

1203**FINE AGGREGATE SIEVE ANALYSIS**

AASHTO Designation T 27 (MN/DOT Modified)
AASHTO Designation T 30 (For Bituminous Mixtures)

1203.1 General

This method of test covers a procedure for the determination of the particle size distribution of granular materials using sieves with square openings. It can be adapted for use in the sieve analysis of aggregate recovered from bituminous mixtures (See Section 1203.5); but, cannot be used for the sieve analysis of mineral fillers.

1203.2 Apparatus

- A.** Balance - Shall conform to AASHTO M 231 (Class G2).
Readability & sensitivity = 0.1 grams, accuracy = 0.1 grams or 0.1%.
- B.** Sieves - Standard 200 or 300mm (8" or 12") round sieves with square openings shall be used and the woven wire cloth shall conform to AASHTO M 92. Suitable sieve sizes shall be selected to furnish the information required by the specifications covering the material to be tested. **See Section 1203.7, Table 1 for sieve nests to use for various materials.**
- C.** Shaker (Mechanical) - Shall be equipped with a device that locks the screens in place. The shaker shall impart a vertical, or lateral and vertical motion to the sieve(s), causing the particles thereon to bounce and turn so as to present different orientations to the sieving surface. Also, it shall be equipped with a timer capable of turning off the shaker after a required time limit has been achieved. Other mechanical shakers are acceptable so long as the equipment provides a result in which not more than 0.5 percent by weight of total sample passes any sieve during one minute of hand sieving.
- D.** Oven - The oven shall be capable of maintaining a uniform temperature of 110 ± 5 °C (230 ± 9 °F).
- E.** Miscellaneous - Necessary bowls, pans, spatulas etc.; including a 75µm (#200) sieve for washing the entire minus 4.75mm (#4) material.
- F.** Sample Splitter - Shall conform to AASHTO T 248. **See Section 1002 for requirements and procedure.**
- G.** Mechanical Washer (Optional)- Conforming to AASHTO T30

1203.3 Procedure

- A.** Upon completion of the coarse gradation (when there is plus 4.75mm [#4] material) the material passing the 4.75mm (#4) sieve and retained on the bottom pan of the shaker is weighed, it is then split down to between 450 and 600 grams using a sample splitter. The entire sample of minus 4.75mm (#4) material is

uniformly distributed over the splitter from edge to edge, so that when it is introduced into the chutes approximately equal amounts will flow through each chute. Reintroduce the portion of the sample in one of the receptacles into the splitter as many times as necessary to reduce the sample to the size specified for the intended test, each time alternating the receptacles. The portion of the material left over after splitting may be used for other tests required. If no other tests are required the material shall be placed into a container properly marked with the laboratory number and saved for future testing or in case of a failure. **See Section 1003 for Lab-Field Tolerance Procedures.**

Note 1: Do not attempt to obtain an exact, predetermined weight for any sample that is to be sieved.

- B.** After sample has been split and dried in the oven at 110 ± 5 °C (230 ± 9 °F) to a constant weight, the sample shall be cooled to room temperature and weighed (including pan) to 0.1 gram. Record that weight on the gradation work sheet under "Pan & Sample Before Washing". After weighing the sample is then washed in the same pan over the 75 μ m (#200) sieve by adding water to the sample, stirring the sample with a spoon or spatula and pouring the cloudy water on to the 75 μ m (#200) sieve being careful not to lose any of the material or allow the 75 μ m (#200) sieve to overflow. Repeat this procedure until the water is fairly clean. Turn the sieve over and wash the material back into the pan being careful not to lose any of the material. Then let stand until fines have settled out of the water. Carefully pour off excess water, again being careful not to lose any material. Place in an oven at 110 ± 5 °C (230 ± 9 °F) and dry to a constant weight.

Note 2: Any mechanical washing device may be utilized provided the device provides comparable results. Devices should be evaluated using a wide range of aggregate types.

Note 3: To help prevent plugging the 75 μ m (# 200) sieve pre-wet it. This will also assist in washing the minus 75 μ m (# 200) material through it.

Note 4: Protect the 75 μ m (# 200) sieve by placing a 2.36 - 1.18mm (#8 - #16) sieve on top of it.

- C.** When sample is dry remove from oven, cool to room temperature, weigh pan & sample to the nearest 0.1 gram and record on work sheet under "Pan & Sample After Washing".

