METHODS OF SAMPLING AND TESTING
MT 336-22
METHOD OF BATCHING ASPHALT AGGREGATE FOR MIX DESIGN VERIFICATION

1 Scope

1.1 This method describes the procedures for batching asphalt aggregates for the mix design verification process.

1.2 Stockpile samples are sieved into individual size fractions then recombined in batches in accordance with the JMF (job mix formula) submitted by the Contractor. The various batched aggregates are subjected to asphalt mixture testing and aggregate consensus testing including, but not limited to, Hamburg testing, Rice gravity, asphalt ignition ovens, and aggregate consensus properties. Hamburg testing will be conducted by MDT if not already tested by the Contractor.

2 Reference Documents

AASHTO
M 231 Weighing Devices Used in the Testing of Materials
T 176 Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test

MDT Materials Manual
MT 201 Sampling Roadway Materials
MT 202 Sieve Analysis for Fine and Coarse Aggregate
MT 607 Procedure for Reducing Field Samples of Aggregate to Testing Size

3 Apparatus

3.1 *Balance* – of sufficient capacity and conforming to the requirements of AASHTO M 231, Class G2

3.2 *Pans* – A flat metal pan (or bowl) of sufficient size to contain the batch samples

3.3 *Mixing apparatus* – Scoop, spoon, spatula, etc. for measuring and mixing

3.4 *Oven* – Temperature controlled oven that can maintain temperatures within ±5ºC between 121.1ºC and 176.7ºC (250ºF to 350ºF)

3.5 *Sample Mixing Apparatus* – mixing apparatus appropriately sized for mixing the aggregate and asphalt binder. Must be able to accommodate the required mixing temperature

4 Reagents and Materials

4.1 *Hydrated Lime* – Supplied by the Contractor or MDT's supply of the same source, as requested by the Contractor.

4.2 *Recycled Asphalt Pavement* (*RAP)/Recycled Asphalt Shingles (RAS)* – As indicated in the JMF, representative of the stockpile, and supplied by the Contractor.

4.3 *Asphalt Binder* – Supplied by the Contractor or MDT's supply of the same source and grade, as requested by the Contractor.

4.4 *Asphalt Additives* – Supplied by the Contractor, and defined as any other additives required by the mix design or supplied at the Contractor's option or convenience (e.g., warm mix additives, rejuvenators, etc.)

5 Sampling

Sample each stockpile (Coarse, Intermediate, Fines, Sand, RAP, etc.) in the field in accordance with MT 201. The amount of material sampled should be in accordance with MDT's Standard

Specifications 401.03.1. Stockpiles are sampled by the Contractor and witnessed by MDT. Samples are then transported to MDT District or Area Lab by MDT personnel, where they are dried and reduced per MT 607, if necessary. District or Area Labs will perform gradation analysis of the samples to verify representativeness of the stockpiles.

MDT personnel from the District/Area Labs will then send a sufficient quantity representing each stockpile to the MDT Materials Lab in Helena for batching.

6 Procedure (MDT Materials Lab)

6.1 Fractionate the stockpile samples in accordance with MT 202 using the following sieve sizes:

¾ in. (19 mm),
½ in. (12.5 mm),
3/8 in. (9.5 mm),
No. 4 (4.75 mm),
No. 8 (2.36 mm),
No. 16 (1.18 mm),
No. 30 (0.6 mm),
No. 50 (0.3 mm),
No. 100 (0.15 mm), and
No. 200 (0.075 mm).

Maintain each size fraction separately.

Note 1: MDT does not fractionate recycled material and hydrated lime at this time.

6.2 Based on the submitted JMF, determine the amount of each size fraction needed to develop the various batches required for testing.

6.2.1 Example calculations for 2000 gram batch:

A. Calculate the amount needed from each stockpile based on the bin split percentages.

	Coarse	Intermediate	Cr. Fines	RAP	Hyd. Lime	Total
% Bin Splits	42.5	12.8	28.3	15	1.4	100
Grams	850	256	566	300	28	2000

B. Calculate the amount needed from each size fraction for each stockpile by multiplying the percent retained with the amount needed from each stockpile.

	Coarse	
Bin Split%	42.5	
Total, Grams	850	
Sieve	% Pass	Grams per sieve
3/4"	100.0	
1/2"	84.0	$(100-84/100)(850)=136.0$
3/8"	38.0	$(84-38/100)(850)=391.0$
#4	2.0	$(38-2/100)(850)=306.0$
#8	2.0	$(2-2/100)(850)=0$
#16	1.0	$(2-1/100)(850)=8.5$
#30	1.0	
#50	1.0	
#100	1.0	
#200	1.0	
Pan		remainder=8.5
Total, g		850.0

C. Calculate the cumulative amount for each size fraction.

	Coarse		Intermediate		Cr. Fines		RAP		Hyd. Lime		Cum. Total
Bin Split %	42.5		12.8		28.3		15		1.4		100
Grams	850		256		566		300		28		2000
Sieve	% Pass	grams	% Pass	grams	% Pass	grams	% Pass	grams	% Pass	grams	grams
3/4"	100.0		100.0		100.0		100.0		100.0		
1/2"	84.0	136.0	100.0		100.0		100.0		100.0		136.0
3/8"	38.0	391.0	100.0		100.0		100.0		100.0		391.0
#4	2.0	306.0	13.0	222.7	89.0	62.3	100.0		100.0		591.0
#8	2.0		3.0	25.6	61.0	158.5	100.0		100.0		184.1
#16	1.0	8.5	2.0	2.6	29.0	181.1	100.0		100.0		192.2
#30	1.0		2.0		19.0	56.6	100.0		100.0		56.6
#50	1.0		2.0		14.0	28.3	100.0		100.0		28.3
#100	1.0		2.0		11.0	17.0	100.0		100.0		17.0
#200	1.0		1.5	1.3	8.5	14.2	100.0		100.0		15.4
Pan		8.5		3.8		48.1					60.4
Totals, g		850.0		256.0		566.0		300.0		28.0	2000.0

6.2.2 RAP/RAS and hydrated lime are not fractionated. RAP/RAS are added to each batch as a total amount based on the bin split percentages from the JMF. RAP/RAS and hydrated lime **<u>are not</u>** added to wash and consensus batches.

