

ND T 27 – SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES

Conduct this procedure according to ND T 27.

The AASHTO standard test procedure reports the percentage of material finer than the No. 200 sieve to the nearest 0.1%; except if the result is 10% or more, than report to the nearest whole number. The NDDOT modification is for accuracy and reports to the same significant digit as specified in the specifications for the class of aggregate.

Consult the current edition of AASHTO for procedure in its entirety and equipment specification details.

SCOPE

This test method determines the particle size distribution of fine and coarse aggregates by sieving. The No. 4 sieve is designated as the division between the fine and coarse aggregate.

REFERENCED DOCUMENTS

ND T 2 and AASHTO T 2, Sampling Aggregates
ND T 11 and AASHTO T 11, Materials Finer than No. 200 (75 μ m) Sieve in Mineral Aggregates by Washing
AASHTO T 27, Sieve Analysis of Fine and Coarse Aggregates
ND T 89 and AASHTO T 89, Determining the Liquid Limit of Soils
ND T 90 and AASHTO T 90, Determining the Plastic Limit and Plasticity Index of Soils
ND T 248 and AASHTO T 248, Reducing Samples of Aggregate to Testing Size
ND T 255 and AASHTO T 255, Total Evaporable Moisture Content of Aggregate by Drying

APPARATUS

Balance
Sieves: 8" round, 12" round, or 14" square
Mechanical sieve shaker
Oven
Bronze brush
Paint brush, approximately 1" wide
Sample splitters, small and large
Mortar and rubber tipped pestle
Spoons
Large pans required for drying and handling sample

TEST SPECIMEN

Obtain sample according to ND T 2. Thoroughly mix and reduce according to ND T 248.

PROCEDURE

Use SFN 9987 or SFN 2455 to record all information. All weights are recorded to the nearest 0.1 g.

Dry the sample according to ND T 255 at a temperature of $230 \pm 9^{\circ}\text{F}$ ($110 \pm 5^{\circ}\text{C}$).

Select sieves to furnish the information required by the specifications covering the material to be tested. Use of additional sieves may be desirable to prevent the required sieves from becoming overloaded.

At the completion of the sieving operation, the quantity retained on any sieve with openings smaller than the No. 4 sieve shall not exceed 4 g/sq.in. of sieving surface area. If this occurs it is considered overloading of the sieve. The overload amount for an 8" diameter sieve is 200 g.

At the completion of the sieving operation, the quantity retained on any sieve with openings of No. 4 and larger shall not exceed 2.5 times sieve opening times effective sieve area. If this occurs, it is considered overloading of the sieve. The following table shows the maximum amount of material to be retained on a sieve before being considered overloaded.

Maximum Allowable Quantity Of Material Retained*		
Sieve Opening Size	8" Diameter Sieve	14" Square Sieve
2" (50 mm)	7.9 lbs (3.6 kg)	33.7 lbs (15.3 kg)
1½" (37.5 mm)	6.0 lbs (2.7 kg)	25.4 lbs (11.5 kg)
1" (25.0 mm)	4.0 lbs (1.8 kg)	17.0 lbs (7.7 kg)
¾" (19.0 mm)	3.1 lbs (1.4 kg)	12.8 lbs (5.8 kg)
½" (12.5 mm)	2.0 lbs (0.89 kg)	8.4 lbs (3.8 kg)
⅜" (9.5 mm)	1.5 lbs (0.67 kg)	6.4 lbs (2.9 kg)
No. 4 (4.75 mm)	0.7 lbs (0.33 kg)	3.3 lbs (1.5 kg)

**Table 1 of the current AASHTO T 27 standard shows a complete table of different size sieves of the maximum allowable quantities of material retained on a sieve.*

Preventing overloading of material on an individual sieve can be accomplished by one of the following methods:

- Insert an additional sieve with opening size intermediate between the sieve that may be overloaded and the sieve immediately above that sieve.
- Split the sample into two or more portions, sieve each portion individually and combine the portions retained on the sieve before calculating the percentage of the sample on the sieve.
- Use sieves having a larger frame size and providing a greater sieving area.

