Standard WFLHD Method of Test for

Determining Asphalt Content in Asphalt Paving Mixtures by the Ignition Method

1. SCOPE

1.1 This test method covers the determination of asphalt content in hot-mixed paving mixtures by ignition of the asphalt cement at 538 ±20° C in a furnace. The remaining aggregate can then be used for sieve analysis using AASHTO Test Method T 30.

1.2 This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices.

2. REFERENCED DOCUMENTS

2.1 *AASHTO Standards:*

T 2 Sampling of Aggregates
T 30 Mechanical Analysis of Extracted Aggregate
T 168 Sampling Bituminous Paving Mixtures
T 248 Reducing Field Samples of Aggregates to Testing Size
M 231 Balances Used in the Testing of Materials

2.2 Manufacturer's instruction manual

3. SUMMARY OF TEST METHOD

3.1 The asphalt in a sample of hot-mix paving material is burned by ignition at 538 ±20° C. The asphalt content is calculated by differences from the mass of the residual aggregate, moisture content, and the temperature compensation for the change in mass in the sample container. The asphalt content is expressed as mass percent of moisture-free mixtures. This method may not be applicable to mixtures containing fibers or ground tire rubber (dry process).

4. SIGNIFICANCE AND USE

4.1 This method can be used for quantitative determination of asphalt binder and gradation of aggregates in hot-mixed paving mixtures and pavement samples for quality control, specification acceptance, and mixture evaluation. This method does not require the use of solvents. Aggregate obtained by this test method may be used for gradation analysis according to *AASHTO T 30*.

5. APPARATUS

5.1 *Forced air ignition furnace,*[1] capable of maintaining the temperature at 538 ±20° C, with an internal balance thermally isolated from the furnace chamber sensitive to 0.1 g. The balance shall meet the accuracy requirements of AASHTO M 231 for general class balances in the range of principal sample weights under test and when in operation as part of the furnace shall be capable of weighing a 3,500 gram sample in addition to the sample baskets. The furnace shall calculate a temperature compensation factor for the change in mass of the sample baskets and provide for the input of a correction factor for aggregate loss. The furnace shall provide a printed ticket with the initial sample weight, sample weight loss, temperature compensation, correction factor, corrected asphalt content (%), test time, and test temperature. The sample chamber shall be of adequate size to allow sufficient air flow for complete ignition of the asphalt from the test sample. A method for reducing furnace emissions shall be provided. The furnace shall provide an audible alarm and indicator light when the percent loss remains constant within tolerance for three consecutive minutes. The furnace shall be equipped with a mechanism for ensuring that the door remains locked until the completion of the test procedure.

5.2 *Stainless steel catch pan*, approximately 2.5 cm larger than the sample baskets.

5.3 *Sample baskets*, tempered stainless steel 2.36 mm mesh or otherwise perforated. The basket assembly may contain multiple sample baskets in order to have a minimum surface area of approximately 1400 sq. centimeters on which to spread the sample. The sample baskets shall have a cover, be nested, and attached to the catch pan with a suitable clamping assembly.

5.4 *Oven*, capable of maintaining the temperature at 125 ±5° C.

5.5 *Balance*, meeting the requirements of M 231 shall be provided as appropriate for the sample mass.

5.6 *Safety equipment*: face shield or safety glasses and high temperature gloves. Additionally, a heat resistant surface capable of withstanding 650° C and a protective cage capable of surrounding the sample basket assembly shall be provided.

5.7 *Pan*, flat, of appropriate size to transfer materials after ignition.

5.8 *Miscellaneous equipment*: thermometers, spatulas, stirring spoons, gloves, metal pans, and pouring containers as necessary.

6. SAMPLING

6.1 The test sample shall be the end result of quartering a larger sample taken in accordance with AASHTO T 168 (AASHTO T 248 may be used as a guide to quartering).

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[1] The National Center for Asphalt Technology (NCAT) Asphalt Content Tester manufactured by Barnstad Thermolyne has been found to be suitable.

6.2 Preparation of Test Samples

6.2.1 If the test sample is not sufficiently soft to separate easily, it may be warmed to 125 ±5° C only until it can be handled and mixed. Split or quarter the material until the sample is of the required mass.

6.2.2 The size of the test sample shall be governed by the nominal maximum aggregate size of the mixture and shall conform to the mass requirement shown in Table 1 (NOTE 1).

Note 1) When the mass of the test specimen exceeds the capacity of the equipment used, the test specimen may be divided into suitable increments, tested, and the results appropriately combined for calculation of the asphalt content (Section 8).

TABLE 1 Size of Sample

Nominal Maximum Aggregate Size, mm	Minimum Mass of Sample, g
4.75	1200
9.5	1500
12.5	2000
19.0	2500
25.0	3000
37.5	4000

6.2.3 In addition, a test sample for moisture determination will be made and tested in accordance with the specified test method.

