracted from bituminous mixtures. The results are used to determine compliance of the particle-size distribution with applicable specification requirements and to provide necessary data for control of the production of various aggregates to be used in bituminous mixtures.

4. APPARATUS

4.1. The apparatus shall consist of the following:

4.1.1. The balance shall have sufficient capacity, be readable to 0.1 percent of the sample mass or better, and conform to M 231.

4.2. *Sieves*—The sieve cloth shall be mounted on substantial frames constructed in a manner that will prevent loss of material during sieving. The sieve cloth and standard sieve frames shall conform to

the requirements of M 92. Nonstandard sieve frames shall conform to the requirements of M 92 as applicable.

4.3. *Mechanical Sieve Shaker*—A mechanical sieving device, if used, shall create motion of the sieves to cause the particles to bounce, tumble, or otherwise turn so as to present different orientations to the sieving surface. The sieving action shall be such that the criterion for adequacy of sieving described in Section 6.7 is met in a reasonable time period.

Note 1—Use of a mechanical sieve shaker is recommended when the size of the sample is 20 kg or greater, and may be used for smaller samples, including fine aggregate. Excessive time (more than approximately 10 minutes) to achieve adequate sieving may result in degradation of the sample. The same mechanical sieve shaker may not be practical for all sizes of samples, since the large sieving area needed for practical sieving of a large nominal size coarse aggregate very likely could result in loss of a portion of the sample if used for a smaller sample of coarse aggregate or fine aggregate.

4.4. *Oven*—An oven of sufficient size, capable of maintaining a uniform temperature of 110 ± 5ºC (230 ± 9ºF).

4.5. *Wetting Agent*—Any dispersing agent, such as Calgon, Joy, or other detergent, or a soap, that will promote separation of the fine materials.

4.6 Containers and utensils: 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. SAMPLE

5.1. The sample shall consist of the entire lot or sample of aggregate obtained according to T 164 or T 308 from which the binder has been extracted.

6. PROCEDURE

6.1. Sample

6.1.1 The sample shall be dried until further drying at 110 ± 5ºC (230 ± 9ºF) does not alter the mass by 0.1 percent , the precision of weighing. The total mass of aggregate in the asphalt mixture being tested is the sum of the mass of the dried aggregates and the mineral matter contained in the extracted asphalt. The latter is to be taken as the sum of the mass of ash in the extract and the increase in mass of the filter element as determined in T 164.

6.1.2 For the aggregate sample obtained from T 308, determine and record the mass of the sample to the nearest 0.1g. This mass shall agree with the mass of aggregate remaining after ignition (M_f from T 308) within 0.1 percent of M_f. If the variation falls outside the 0.1 percent, the results of this test should not be used for acceptance purposes.

6.2. The test sample, shall be placed in a container and covered with water. A detergent, dispersing agent, or other wetting solution may be added to the water to assure a thorough separation of the material finer than the 75 μm (No. 200) sieve from the coarser particles. 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. The contents of the container shall be agitated vigorously and the wash water immediately poured over a nest of two sieves consisting of a 2.00- or 1.18-mm (No. 10 or No. 16) sieve superimposed on a 75-μm (No. 200) sieve. The use of a large spoon to stir and agitate the aggregate in the wash water has been found satisfactory.

Note 1— The use of a mechanical apparatus to perform the washing operation is not precluded, providing the test results are consistent with those obtained using manual operations. The use of some mechanical washing equipment with some samples may cause degradation of the sample.

6.3. The agitation shall be sufficiently vigorous to result in the complete separation of all particles finer than the 75-μm (No. 200) sieve from the coarse particles and bring them into suspension in order that they may be removed by decantation of the wash water. Care should be taken to avoid, as much as possible, the decantation of the coarse particles of the sample. The operation shall be repeated until the wash water is clear.

6.4. All material retained on the nested sieves shall be returned to the container. The washed aggregate in the container shall be dried to constant mass per AASHTO T 255, and weighed to the nearest 0.1 percent.

6.5. The aggregate shall then be sieved over sieves of various sizes required by the specification covering the mixture, including the 75-μm (No. 200) sieve. Nest the sieves in order of decreasing size of opening from top to bottom and place the sample on the top sieve. Agitate the sieves by mechanical apparatus for a sufficient period, established by trial or checked by measurement on the actual test sample, to meet the criterion for adequacy of sieving described in Section 6.7.