The portion finer than the No. 4 sieve may be reduced using a mechanical splitter.

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 hand or by mechanical apparatus until meeting the criteria for adequacy of sieving.

When using a mechanical shaker, place the sample in the stack of sieves and shake until not more than 0.5% by weight of the total sample passes any sieve during one minute. Approximately 10 minutes will be sufficient for most material. Use manual shaking of the material on any one sieve to check on the thoroughness of sieving by any mechanical shaker.

Remove the top sieve, brush the retained material into a pan, weigh and record. Be sure to thoroughly clean each sieve. Repeat this process with each succeeding sieve, brushing the material into individual pans, and record the non-cumulative weights.

CALCULATIONS

Add the non-cumulative weight retained on the largest sieve to the weight retained on the next smallest sieve and record in the cumulative column.

Calculate the percent retained on each sieve by dividing each weight by the original total dry weight and multiplying by 100. This is the percent retained. Subtract each of these values from 100 to obtain the percent passing each sieve. Continue this process for each sieve. The equations are as follows:

$$\% \text{ retained on sieve} = (\text{Cumulative weight} / \text{Total weight}) \times 100$$

$$\% \text{ passing} = 100 - \% \text{ retained on sieve}$$

This calculation is completed for both the coarse and fine aggregate.

If an accurate determination of the amount of material passing the No. 200 was accomplished by performing ND T 11, subtract the weight after wash from the original weight and record as wash loss.

Add together the cumulative weight retained on the No. 200, the weight of the Minus No. 200 material, and the wash loss, and record as the weight check.

To calculate the percent passing of the total sample for the fine portion of the aggregate, multiply the percent passing the No. 4 times the percent passing on each individual sieve in the fine aggregate portion and divide by 100.

The equation is as follows:

$$\% \text{ total sample} = [(\% \text{ passing No.4}) \times (\% \text{ passing smaller sieve})]/100$$

Final calculations of percentages passing are reported to the nearest whole number with the exception of the No. 200, which is reported to same significant digit as specified by the specification for the class of aggregate.

For both the Plus No. 4 and Minus No. 4, compare the original weight to the weight check. Subtract the smaller value from the larger value, divide the result by the original weight, and multiply by 100, to obtain the percent difference. For acceptance purposes, the two must not differ by more than 0.3%.

NOTES

Accurate determination of material finer than the No. 200 sieve cannot be achieved by using this method alone. Test method ND T 11 for material finer than the No. 200 sieve by washing should be employed.

Sieves mounted in frames larger than standard 8" diameter are used for testing coarse aggregate to reduce the possibility of overloading the sieves.

When working with mixed materials that are coated, lumpy, or baked together, the material must be pulverized enough to separate the particles and remove the coating as much as possible. The idea is to pulverize enough to separate most of the particles, without breaking up any appreciable amount of individual material particles.

In brushing the material out of the sieves, use the bronze brush for approximately the No. 30 sieve and coarser, and the paintbrush for the finer sieves. Tapping the sieves lightly with a stick of wood on the retaining ring to facilitate removal of the particles is acceptable. Do not attempt to completely remove all the particles, but examine each sieve visually before and after sieving. The amount of aggregate particles stuck in the mesh must appear to remain approximately the same for accurate results.

Examine the sieves constantly for damage, which will affect the test results. A common occurrence is the separation of the mesh from the side of the sieve, especially in the finer sieves. Hold the sieves up to a light to inspect for damages.

Dry the sample according to ND T 255 using an oven at a temperature of $230 \pm 9^{\circ}\text{F}$ ($110 \pm 5^{\circ}\text{C}$). If the sample is used to determine ND T 89 for liquid limit, and ND T 90 for plastic limit, the sample must be dried using an oven at a temperature of 140°F (60°C).

CALIBRATION

A calibration check of the equipment should be performed annually as a minimum, or whenever damage or repair occurs.