6.3 *Wash Batch*: Develop a 2000 gram batch based on the JMF of only virgin minus 3/8-inch (9.5 mm)/plus 200 (0.075 mm) material. Wash this material over a No. 200 (0.075 mm) sieve in accordance with MT 202 to determine the amount of clinging fines material. Subtract the percent of clinging fines from the minus No. 200 material in the JMF for developing individual test batches.

Note 2: It is recognized that the method in section 6.3 excludes the clinging fines on aggregate larger than 3/8" (9.5mm); however, for a significant number of sources, the effect of clinging fines on coarse aggregate is negligible. See ***Section 8*** *for the referee method in cases of dispute.*

6.4 Produce batches based on the calculations from Section 6.2 and in accordance with the submitted JMF for the tests listed in the table below. Hamburg testing may be performed with either slabs or gyratory pucks. The batch weights and number of batches for each test indicated in the table are based on MDT's practice for batching and provided only as guidelines.

Ensure the minus No. 200 material size fraction has been adjusted for the % clinging fines as determined in Section 6.3.

Note 3: If additional material is needed for a specific size fraction, fractionate more of the stockpile samples.

Test	Method	MDT Batch Weight (grams) [a]	MDT Number of Batches [a]
Asphalt Mix Tests			
Hamburg Slabs **Or** Gyratory	MT 334 Method of Test for Hamburg Wheel-Track Testing of Compacted Bituminous Mixtures MT 335 Linear Kneading Compaction of Bituminous Mixtures MT 332 Gyratory Compaction of Bituminous Mixtures	6500 (13,000 = 1 slab) 4800	4 4
Rice Gravity	MT 321 Determining Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures	2000	2
Ignition Oven [b]	MT 319 Determining the Asphalt Binder Content of Plant Mix Surfacing by the Ignition Method MT 320 Mechanical Analysis of Aggregate Recovered from Ignition Oven Burn	2000	5
Asphalt Consensus Tests (**Do not** include hydrated lime and/or RAP/RAS – *until further notice*)			
Fine Aggregate Angularity	AASHTO T 304 Standard Method of Test for Uncompacted Void Content of Fine Aggregate	4800	1
Sand Equivalent	AASHTO T 176 Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test		
Flat elongated particles	ASTM D4791 Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate		
Fractured Faces	AASHTO T 335 Standard Method of Test for Determining the Percentage of Fracture in Coarse Aggregate		

[a] For reference use only
[b] Sent to District/Area Labs for Ignition Oven Correction Factor Determination

7 Testing

Test the batches in accordance with the above referenced test methods. Follow Section 7.1 for combining the Asphalt Mix Testing batches with the asphalt binder.

7.1 Asphalt Mix Testing

7.1.1 Determine the required amount of asphalt binder based on the submitted mix design. Use the following equation:

$$W_{Asph} = \frac{W_{Agg} X\ P_{Asph}}{1 - P_{Asph}}$$

Where:

W_{Asph} = Weight of asphalt binder
W_{Agg} = Weight of aggregate
P_{Asph} = Binder percentage by weight of total mix

7.1.2 Heat the aggregate at the required mixing temperature in the oven overnight.

7.1.3 Heat the asphalt binder to approximately the aggregate temperature. Do not exceed 190ºC (375ºF).

7.1.4 Heat the mixing bowl in the oven. Do not exceed 190ºC (375ºF). Add in the heated aggregate and dry mix thoroughly. Remove the asphalt binder from the oven and stir until uniform. Pour the required amount of asphalt binder into the aggregate. Mix the aggregate and asphalt binder thoroughly and as quickly as possible until all particles are coated, and the mixture is homogenous.

7.1.5 Transfer the mixture to a pan and place in the oven for 2 hours at the compaction temperature, 140 to 160ºC (285 to 320ºF).

7.1.6 The mixture is now ready for testing.

8 Referee Method for Sand Equivalent (SE) Determination – AASHTO T 176

8.1 The referee method described below applies in the event of a difference of more than 10 points between the submitted SE value and the MDT determined SE value based on the wash batch as described in section 6.3 above. In these cases, a new wash batch will be developed using the full JMF to determine the amount of clinging fines and SE testing will be repeated.

8.2 RAP/RAS and hydrated lime are not fractionated. RAP/RAS are added to each batch as a total amount based on the bin split percentages from the JMF. RAP/RAS and hydrated lime **<u>are not</u>** added to wash and consensus batches.

8.3 *Wash Batch*: Develop a 2000 gram batch based on the JMF of only virgin aggregates retained on the No. 200 (0.075 mm) sieve. Wash this material over a No. 200 (0.075 mm) sieve in accordance with MT 202 to determine the amount of clinging fines material. Subtract the percent of clinging fines from the minus No. 200 material in the JMF for developing individual test batches.

8.4 Produce batches based on the calculations from Section 6.2 and in accordance with the submitted JMF for SE determination and ensure the minus No. 200 material size fraction has been adjusted for the % clinging fines as determined in Section 8.3.

Note 4: If additional material is needed for a specific size fraction, fractionate more of the stockpile samples.