

State of Nevada  
Department of Transportation  
Materials Division

**METHOD OF TEST FOR SIEVE ANALYSIS OF  
COARSE AND FINE AGGREGATE**

**SCOPE**

This test method, which is a modification of AASHTO Designation T 27 and T 11, covers the procedures for washing and sieving used for the determination of the particle size distribution of coarse and fine aggregate samples, including Base Aggregates, Aggregates for Bituminous Courses, Concrete Aggregates, and other selected materials. As used herein, the term "coarse aggregate" refers to material retained on the 4.75 mm sieve, and the term "fine aggregate" refers to material passing the 4.75 mm sieve.

**A. APPARATUS**

1. A balance or scale sensitive to within 0.2 percent of the weight of the sample to be tested. Normally, fine aggregate samples are weighed to the nearest gram, and coarse aggregate samples to the nearest gram.
2. Sieves. The testing sieves shall be of the woven-wire type with square openings, and shall conform to the Standard Specifications for Sieves for Testing Purposes, AASHTO Designation M 92.
3. An oven or other controllable heating device.
4. Hand washing vessel. A pan or container of a size sufficient to contain the sample covered with water and to permit vigorous agitation without loss of any material.

**B. TEST RECORD FORM**

Record the test data on the appropriate work sheet. A sample work sheet in common use is shown in Figures 1 & 2.

**C. PREPARATION OF TEST SAMPLES**

1. Obtain the test sample from the material submitted by the use of a sample splitter or by the method of hand quartering as outlined in Test Method Nev. T 203. Fine aggregate shall be thoroughly mixed in a moist condition before splitting or quartering. The sample for test shall be the end result of the sampling method. Samples shall weigh, after drying, not less than the amount indicated in Table 1. The selection of samples of an exact predetermined weight shall not be attempted.
2. Dry the test sample to constant weight at a temperature not exceeding 110°C.
3. Weigh the test sample on a scale or balance conforming to the requirements specified in Section A, "Apparatus", and record on the appropriate work sheet.

**TABLE 1**

**Test Sample Size**

Aggregate Size <sup>1</sup>	Minimum Dry Weight <sup>2</sup> Grams
	At the discretion of the Engr.
100 ± 3.0 mm	30 000
90 ± 2.7 mm	25 000
75 ± 2.2 mm	20 000
63 ± 1.9 mm	15 000
50 ± 1.5 mm	9000
38.1 ± 1.1 mm	3000
25 ± 0.8 mm	2500
19 ± 0.6 mm	1500
12.5 ± 0.5 mm	1000
9.5 ± 0.375 mm	500
4.75 mm	250
2.36 mm	

<sup>1</sup>For purposes of this test method, "Aggregate Size" is defined to be the smallest sieve which will pass at least 90 percent of the sample.

<sup>2</sup>Samples weighing 3000 grams or more shall be sieved through 40.640 x 10<sup>-2</sup>m or larger diameter sieves, at least to reduce the sample aggregate down to a size that can be tested with 203.2 mm

diameter sieves. If this procedure is used, a combined sieve determination is made (refer to F.3.). The testing sieve frames may be square, round or rectangular, provided that not less than  $1290.2 \times 10^{-2} \text{m}$  of sieving area is exposed.

**D. WASH TEST PROCEDURE**

1. Perform the wash test on all samples except as follows:

Samples containing large portions of plus  $25 \pm 0.8 \text{ mm}$  aggregate may first be dry sieved over the required coarse aggregate sieve sizes down to the  $9.5 \pm 0.375 \text{ mm}$  or  $4.75 \text{ mm}$  sieve. The portion passing the  $9.5 \pm 0.375 \text{ mm}$  or  $4.75 \text{ mm}$  sieve is then split down to a representative sample of the required size (Table 1) and the wash test performed on this smaller sample.

In case of dispute, however, the wash test shall be performed on the entire sample prior to making the sieve test.

2. Place the dried and weighed wash test sample in a container or containers and cover with water. If desired, a small amount of wetting agent may be added to assure a thorough separation of the finer aggregate particles from the coarser particles.
3. Agitate the contents of the container vigorously and immediately pour the wash water over a nest of two sieves consisting of a  $2.36 \text{ mm}$  or  $1.18 \text{ mm}$  sieve on top and a  $75 \text{ micron}$  sieve on the bottom.

