METHOD OF SAMPLING AND TESTING
MT 320-14
MECHANICAL ANALYSIS OF AGGREGATE RECOVERED FROM IGNITION OVEN BURN

1 Scope

1.1 This test method is a procedure for the determination of the particle size distribution using square mesh sieves of fine and coarse aggregates recovered from bituminous mixtures by MT319.

2 Referenced Documents

AASHTO Standards
M 231 Weighing Devices Used in the Testing of Materials

MT Materials Manual
MT 319 Determining the Asphalt Binder Content of Plant Mix Surfacing (PMS) by the Ignition Method
MT 405 Wire Cloth Sieves for Testing Purposes
MT 607 Reducing Field Samples of Aggregate to Testing Size

3 Terminology

3.1 *Constant mass* – the state at which a mass does not change more than 0.10 percent, after additional drying for a defined time interval in Table 3.1

Table 3.1
Methods of Drying

Heat Source	Specific Instructions	Drying increments (minutes)
Controlled: Forced draft (preferred), ventilated, or convection oven	110 ±5°C (230 ±9°F)	30
Uncontrolled: Hot plate, Heat Lamp, etc.	Stir frequently	20
Microwave	Heap sample and cover with ventilated lid	10

4 Significance and Use

Use this method to determine the grading of aggregates extracted from bituminous mixtures. Use the results to determine compliance of the particle-size distribution with applicable specification requirements.

5 Apparatus

Ensure equipment used meets the following requirements:

5.1 *Balance* – balance or scale with a capacity larger than the size of the sample being tested. Use a balance or scale with sensitivity of 0.1 gram and in accordance with AASHTO M 231.

5.2 *Sieves* – square mesh sieves mounted on substantial frames constructed to prevent loss of material during sieving. Select suitable sieve sizes to furnish the information required by the specifications covering the material being tested. Ensure the sieves conform to the requirements of MT 405 Wire Cloth Sieves for Testing Purposes.

5.3 *Mechanical Sieve Shaker* - A mechanical sieving device creating a motion of the sieves that causes the particles to bounce, tumble, or otherwise turn so as to present different orientations to the sieving surface. Excessive time (more than 10 minutes) to achieve adequate sieving may result in degradation of the sample.

5.4 *Heat Source* - Oven, Hot Plate or alternate heating source.

5.5 *Wetting Agent* – Any dispersing agent, such as dishwashing detergent, or a soap that promotes separation of the fine materials.

5.6 *Container and utensils* - A container sufficient to contain the sample covered with water and to permit vigorous agitation without inadvertent loss of any part of the sample or water.

5.7 *Mechanical Washing Apparatus (Optional)* – A mechanical washing apparatus, if used, must provide results that are consistent with those obtained by use of manual operations.

6 Sample

6.1 Ensure the sample consists of the entire sample of aggregate obtained in accordance with MT 319.

Note 1 – If the sample is overloading screens, split or quarter the sample in accordance with MT 607, Procedure for Reducing Field Samples of Aggregate to Testing Size. Grade each part of the sample separately and combine the weights to obtain a representative gradation. Use the following table to determine if screens are overloaded.

MAXIMUM WEIGHT RETAINED				
Screen Size	8-inch (203 mm) Diameter Screen		12-inch (304.8 mm) Diameter Screen	
	Maximum Grams	Maximum Pounds	Maximum Grams	Maximum Pounds
1 ¼-inch (31.75 mm)			3821.9	8.4
1-inch (25.0 mm)			3057.5	6.7
¾-inch (19.0 mm)			2598.9	5.7
⅝-inch (16.0 mm)			2293.2	5.1
½-inch (12.5 mm)			1987.4	4.4
⅜-inch (9.5 mm)			223.0	2.7
No. 4 (4.75 mm)			318	0.7
No. 8 (2.36 mm)	194	0.4	436.5	0.9
No. 10 (2.00 mm)	194	0.4	436.5	0.9
No. 16 (1.18 mm)	194	0.4	436.5	0.9
No. 30 (0.600 mm)	194	0.4	436.5	0.9
No. 40 (0.425 mm)	194	0.4	436.5	0.9
No. 50 (0.300 mm)	194	0.4	436.5	0.9
No. 80 (0.180 mm)	194	0.4	436.5	0.9
No. 100 (0.150 mm)	194	0.4	436.5	0.9
No. 200 (0.075 mm)	194	0.4	436.5	0.9

7 Procedure

7.1 Dry the sample to constant mass. The total mass of aggregate in the bituminous mixture being tested is the sum of the mass of the dried aggregates and the mineral matter contained in the extracted asphalt.