6.6. Limit the quantity of material on a given sieve so that all particles have opportunity to reach sieve openings a number of times during the sieving operation. For sieves with openings smaller than 4.75 mm (No. 4), the mass retained on any sieve at the completion of the sieving operation shall not exceed 6 kg/m^2 (4 $g/in.^2$) of sieving surface. For sieves with openings 4.75 mm (No. 4) and larger, the mass in kg shall not exceed the product of 2.5 × (sieve opening in mm) × (the sieving surface area in m^2). In no case shall the mass be so great as to cause permanent deformation of the sieve cloth.

Note 2—The 7 kg/m^2 (4 $g/in.^2$) amounts to 200 g for the usual 203-mm (8-in.) diameter sieve. The amount of material retained on a sieve may be regulated by (1) the introduction of a sieve with larger openings immediately above the given sieve or (2) testing the sample in a number of increments.

6.7. Continue sieving for a sufficient period and in such manner that, after completion, not more than 0.5 percent by mass of the total sample passes any sieve during 60 seconds of continuous hand-sieving performed as follows: Hold the individual sieve, provided with a snug-fitting pan and cover, in a slightly inclined position in one hand. Strike the side of the sieve sharply and with an upward motion against the heel of the other hand at the rate of about 150 times per minute, turning the sieve about one-sixth of a revolution at intervals of about 25 strokes. In determining the adequacy of sieving for sizes larger than the 4.75-mm (No. 4) sieve, limit the material on the sieve to a single layer of particles. If the size of the mounted testing sieves makes the described sieving motion impractical, use 203-mm (8-in.) diameter sieves to verify the adequacy of sieving.

7. CALCULATIONS

7.1 The mass of material passing each sieve and retained on the next and the amount passing the 75-µm (No. 200) sieve shall be recorded. The summation of these various masses must check the dried mass after washing within 0.2 percent of the total mass. The mass of dry material passing the 75-µm (No. 200) sieve by dry sieving shall be added to the mass removed by washing, and if applicable the mass of mineral matter in the asphalt, in order to obtain the total passing the 75-µm (No. 200) sieve. The masses of fractions retained on the various sieves and the total passing the 75-µm (No. 200) sieve shall be converted to percentages by dividing each by the total mass of aggregate in the asphalt mixture from Section 6.1.

7.2 When an aggregate correction factor is required by T 308, the aggregate correction factor is applied prior to final rounding and reporting percentages.

7. 8. REPORT

7.1. 8.1 The results of the sieve analysis shall be reported as follows: (a) total percentages passing each sieve, or (b) total percentages retained on each sieve, or (c) percentages retained between consecutive sieves, depending upon the form of the specifications for the use of the material being tested. Percentages shall be reported to the nearest whole number except for the percentage passing the 75-µm (No. 200) sieve which shall be reported to the nearest 0.1 percent.

8. 9. PRECISION AND BIAS

8.1. *9.1 Precision*—The estimates of precision for this test method are listed in Table 1. The estimates are based on the results from the AASHTO Materials Reference Laboratory Proficiency Sample Program, with testing conducted by T 30. The data are based on the analyses of the test results from 47 to 190 laboratories that tested 17 pairs of proficiency test samples (Samples No. 1 through 34). The values in the table are given for different ranges of total percentage of aggregate passing a sieve.

Table 1—Precision

	Total Percentage of Material Passing a Sieve		Standard Deviation (1S) Percent[a]	Acceptable Range of Two Results—(D2S)[a] Percent
Extracted aggregate:[b]				
Single-operator	<100	≥95	0.49	1.4
Precision	<95	≥40	1.06	3.0
	<40	≥25	0.65	1.8
	<25	≥10	0.46	1.3
	<10	≥5	0.29	0.8
	<5	≥2	0.21	0.6
	<2	≥0	0.17	0.5
Multilaboratory	<100	≥95	0.57	1.6
Precision	<95	≥40	1.24	3.5
	<40	≥25	0.84	2.4
	<25	≥10	0.81	2.3
	<10	≥5	0.56	1.6
	<5	≥2	0.43	1.2
	<2	≥0	0.32	0.9

[a] These numbers represent, respectively, the (1S) and (D2S) limits described in ASTM C 670.

[b] The precision estimates are based on aggregates with nominal maximum sizes of 19.0 mm ($^3/_4$ in.) to 9.5 mm ($^3/_8$ in.).

8.2. *9.2 Bias*—This test method has no bias since the values determined can only be defined in terms of this test method.