The agitation should be sufficiently vigorous to result in the complete separation from the coarse particles of all particles finer than the  $75 \text{ micron}$  sieve and bring the fine material into suspension, in order that it will be removed by decantation of the wash water. Care shall be taken to avoid, as much as possible, the decantation of the coarse particles of the sample.

In order to remove all coatings and disperse all lumps, it may sometimes be necessary to scrub individual aggregate particles with a stiff fiber brush, and to rub soil lumps against sides and bottom of vessel. the use of a spoon or rod to stir and agitate the aggregate in the washing container has also been found satisfactory.

Repeat the agitation/decantation procedure until the wash water is clear.

4. Wash the fine material retained on the nested sieves with a gentle stream of running water. Check the cleanness of the soil retained on the 75 micron sieve by rubbing small amounts between the thumb and fingers. **DO NOT RUB THE SOIL OVER THE SURFACE OF THE 75 MICRON SIEVE.** Continue until the wash water runs clear.
5. Rinse the material retained on the nested sieves, plus the material remaining in the washing vessel, into a wide shallow pan. Pour the excess surface water back over the 75 micron sieve, and dry both the washed sample and the 75 micron sieve to constant weight at a temperature not exceeding 110°C.
6. Return any dry material retained on the 75 micron sieve to the washed and dried sample. Weigh the entire sample and record as "Washed Weight".
7. The amount of material removed from the sample by washing is found by subtracting the "washed weight" from the total dry weight of the test sample prior to washing, or from the "adjusted dry weight" as per the note in section F.1. The amount removed ("wash") will be combined with the weight passing the 75 micron sieve by dry sieving to give the total amount of material finer than the 75 micron sieve.

#### **E. SIEVE TEST PROCEDURE**

1. Make the sieve analysis on either the oven dried and cooled sample residue from the washing procedure, or the oven dried and cooled sample of material to be sieved without prior washing. See paragraph D.1. above.
2. Separate the sample into a series of sizes, using such sieves as are necessary to determine compliance with the specifications for the material under test. Either hand sieving or mechanical sieving may be used.
  - (a) Hand sieving - Perform the hand method of sieving by means of a lateral and vertical motion of the sieve, accompanied by a jarring action so as to keep the sample moving continuously over the surface of the surface of the sieve. In no case

shall fragments in the sample be forced through the sieve by hand. Sieving shall be continued until not more than one percent by weight of the residue passes any sieve during one of continuous shaking. For coarse aggregate, the thoroughness of sieving shall be determined with a single layer of material on the sieve.

- (b) Mechanical sieving - Perform mechanical sieving on an approved mechanical shaker which gives the same type of shaking action described in (a) "Hand Sieving". Normally, shaking time is three to five minutes for coarse aggregate samples, and ten minutes for combined (coarse and fines) or fine aggregate samples. Sieving time and thoroughness of mechanical sieving shall be tested periodically by the above described hand sieving method.
3. When sieving coarse aggregate samples without prior washing, brush the larger aggregate particles with a stiff bristle brush to remove coatings, and break up soil lumps, taking care not to lose the fine particles thus obtained.
4. When sieving fine aggregate (passing 4.75 m sieve), in no case shall the fraction retained on any sieve at the completion of the sieving operation weigh more than 4 grams per 25.4 mm<sup>2</sup> of sieving surface. This amounts to 200 grams for the usual 20.32 x 10<sup>-2</sup>m diameter sieve. To reduce the amount of material retained on the critical sieve, either use an additional sieve with openings slightly larger than the openings in the critical sieve, or split the entire sample into smaller portions, prior to sieving, and then combine respective fractions after sieving.
5. After sieving, weigh the material passing each sieve and retained on the next, and the amount passing the 75 micron sieve (pan) for fine aggregate samples, on the same scale or balance used to weigh the total sample prior to sieving, and record these weights on the work sheet. The summation of these various weights must check with the weight before sieving within 1 gram for fine aggregate or within 45 g for coarse aggregate.
6. Add the amount passing the 75 micron sieve by dry sieving to the amount removed by washing to give the total amount passing the 75 micron sieve.

**F. CALCULATIONS**

1. Convert the weights of fractions retained on the various sieves and the total passing the 75 micron sieve to percentages by the following formula:

$$P_r = \frac{100W_r}{W_t}$$

Where:

$P_r$  = Percentage retained on each sieve (or percentage passing 75 micron sieve).

$W_r$  = Weight retained on each sieve (or total amount passing 75 micron sieve).