7.2 Place the test sample in a container and cover with water. Add a detergent, dispersing agent, or other wetting solution to the water to ensure a thorough separation of the material passing the No. 200 sieve from the coarser particles. Add just enough wetting agent to produce a small amount of suds when the sample is agitated. The quantity depends on the hardness of the water and the quality of the detergent. Excessive suds may overflow the sieves and carry some material with them. Agitate the contents of the container vigorously and immediately pour the wash water over a nest of 2 sieves consisting of a No. 10 or 16 sieve superimposed on a No. 200 sieve. Use a large metal spoon to stir and agitate the aggregate in the wash water.

7.3 Ensure the agitation is sufficiently vigorous to result in the complete separation of the coarse particles from all particles finer than the No. 200 sieve and bring them into suspension in order that they may be removed by decantation of the wash water. Take care to avoid, as much as possible, the decantation of the coarse particles of the sample. Repeat the operation until the wash water is clear. Do not overflow or overload the No. 200 sieve.

7.4 Return all material retained on the nested sieves to a drying container. Dry the washed aggregate in the container to constant mass in an oven or alternate heating source. Weigh the sample and record to the nearest 0.1 gram.

7.5 Cool the aggregate and mechanically sieve over sieves of the various sizes required by the specification, for approximately 10 minutes. Record the weight of material passing each sieve and the amount passing the No. 200 sieve.

8 Calculations

8.1 Convert the individual weights retained to total weight passing each of the various sieves. Divide the total weight passing by the total weight of the sample, multiply by 100, which will result in the percent passing.

8.2 Ensure the total mass of the material after sieving closely aligns with the original mass of the sample placed on the sieves (dry mass after washing). Confirm the sum of these masses is within 0.2 percent of the mass after wash.

8.2.1 Calculate the percent change using the constant mass equation:

$$\frac{M_1 - M_2}{M_1} \times 100 = \%\ Change$$

Where:

M_1 = mass prior to sieving
M_2 = total mass after sieving

9 Report

9.1 Report the results of the sieve analysis as the total percentages passing each sieve size and report to the nearest whole number for all material coarser than the 200 mesh. Report the 200 mesh material to one tenth of one percent (0.1). Calculate the percentages on the basis of the total initial weight (before wash) of the sample, including any material finer than the 200 mesh sieve.

GRADATION WORKSHEET EXAMPLE

Date:_____ Project/Termini_____

Contract ID_____ Sample Number_____

Before Wash 2405 After Wash 2352.2 LBW 52.8

Wt. Retained		Wt. Pass.	Percent Passing
0.0	25M	2405	100
144.0	19M	2261	94
312.0	12.5M	2093	87
673.0	9.5M	1732	72
1322.0	4.75M	1083	45
1538.0	2.36M	867	36
1827.1	1.18M	577.9	24
2019.1	0.60M	385.9	16
2115.1	0.30M	289.9	12
2163.1	0.15M	241.9	10
2259.1	0.075M	145.9	6.1
2352.0	Dry Pan	53.0	

Remarks:

All weights are recorded to 0.1 of a gram.

GRADATION WORKSHEET

Date:_____ Project/Termini_____

Contract ID_____Sample Number_____

Before Wash _____ After Wash _____ LBW _____

Wt. Retained		Wt. Pass.	Percent Passing
_____	25M	_____	_____
_____	19M	_____	_____
_____	12.5M	_____	_____
_____	9.5M	_____	_____
_____	4.75M	_____	_____
_____	2.36M	_____	_____
_____	1.18M	_____	_____
_____	0.60M	_____	_____
_____	0.30M	_____	_____
_____	0.15M	_____	_____
_____	0.075M	_____	_____
_____	Dry Pan	_____	

Remarks:

All weights are recorded to 0.1 of a gram.