



Standard Test Procedures Manual

Section: ASPHALT MIXES

Subject: MARSHALL STABILITY AND FLOW

1. SCOPE

1.1. Description of Test

This method covers the measurement of resistance to plastic flow of cylindrical specimens of asphalt mixtures loaded on the lateral surface by means of the Marshall apparatus. This method is for use with mixtures containing asphalt cement, asphalt cutback, and aggregate up to 25.4 mm maximum size.

1.2. Application of Test

The testing section of this method can also be used to obtain maximum load and flow for asphalt concrete specimens cored from pavements or prepared by STP 204-8, Preparation of Marshall Compaction Specimens.

1.3. Units of Measure

Stability is measured in Newtons. Flow is measured in mm.

2. APPARATUS AND MATERIALS

2.1. Equipment Required

Breaking Head - the breaking head shall consist of upper and lower cylindrical segments or test heads having an inside radius of curvature of 50.8 mm accurately machined. The lower segment shall be mounted on a base having two perpendicular guide rods or posts extending upward. Guide sleeves in the upper segment shall be in such a position as to direct the two segments together without appreciable binding or lose motion on the guide rods.

Loading Jack - the loading jack shall consist of a screw jack mounted in a testing frame and shall produce a uniform vertical movement of 50.8 mm/minute. An electric motor may be attached to the jacking mechanism.

Ring Dynamometer Assembly or Electronic Equivalent - one ring dynamometer of 2267 kg capacity and sensitivity of 4.536 kg up to 453.6 kg and 11.34 kg between 453.6 and 2267 kg shall be equipped with a micrometer dial. The micrometer dial shall be graduated in 0.0025 mm. Upper and lower ring dynamometer attachments are required

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for fastening the ring dynamometer to the testing frame and transmitting the load to the breaking head.

Flowmeter - the flowmeter shall consist of a guide sleeve and a gauge. The activating pin of the gauge shall slide inside the guide sleeve with a slight amount of frictional resistance. The guide sleeve shall slide freely over the guide rod of the breaking head. The flowmeter gauge shall be adjusted to zero when placed in position on the breaking head when each individual test specimen is inserted between the breaking head segments.

Water Bath - the water bath shall be at least 152 mm deep and shall be thermostatically controlled so as to maintain the bath at $60 \pm 1^{\circ}$ C. The tank shall have a perforated false bottom or be equipped with a shelf for supporting specimens 51 mm above the bottom of the bath.

Air Bath - the air bath for asphalt cutback mixtures shall be thermostatically controlled and shall maintain the air temperature at $25 \pm 1^{\circ}$ C.

2.2. Materials Required

Samples may include cored specimens, field or lab prepared specimens.

2.3. Sample to be Tested

Density of the specimen is required to obtain the volume for a correlation ratio. Density can be determined as outlined in STP 204-21, DENSITY AND VOID CHARACTERISTICS.

3. PROCEDURE

3.1. Equipment Preparation

Thoroughly clean the guide rods and the inside surfaces of the test heads prior to making the test, and lubricate the guide rods so that the upper test head slides freely over them.

3.2. Sample Preparation

Samples will be prepared in accordance with STP 204-8, Preparation of Marshall Compaction Specimens or collected in accordance with STP 204-5, Asphalt Concrete Samples Obtained by Coring.

3.3. Test Procedure

Bring the specimens prepared with asphalt cement to the specified temperature by immersing in a water bath 30 minutes. Maintain the bath or oven temperature at $60 \pm 1^\circ$ C for asphalt cement specimens. Bring the specimens prepared with asphalt cutback to the specified temperature by placing them in the air bath for a minimum of 2 hours. Maintain the air bath temperature at $25 \pm 1^\circ$ C.

The testing head temperature shall be maintained between 20 to 38° C. Remove the specimen from the water bath, oven or air bath and place in the lower segment at the breaking head. Place the upper segment of the breaking head on the specimen and place the complete assembly in position on the testing machine. Place the flowmeter, where used, in position over one of the guide rods and adjust the flowmeter to zero while holding the sleeve firmly against the upper segment of the breaking head. Hold the flowmeter sleeve firmly against the upper segment of the breaking head while the test load is being applied. Apply the load to the specimen by means of the constant rate of movement of the load jack or testing machine head of 50.8 mm/minute until the maximum load is reached and the load decreases as indicated by the dial. Record the maximum load noted on the testing machine or converted from the maximum micrometer dial reading. Release the flowmeter sleeve or note the micrometer dial reading, where used, the instant the maximum load begins to decrease. Note and record the indicated flow value or equivalent units in mm if a micrometer dial is used to measure the flow. The elapsed time for the test from removal of the test specimen from the water bath to the maximum load determinations shall not exceed 30 seconds.

4. RESULTS & CALCULATIONS

4.1. Collection of Test Results

For specimens other than 63.5 mm in thickness correct the load by using the proper multiplying factor from Table 1.

The reports shall include the following information:

- a) Type of sample tested (lab sample or pavement core specimen). For core specimens the height of each test specimen in mm shall be reported.
- b) Average maximum load in newtons, corrected when required.
- c) Average flow value in millimetres.
- d) Test temperature

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TABLE 1 - Stability Correlation Ratios*

Volume of Specimen (cm ³)	Thickness of Specimen (mm)	Correlation Ratio
200 to 213	25.4	5.56
214 to 225	27.0	5.00
225 to 237	28.6	4.55
238 to 250	30.2	4.17
251 to 264	31.8	3.85
265 to 276	33.3	3.57
277 to 289	34.9	3.33
290 to 301	36.5	3.03
302 to 316	38.1	2.78
317 to 328	39.7	2.50
329 to 340	41.3	2.27
341 to 353	42.9	2.08
354 to 367	44.4	1.92
368 to 379	46.0	1.79
380 to 392	47.6	1.67
393 to 405	49.2	1.56
406 to 420	50.8	1.47
421 to 431	52.4	1.39
432 to 443	54.0	1.32
444 to 456	55.6	1.25
457 to 470	57.2	1.19
471 to 482	58.7	1.14
483 to 495	60.3	1.09
496 to 508	61.9	1.04
509 to 522	63.5	1.00
523 to 535	64.0	0.96
536 to 546	65.1	0.93
547 to 559	66.7	0.89
560 to 573	68.3	0.86
574 to 585	71.4	0.83
586 to 598	73.0	0.81
599 to 610	74.6	0.78
611 to 625	76.2	0.76

* The measured stability of a specimen multiplied by the ratio for the thickness of the specimen equals the corrected stability for a 63.5 mm specimen.

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5. REPEATABILITY

At least 3 test specimens should be used and the individual results averaged. Repeatability shall be as outlined in ASTM D1559, Standard Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.

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APPROVAL SHEET

New Revision Date of Previous Document 90-05-10
Effective Date: 92-04-11

Description of Revision (Reason for Revision):

- The requirement that the flow meter have .25 mm divisions was removed.
- The water bath will be maintained at 60° C only, not at 60° C or 37.8° C.
- Electronic equivalent may be used instead of a Ring Dynamometer.

Review/Implementation Process:

Lab Supervisor's Committee

Other Manuals/Policies Affected:

Nil

Follow Up/Training Required:

Nil

Comments/Concerns/Implications (Budget/Environment/Stakeholders):

Prepared and Recommended by D. MacLeod 92-04-02
Quality Control Engineer Date

Approval Recommended by R.A. Widger 92-04-08
Date

Approval Recommended by A.R. Gerbrandt 92-04-09
Dir., Technical Standards & Policies Br. Date

Approved by D.G. Metz 92-04-11
Assistant Deputy Minister, Infrastructure Date

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