$W_t$  = Total weight of test sample (dry) prior to washing and sieving.

Make all calculations to the nearest 0.1 percent. The sum of the percentages retained on all sieves plus the percentage passing the 75 micron sieve must equal 100.0 percent.

**\*NOTE:** If the sieve analysis test is being performed on aggregates for bituminous mixes that have had mineral filler added, " $W_t$ " shall first be adjusted by that amount before " $P_r$ " is calculated for each sieve as follows:

$$"W_t" \text{ (adjusted)} = \frac{W_t}{1 + (\text{Decimal equiv. of percent mineral filler})}$$

If, due to this adjustment, " $W_t$ " (adjusted) is less than or equal to the dry weight total after washing, the "wash" section of the "weight retained" column of form 040-013 (Field Material Sieve Test) shall be reported as "0".

2. Calculate the percent passing each sieve by one of the following methods:
  - a. Method 1: Add the percentage passing the 75 micron sieve to the percentage retained on the 75 micron sieve to give the percentage passing the next larger sieve. continue in this manner for each

sieve until the largest size is reached, at which time the percentage passing should be 100.0 percent.

- b. Method 2: Starting with the largest sieve size used, subtract the percent retained on that sieve from 100 percent to give the total percent passing that sieve. Then subtract the percentage retained on the next smaller sieve from the figure just obtained to give the total percent passing the second sieve. continue in this manner until the minus 75 micron is reached, at which time the percent passing should be 0.0 percent.
3. If a coarse aggregate sample has been separated into two sizes for testing (see paragraph D.1.), compute the combined grading as follows:
- a. Compute the individual grading of each size separately following the procedures outlined in paragraphs F.1. and F.2. above. this will give the percent passing each sieve in both the coarse and fine portions of the sample.
  - b. Compute the percentage represented by each size, based on the total weight of the sample.

Example:

<u>Fraction</u>	<u>Size</u>		<u>Weight</u>	
	<u>Pass</u>	<u>Retained</u>	<u>Kilograms</u>	<u>Percentage</u>
Coarse	50 ± 1.5mm	9.5 ± 0.375mm	9.25 kg	49.5
<u>Fine</u>	9.5 ± 0.375mm	<u>0</u>	9.43 kg	<u>50.5</u>
Total	50 ± 1.5mm	0	18.69 kg	100.0

- c. Taking the coarse and fine sizes separately, multiply the percentage of that size by the percent passing each sieve.
- d. Add the products thus obtained on corresponding sieves. These sums constitute the overall grading on the combined sample.
- e. See Figure 2 for a sample work sheet involving the above calculations.

**G. PRECAUTIONS**

1. Proper care of the sieves is necessary for accurate sieving. Use the following procedure in removing particles stuck in the mesh of the fine aggregate sieves:
  - a. No's. 4.75 mm, 2.36 mm and 1.18 mm sieves. Clean by brushing with a brass or steel wire brush. A rounded piece of wood, such as a brush handle, can be used if the hand is placed on the opposite side when pushing against the sieve in order to avoid stretching the sieve out of shape.
  - b. No's. 600 micron and 425 micron, and 300 micron sieves. Clean by brushing with a stiff short bristle brush such as a brass wire brush.
  - c. No's. 150 micron and 75 micron sieves. Clean only by brushing with a small paint brush. these sieves are easily damaged.
  - d. Do not use a sharp object to push out particles which are stuck in the mesh of the sieves because this will result in enlarging the openings.
2. Examine sieves each day for broken wires, and solder any breaks. This soldering decreases effective sieving area; therefore sieves with large breaks or several small breaks should be discarded.
3. Check all sieves from 4.75 mm through 75 micron periodically, with a standard sample of known grading made up from hard, clean aggregate that does not degrade from repeated sieve shaking procedure. this is especially useful for checking No's. 150 micron and 75 micron sieves, as small breaks and distortions are easily missed in these fine mesh sieves.
4. Never sieve hot sample, as hot aggregate will distort the fine meshes of the No's 150 micron and 75 micron sieves.
5. Take care to avoid loss of material during transfer of sample from washing container to nested sieves and also during rinsing.
6. Never allow any sieve to come into direct contact with hot drying device.



**H. REPORTING OF RESULTS**

Report the total percentages passing each sieve on the appropriate report form. Percentages shall be reported to the nearest whole number on the cover sheet (0.1% on the worksheet).