7. CALIBRATION

For mix designs containing RAP, sufficient quantity of the RAP should be obtained to provide representative samples to be used in determining the Job Mix Correction Factor (JMCF). The individual portions of RAP to be used in the preparation of the calibration samples should be obtained using an appropriate sample splitter.

7.1 At least three calibration samples conforming to Section 6.2.2, shall be prepared. One at the design asphalt content and one each at 0.5% above and below the design asphalt content. A butter mix shall be prepared at the design asphalt content, mixed, and discarded prior to mixing any of the calibration samples to ensure accurate asphalt content. Aggregates used in the calibration procedure shall be sampled from stockpiled material produced for the current construction season. Any method may be used to combine the aggregates, however an additional

'blank' sample shall be batched and tested according to AASHTO T 30. The washed gradation of the unburned 'blank' sample shall fall within the Job Mix Formula (JMF) tolerances. The calibration procedure for determining the Job Mix Correction Factor (JMCF) to be used in conjunction with steps in Section 7 shall be performed and a correction factor for each mix design and oven to be used during production testing shall be submitted for approval before acceptance testing begins.

Note: It is advised that the residual aggregate from each of the three calibration samples be tested according to AASHTO T 30 for comparison to the gradation of the unburned 'blank' sample.

7.1.1 *Preparation of Aggregates)* Obtain a sample of aggregate (at least 10 kilograms) in accordance with AASHTO T 2 from the cold feed conveyor belt or if the plant is not operational, from the stockpiles. Dry, sieve, and separate the aggregate into appropriate sizes. Batch the aggregates for each of the required test samples to the target values established in the JMF. Dry the batched portions of aggregate to a constant weight at 150 ±5° C except when using polymer modified asphalt cements dry the aggregate to a constant weight at 170 ±5° C. Maintain the temperature for mixing.

7.1.2 *Asphalt Cement)* Obtain a sample of the asphalt cement (approximately one liter) in accordance with AASHTO T 40 from the asphalt cement that will be used in the production of the asphalt concrete mixture. Heat the liquid asphalt to the appropriate temperature specified in 7.1.1.

7.1.3 *Mixing Equipment)* Pre-heat the buttered mixing bowl and spoon to the appropriate temperature as specified in 7.1.1.

7.2 *Preparation of Test Mixes:*

7.2.1 Weigh the heated aggregate to the nearest 0.1 gram and record the weight. To obtain the weight of asphalt needed, multiply the weight of the heated aggregate by the percent asphalt (by weight of aggregate) specified in the approved Job Mix Formula.

$$\text{Note: \% asphalt by weight of aggregate} = 100 \times \frac{\text{\% asphalt by weight of mix}}{100 - \text{\% asphalt by weight of mix}}$$

7.2.2 Pre-tare the heated, buttered mixing bowl and spoon. Place the heated aggregate in the mixing bowl, make a small crater in the center of the aggregate, and add the required amount of heated asphalt. Record the weight of asphalt added to the nearest 0.1 gram. Mix the heated aggregate and asphalt until all aggregate particles are thoroughly coated. Hand mixing using the spoon and bowl has been found to be an acceptable method. Reheating the mixture in the oven may be necessary to insure complete coating of all the aggregate. Use caution not to loose any of the mix (aggregate or asphalt) during mixing. Every effort should be made to ensure that the buttered bowl and spoon weigh as nearly as possible the same just prior to and after each calibration sample is mixed.

7.2.3 Determine and record the weight of the complete sample basket assembly to the nearest 0.1 gram.

7.2.4 Place the sample directly into the sample basket assembly. As nearly as possible scrape all material from the bowl and spoon in the same manner as when preparing the butter mix. Evenly distribute the sample taking care to keep the material away from the edges. If multiple sample basket are used to make up the assembly, divide the sample evenly between the individual units, taking care not to loose any material in the process. Replace the cover and complete the assembly by attaching the sample baskets to the catch pan with the clamping device. Weigh and record the weight of the sample basket assembly and the test mixture to the nearest 0.1 gram. Calculate and record the initial weight of the test sample (total weight minus the weight of the sample basket assembly) to the nearest 0.1 gram.

7.3 *Determine Asphalt Content of Test Mixes:*

7.3.1 Pre-heat the ignition furnace to 538 ±20° C. This should be done at the beginning of each day the furnace is to be used so that is stabilized at the proper temperature before the test. Record the furnace temperature (set point) prior to initiating the test.

7.3.2 Insure the stability threshold is set to 0.01 percent or 0.2 grams, depending on the software version in use.

7.3.3 Enter a correction factor of **0.00** into the furnace controller.

7.3.4 Input the initial weight of the test sample, rounded to the nearest whole gram, into the ignition furnace controller. Verify that the correct weight has been entered.

