

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES

AASHTO T 27

SCOPE

The sieve analysis, commonly known as the gradation test, is a basic essential test for all aggregate technicians. The sieve analysis determines the gradation (the distribution of aggregate particles, by size, within a given sample) in order to determine compliance with design, production control requirements, and verification specifications. The gradation data may be used to calculate relationships between various aggregate or aggregate blends, to check compliance with such blends, and to predict trends during production by plotting gradation curves graphically, to name just a few uses. Used in conjunction with other tests, the sieve analysis is a very good quality control and quality acceptance tool.

NOTE: Accurate determination of material passing the No. 200 (75 μm) sieve cannot be made with this test alone. This test is recommended to be used in conjunction with AASHTO T 11 to determine the amount of material finer than the No. 200 (75 μm) sieve.

SUMMARY OF TEST

A known weight of material, the amount being determined by the largest size of aggregate, is placed upon the top of a group of nested sieves (the top sieve has the largest screen openings and the screen opening sizes decrease with each sieve down to the bottom sieve which has the smallest opening size screen for the type of material specified) and shaken by mechanical means for a period of time. After shaking the material through the nested sieves, the material retained on each of the sieves is weighed.

The cumulative method requires that each sieve beginning at the top be placed in a previously weighed pan (known as the tare weight), weighed, the next sieve's contents added to the pan, and the total weighed. This is repeated until all sieves and the bottom pan have been added and weighed.

Apparatus

Balance, general purpose class G₂ (AASHTO M231).

Sieves, mounted on suitable frames, designed not to leak. Sieves shall conform to AASHTO M92.

Mechanical sieve shaker, if used, must provide a vertical or lateral and vertical motion to the sieve, causing the particles thereon to bounce and turn so as to present different orientations to the sieving surface. Sieve shakers must provide sieving thoroughness within a reasonable time.

Oven, capable of maintaining $230 \pm 9^{\circ}\text{F}$ ($110 \pm 5^{\circ}\text{C}$). When tests are performed in the field where ovens are not available, test samples may be dried in suitable containers over open flame or electric hot plates with sufficient stirring to prevent overheating.

Sample Preparation

Samples should be obtained in the field and reduced to test size in accordance with AASHTO T 248. Samples are dried to a constant weight in an oven set at $230 \pm 9^{\circ}\text{F}$ ($110 \pm 5^{\circ}\text{C}$), in an electric skillet, or over an open flame.

The original sample must be reduced to a test sample size which falls within the minimum and maximum weight in the following table.

WEIGHT OF TEST SAMPLE

AGGREGATE SIZE	MINIMUM	MAXIMUM
No.1	68,000 g	90,700 g
No.2	11,300 g	---
No.5, No. 8, and No. 91	6000 g	8000 g
No. 9	4000 g	6000 g
No. 11	2000 g	---
No. 12	1000 g	--
No.53	6000 g	8000 g
No.73	5000 g	---
B-Borrow: 1/2 in. (12.5 mm), 1 in. (25.0 mm), 1½ in. (37.5 mm), & 2 in. (50 mm)	4000 g	6 000 g
B-Borrow: No. 4 (4.75 mm) & No. 30 (600 µm)	300 g	---
Fine Aggregate	300 g	---

Procedure

1. Weigh the sample to the nearest 0.1 g by total weight of sample. This weight will be used to check for any loss of material after the sample has been graded. Select suitable sieve sizes in accordance with the specifications.
2. Nest the sieves in order of decreasing size from top to bottom and begin agitating and shaking the sample for a sufficient amount of time.

For coarse aggregate, the large tray shaker is most commonly used (Figure 1). This device provides a clamping mechanism which holds the sieve in place during agitation. Shakers of this make need to be run 5 minutes for size 9 or larger and 10 minutes for sizes smaller than size 9.

For fine aggregate, round 8" (203.2 mm) or 12" (304.8 mm) sieves are commonly used (Figure 2). These sieves are self-nesting and supported in a shaking mechanism at the top and bottom by a variety of clamping and/or holding mechanisms. Small shakers of this type require shaking times of 15 minutes to adequately grade the fine aggregate sample.



Figure 1
Large Tray Shaker



Figure 2
Small Sieve Shaker

NOTE: Every effort should be made to avoid overloading the sieves. AASHTO defines overloading large sieves as weight retained in excess of 2.5 times the sieve opening in in. (mm), as expressed in gm/in.^2 (kg/m^2). For fine aggregate, no weight shall be in excess of 4 gm/in.^2 (7 kg/m^2).

3. Coarse Aggregates

After the material has been sieved, remove each tray, weigh each size, and record each weight to the nearest 0.1 g. Be sure to remove any aggregate trapped within the sieve openings by gently working from either or both sides with a trowel or piece of flat metal until the aggregate is freed. Banging the sieve on the floor or hitting the sieve with a hammer will damage the sieve. The final total of the weights retained on each sieve should be within 0.3% of the original weight of the sample prior to grading. Particles larger than 3 in. (75 mm) should be hand-sieved. When passing large stones through sieves, do not force the aggregate through the sieve openings.

4. Fine Aggregates

Weigh the material retained on each sieve size to the nearest 0.1 g. Ensure that all material entrapped within the openings of the sieve are cleaned out and included in the weight retained. This may be done using brushes to gently dislodge entrapped materials. The 8 in. (203 mm) or 12 in. (304.8 mm) round sieves need to be handled with special care due to the delicate nature of their screen sizes. As a general rule, use coarse wire brushes to clean the sieves down through the No. 50 (300 μm) sieve (Figure 3). Any sieve with an opening size smaller than the No. 50 (300 μm) should be cleaned with a softer cloth hair brush (Figure 4). The final total of the weights retained on each sieve should be within 0.3% of the original weight of the sample prior to grading.



Figure 3
Use Wire brush on Coarse Sieve



Figure 4
Use Hair Brush on Fine Sieves