Note 5: Do not sieve hot samples. Hot aggregate will distort the mesh of the finer sieves.

- D.** Pour entire sample into a nested set of 200 or 300mm (8" or 12") round sieves. (Use sieve sizes required by specifications for the type of material being tested - Refer to Section 1203 Table 1.) Place the sieve nest in the shaker and sieve until no more than 0.5% by weight of total sample passes any individual sieve during one minute of shaking.

Note 6: Shaking time shall be determined for each mechanical shaker by a calibration procedure. For information purposes only, using the existing Mn/DOT Central Laboratory equipment: (the “Maryann”) satisfactory results can be obtained by sieving for a minimum of 7 minutes and the “Ro-Tap” satisfactory results can be obtained by sieving for a minimum of 7 minutes.

- E.** After sieving has been completed, remove each sieve from top to bottom, weigh and record the material retained on each sieve (to the nearest 0.1 gram) on the work sheet under the correct sieve size. Also, weigh and record the material in the bottom pan and the pan weight (both to the nearest 0.1 gram). After all weights have been recorded, add all the weights including the loss by washing, the total weight **must check with the original dry weight within $\pm 0.3\%$** . If not the sample shall be re-sieved and each individual sieve re-weighed. In no case; however, shall the fraction retained on any sieve at the completion of the sieving operation weigh more than 200 grams (200mm [8"] sieves) or 450 grams (300mm [12"] sieves). This can be regulated by the introduction of a sieve having a larger opening placed above the critical sieve.

Note 7: The material retained on the bottom or pan should not be greater than 10 percent of the total amount passing the 75 μ m (#200) sieve. If it is the sample should have been washed more thoroughly. This is not a requirement, but a very good practice.

Note 8: Removing particles stuck in the mesh of the sieve can be accomplished by the following procedures: (1) For the 425 μ m (#40) sieve and coarser, clean by brushing with a brass wire brush. (2) For sieves finer than the 425 μ m (#40), clean by brushing with small paint brush. Finer sieves are easily damaged.

Do not use a sharp object to remove particles stuck in the mesh. This can result in oversize openings making the sieve unacceptable.

1203.4 Calculations

$$\% \text{ Passing} = \frac{\text{Total Weight of Material Passing a Particular Sieve}}{\text{Total of Weights Retained on All Sieves Plus Bottom Pan Plus Loss by Washing}} \times 100$$

When the fine gradation represents only a part of the total sample the percentages using the above calculation shall be corrected by multiplying the % passing each fine sieve by the % passing the final sieve used in the coarse gradation test (Typically the 4.75mm (#4) sieve.).

Note 9: This establishes the relationship of the fine sieve portion to the total sample.

1203.5 Modifications Adapting this Procedure for Use in Grading Chemically Extracted or Ignition Burned Bituminous Mixture (BM) Samples [Based on AASHTO T 30 (Mn/DOT Modified)]

- A.** Round sieves, 300mm (12") in diameter conforming to the sieve nest listed in 1203.7, Table 1 should be used.

- B. Section 1203.3A is irrelevant as all the material provided from the extraction process is graded.
- C. In Section 1203.3B it is not necessary to dry the sample prior to washing over the 75 μ m (#200) sieve as the material is dried to a constant weight as the final step in the extraction procedure.
- D. After drying and determining the weight add sufficient water to cover the sample.
- E. Add a wetting agent such as Alconox (5 – 10 grams) and stir to disperse fines.

Note 10: The amount of wetting agent used should produce a small amount of suds. Excessive suds may overflow the sieves and cause loss of material.

- F. For Chemically Extracted samples allow the sample to sit for a minimum of 30 minutes before washing over the 75 μ m (#200) sieve. For Ignition Burned samples the 30 min. soaking period is not required but it can be used to improve the washing efficiency stated in note 7.
- G. See 1203.8 ANNEX for Mechanical Washing Procedure.

- H. The use of a filtering aid, such as Celite, in the extraction process must be accounted for in the gradation results. A known weight and gradation of the filtering aid is added to the sample prior to extraction. From this the weight of the filtering aid can be calculated for each applicable sieve. The total weight of filtering aid is subtracted from the initial dry weight of the sample and the calculated weights of the filtering aid on each applicable sieve are subtracted from those sieves prior to performing the calculations.

Note 11: There is no Celite used with the ignition burns.

