ND T 245 - RESISTANCE TO PLASTIC FLOW OF BITUMINOUS MIXTURES USING MARSHALL APPARATUS

Conduct this procedure according to ND T 245.

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

SCOPE

This procedure is used to prepare cylindrical specimens of bituminous paving mixture loaded on the lateral surface by means of a Marshall apparatus.

REFERENCED DOCUMENTS

NDDOT 5, Sampling and Splitting Field Verification Hot Mix Asphalt (HMA) Samples
AASHTO T 245, Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus

APPARATUS

Mold cylinders, base plate and extension collars
Triple compaction hammer and apparatus
Compaction pedestal
Extrusion jack
Oven or hot plate
Fan (optional)
Balance
Paper disks
Spoons
Spatula
Colored grease pencil
Pans
Mixing Bowl
Mechanical mixing apparatus
Thermometers
Gloves
Breaking head
Marshall Stability machine
Water bath

TEST SPECIMEN

Material used to prepare at least three specimens may be obtained from behind the paver as outlined in NDDOT 5.

PROCEDURE

Heat the sample in an oven to 270 ± 5°F.

Heat the molds and hammer faces to a temperature between 200° to 300°F (93° to 149°C). Once heated, the hammer may be placed in a sand bath or on a hot plate to maintain the temperature.

Enough material shall be used that will result in a compacted specimen 2.5 ± 0.05" (63.5 ± 1.27 mm) in height. This will take approximately 1200 g.

Assemble the mold and collar on the base plate. Place the assembled mold on a scale and place a paper disk in the bottom of the mold. Add approximately 1200 g of mix into the mold.

Position the mold assembly on the mold holder of the triple Marshall Mix compaction machine. Using a heated spatula, spade around the outer perimeter of the mold 15 times. Then spade the interior portion of the mix 10 times.

Form the top of the mix into a smooth, slightly-rounded mound. Place a paper disk on the top of the mix.

Repeat the same steps for the two remaining molds.

Position and attach the Marshall hammers. Verify that the machine counter is set for the correct number of blows required by the mix design. This may be either 50 or 75 blows with the compaction hammer having a free fall of 18". Push the start button on the counter and wait for the machine to complete its blows.

Remove the base plate and collar. Turn the molds over and reassemble the mold with the base plate and collar. Apply the same number of compaction blows as on the reverse side.

When the compaction blows are complete, remove the hammers from the apparatus. Take the molds off the bases and remove the paper disks. Keep the last side compacted facing up.

Mark the specimens on the last side compacted at each asphalt content with a colored grease pencil. As an example, mark them 5-A, 5-B, or 5-C.

Position the mold in the extrusion jack. With the last side pounded facing up, remove the specimen from the mold and set it aside on a smooth, flat surface at room temperature overnight. A fan can be used for rapid cooling if necessary.

TESTING FLOW AND STABILITY OF A SPECIMEN

If the specimens are to be tested for plastic flow, place the specimens in a water bath 30 to 40 minutes or in an oven for 2 hours. Maintain the bath or oven at 140 ± 1.8°F (60 ± 1°C).

The testing head apparatus temperature shall be between 70° to 100°F (21.1 to 37.8°C).

Guide rods shall be thoroughly clean and lubricated so that the upper test head slides freely over them.

Remove the specimen from the water bath or oven and place in the lower segment of the breaking head. Place the upper segment of the breaking head on the specimen and insert assembly into the compression machine. Adjust the measuring dial to zero in the proving ring to measure maximum load and place the flow meter dial on a guide rod to measure flow.

Apply the load to the specimen with a constant rate of movement for the testing machine head of 2" (50.8 mm) per minute until the maximum load is reached. When applying load hold when maximum load is reached, obtain the dial reading in the proving ring and remove the flow meter dial from its location. Record both values.

The elapsed time for the test from removal of the test specimen from the water bath to the maximum load determination shall not exceed 30 seconds.

CALCULATIONS

To determine the stability of the specimen, the dial reading is converted to a maximum load by a chart supplied with the compression machine.

When core specimens vary from the 2.5" depth, a correction factor must be applied to the maximum load.

To determine stability, use the following formula:

Stability = Maximum Load x Correction Factor

Stability is recorded to the nearest whole number.

Flow is a direct reading of the flow meter dial and recorded to 0.01".

Correction factors are found in the following table.

CORRECTION FACTOR TABLE

Volume of Specimen (cm^3)	Thickness of Specimen (in.)	mm	Correlation Ratio	Volume of Specimen (cm^3)	Thickness of Specimen (in.)	mm	Correlation Ratio
200 to 213	1	25.4	5.56	406 to 420	2	50.8	1.47
214 to 225	1 1/16	27.0	5.00	421 to 431	2 1/16	52.4	1.39
226 to 237	1 1/8	28.6	4.55	432 to 443	2 1/8	54.0	1.32
238 to 250	1 3/16	30.2	4.17	444 to 456	2 3/16	55.6	1.25
251 to 264	1 1/4	31.8	3.85	457 to 470	2 1/4	57.2	1.19
265 to 276	1 5/16	33.3	3.57	471 to 482	2 5/16	58.7	1.14
277 to 289	1 3/8	34.9	3.33	483 to 495	2 3/8	60.3	1.09
290 to 301	1 7/16	36.5	3.03	496 to 508	2 7/16	61.9	1.04
302 to 316	1 1/2	38.1	2.78	509 to 522	2 1/2	63.5	1.00
317 to 328	1 9/16	39.7	2.50	523 to 535	2 9/16	65.1	0.96
329 to 340	1 5/8	41.3	2.27	536 to 546	2 5/8	66.7	0.93
341 to 353	1 11/16	42.9	2.08	547 to 559	2 11/16	68.3	0.89
354 to 367	1 3/4	44.4	1.92	560 to 573	2 3/4	69.9	0.86
368 to 379	1 13/16	46.0	1.79	574 to 585	2 13/16	71.4	0.83
380 to 392	1 7/8	47.6	1.67	586 to 598	2 7/8	73.0	0.81
393 to 405	1 15/16	49.2	1.56	599 to 610	2 15/16	74.6	0.78
				611 to 625	3	76.2	0.76

NOTES

Put the compaction hammers on the Marshall machine by attaching them to the pins at the top of the pedestal. There is a hook on one side of the hammer. This hook must be attached to the chain drive on the machine to maintain the proper sequence.

CALIBRATION

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