7.3.5 Open the chamber door and carefully place the sample basket assembly into the furnace. Close the chamber door and verify that the weight displayed on the furnace balance readout indicates that the total weight of the sample basket assembly, including the weight of the test sample, equals the total weight recorded in Section 7.2.4 within ±10 grams. Differences greater than 10 grams or failure of the furnace scale to stabilize may indicate that the sample basket assembly is touching the furnace wall. This condition must be remedied before continuing or the test result will be invalid. Initiate the test by pressing the start/stop button on the furnace controller. This should cause the furnace chamber to be locked and start operation of the combustion blower.

7.3.6 Allow the test to continue until a stable condition has been achieved indicating that the test is complete. Press the start/stop button. This should unlock the chamber door, stop the operation of the combustion blower and cause the furnace controller to print out the results of the test. Record the calibrated asphalt content to the nearest 0.01 percent.

7.3.7 Repeat the steps set forth in 7.1.1 through 7.3.5 above for all required test mixes. Determine and record the calibrated asphalt content for each test mixture.

7.4 *Calculating the Job Mix Correction Factor:*

7.4.1 Calculate the actual percent asphalt in each of the test mixes using the weight of the dry aggregate and the asphalt added to it, as determined in 7.2.1 and 7.2.2 above.

A correction factor for each test mix is then determined by subtracting the actual percent asphalt from the percent asphalt reported by the furnace controller.

The final Job Mix Correction Factor (JCMF) for the ***same oven***, used to perform tests on all asphalt mixture samples using the same Job Mix Formula (Mix Design), is the mean of all valid tests.

Note: A new JMCF must be determined for each Job Mix Formula requiring a new mix design.

7.5 *Precision:*

7.5.1 If the results of any of the individual JMCF determinations are not within 0.1 of the mean of the tests performed, that test is considered invalid and another test must be run until at least three valid results are obtained.

8. PROCEDURE

8.1 Pre-heat the ignition furnace to 538 ±20° C. This should be done at the beginning of each day the furnace is to be used so that it has time to stabilize at the proper temperature before the test is initiated. Record the furnace temperature (set point) prior to initiating the test.

8.2 Insure the stability threshold is set to 0.01 percent or 0.2 grams, depending on the software version in use.

8.3 Enter the correction factor for the specific mix to be tested into the furnace controller. This is the JMCF determined as specified in Section 7.

8.4 Weigh and record the weight of the sample basket assembly to the nearest 0.1 gram.

8.5 Prepare the sample as described in Section 6.2 above. Evenly distribute the sample taking care to keep the material away from the edges. If multiple sample basket are used to make up the assembly, divide the sample evenly between the individual units, taking care not to loose any material in the process. Replace the cover and complete the assembly by attaching the sample baskets to the catch pan with the clamping device. Weigh and record the weight of the sample basket assembly and the test sample to the nearest 0.1 gram. Calculate and record the initial weight of the test sample (total weight minus the weight of the sample basket assembly) to the nearest 0.1 gram.

8.6 Input the initial weight of the test sample, rounded to the nearest whole gram, into the ignition furnace controller. Verify that the correct weight has been entered.

8.7 Open the chamber door and carefully place the sample basket assembly into the furnace. Close the chamber door and verify that the weight displayed on the furnace balance readout indicates that the total weight of the sample basket assembly, including the weight of the test sample, equals the total weight recorded in Section 7.2.4 within ±10 grams. Differences greater than 10 grams or failure of the furnace scale to stabilize may indicate that the sample basket assembly is touching the furnace wall. This condition must be remedied before continuing or the test result will be invalid. Initiate the test by pressing the start/stop button on the furnace controller. This should cause the furnace chamber to be locked and start operation of the combustion blower.

8.8 Allow the test to continue until a stable condition has been achieved indicating that the test is complete. Press the start/stop button. This should unlock the chamber door, stop the operation of the combustion blower and cause the furnace controller to print out the results of the test. Record the calibrated asphalt content to the nearest 0.01 percent.

8.9 Open the chamber door, remove the sample baskets and allow to cool to room temperature 30 ±5 minutes. Weigh the sample basket assembly and the residual aggregate to the nearest 0.1g. Determine and record the weight of the residual aggregate (total weight minus the weight of the sample basket assembly).

9. REPORT

9.1 Report the corrected asphalt content, mix correction factor, compensation factor, total percent loss, initial sample weight, and the test temperature. Attach the original burn ticket to the report.

10. PRECISION AND BIAS

10.1 The following precision and bias were determined in an NCAT Round-Robin study for surface mixes.

Asphalt Content	Standard Deviation	Acceptable Range of Two Test Results, %
Single-Operator Precision	0.04	0.11
Multi-laboratory precision	0.06	0.17