Note 12: It has been found useful to sieve the filtering aid (Celite) through the 75 μ m (#200) sieve prior to use and then use only that portion of the filtering aid that passes the 75 μ m (#200) sieve. This means that the only weight corrections needed are to that sieve and the initial dry weight.

- I. In Section 1203.4 (Calculations) the aggregate remaining in the filter during the chemical extraction process must be accounted for in the gradation results. This weight must be added to the total sample weight and also considered as material passing the 75 μ m (#200) sieve.

1203.6 Modifications to this Procedure for Use in Grading Aggregate Samples Containing Salvaged Asphalt Pavement

- A. Use the "matched sample" method described in Section 5-692.215 of the Grading and Base Manual. Select a second representative sample of equal weight and moisture content to the first sample. Dry this sample and record the weight. Wash and dry the first sample as described below.

- B.** Soak the sample to be washed for 15 (\pm 5) minutes in a detergent and water solution at temperature not to exceed 40°C (100°F). The solution should not contain more than 1 gram of concentrated liquid dish washing detergent per liter (1/4 teaspoon per quart) of water. The sample should be gently stirred at the beginning of and at least once during the soaking period.

Note 13: The concentration of the detergent/dispersant shall not be so harsh as to break down the film of asphalt on the particles of salvaged asphalt pavement.

- C.** Wash the sample through the 75 μ m (#200) sieve as above or in accordance with Grading and Base Manual Section 5-692.215.

Note 14: Samples containing salvaged asphalt pavement are susceptible to degradation of the particles. Hand washing is the preferred method for these samples. However, if a mechanical washing device is to be used, a time limit of five minutes should be employed.

- D.** Dry the sample in accordance with the following method:
1. In an oven at a temperature not to exceed 60 °C (140 °F) overnight.
- E.** Sieve the sample in accordance with established procedures.

1203.7

Table 1 – Sieve Nests to Use for Various Materials

SA	GS & PS	BA (Spec. 2360) & CA	BM (Spec. 2360)
			37.5mm (1 1/2")
			25.0mm (1")
			19.0mm (3/4")
			16.0mm (5/8")
12.5mm (1/2")			12.5mm (1/2")
9.5mm (3/8")	9.5mm (3/8")	9.5mm (3/8")	9.5mm (3/8")
4.75mm (#4)	4.75mm (#4)	4.75mm (#4)	4.75mm (#4)
3.35mm (#6)	2.00mm (#10)	2.36mm (#8)	2.36mm (#8)
2.36mm (#8)	850 μ m (#20)	1.18mm (#16)	1.18mm (#16)
2.00mm (#10)	425 μ m (#40)	600 μ m (#30)	600 μ m (#30)
600 μ m (#30)	180 μ m (#80)	300 μ m (#50)	300 μ m (#50)
Bottom	150 μ m (#100)	150 μ m (#100)	150 μ m (#100)
	75 μ m (#200)	75 μ m (#200)	75 μ m (#200)
	Bottom	Bottom	Bottom

1203.8 ANNEX Procedure for Using a Mechanical Washing Device for Chemically Extracted or Ignition Burned Bituminous Mixture (BM) Samples.

- 1) After completing step 1203.5F place the pre-soaked sample into the Washer bucket.
- 2) Introduce an angle to the Washer (usually at the 3rd peg hole). Some models are not multi-tilt but have fixed angled drums.
- 3) Place a “catch pan” underneath the bottom end of the bucket in order to capture any dripping that might occur during the washing cycle.
- 4) Turn on water supply so that the overflow of water and fines will carefully spillover a #16 & #200 sieve. Adjust water flow so that there’s a continuous stream of water.
- 5) Turn on Mechanical Washer and let spin (agitate) for a minimum of 5 minutes but no more than 10 minutes.
- 6) After washing cycle is complete, tilt the bucket below horizontal and carefully pour remaining water thru the nest of sieves.
- 7) Pour the remaining washed material into a drying pan.
- 8) Pour whatever was captured in the “catch pan” thru the nest of sieves.
- 9) Finally add what was captured on the sieves into the drying pan. Complete this step by turning over each sieve and wash the captured fines back into the drying pan being careful not to lose any of the material.
- 10) Place drying pan in an oven at 110 ± 5 °C (230 ± 9 °F) and dry to a constant weight.

Mechanical Washing Device

