



**DETERMINING ASPHALT BINDER CONTENT
& GRADATION OF HOT MIX ASPHALT (HMA)
BY THE IGNITION METHOD**

SCOPE

This test method covers the procedures used for the determination of the asphalt binder content and gradation of HMA mixtures by ignition of the asphalt binder in an oven. The aggregate remaining after ignition can be used for sieve analysis using IM 331.

REFERENCED DOCUMENTS

AASHTO T308 Determining Asphalt Binder Content of Hot Mix Asphalt (HMA) by Ignition Method
IM 301 Aggregate Sampling & Minimum Size of Samples for Sieve Analysis
IM 322 Sampling Uncompacted Hot Mix Asphalt
IM 323 Sampling Asphaltic Materials
IM 331 Mechanical Analysis of Extracted Aggregate
IM 336 Reducing Aggregate Field Samples to Test Samples
IM 357 Preparation of Hot Mix Asphalt Mix Samples for Test Specimens
IM 510 Design of Hot Mix Asphalt Mixtures

APPARATUS

- Ignition oven – Meeting the requirements of AASHTO T308 Method A or Method B.
- Sample basket(s) – Meeting the requirements of AASHTO T308 Method A or Method B.
- Catch pan of sufficient size to hold the sample basket(s) so that aggregate particles and melting binder falling through the screen mesh are caught.
- Spatula or trowel
- Pan of sufficient size to hold the HMA.
- Oven capable of maintaining $275 \pm 5^{\circ}\text{F}$ ($135 \pm 3^{\circ}\text{C}$).
- Balance: 10,000-gram minimum capacity and readable to 0.1 grams.
- Safety Equipment – safety glasses or face shield, high temperature gloves, long sleeve jacket, a heat resistant surface capable of withstanding 1202°F (650°C) and a protective cage capable of surrounding the sample baskets during the cooling period.
- Miscellaneous Equipment – a pan larger than the sample basket(s) for transferring sample after ignition, spatulas, bowls, and wire brushes.
- Mixer: capable of mixing samples of HMA of at least 2000 grams.

PROCEDURE

Sampling

1. Obtain samples of aggregate in accordance with IM 301.
2. Obtain samples of asphalt binder in accordance with IM 323.
3. Obtain samples of freshly produced hot mix asphalt in accordance with IM 322.

Establishing a Mixture-Specific Calibration Factor

This method may be affected by the type of aggregate in the mixture. Accordingly, to optimize accuracy, a calibration factor will be established with the testing of a calibration sample for each mix to be tested. The calibration factor shall be established using the ignition oven intended for quality control.

The calibration process should be repeated each time there is a significant change in the mix.

Calibrate the ignition oven components per the manufacturer's recommendations.

If using an ignition oven with a built in scale, set the ignition oven to test until either the change in weight does not exceed 0.01 percent of the total sample weight for three consecutive minutes or until the sample weight loss does not exceed 0.2 g for three consecutive minutes.

1. Prepare a calibration sample according to Table 1 at the target binder content. Aggregate used for the calibration specimen shall be sampled from stockpiled material produced in the current construction season and designated for use on the candidate project. A sample of the cold feed from the plant is preferred. The aggregates shall be in the proportions needed to obtain the target aggregate gradation. Combine the aggregates and binder by following the procedure in the Mixture Batching, Curing & Testing Section of IM 510. The aggregates and binder may be combined by hand mixing, such that the aggregates are fully coated with binder prior to curing.

Table 1

Sieve Size	Sample Size, g
1 in.	3000-3100
3/4 in.	2000-2100
1/2 in.	1500-1600
3/8 in.	1200-1300

NOTE: If the Hobart 20 quart (19 liter) mixer is used, a minimum sample size of 6000 grams is required. The extra material may be used to check the calibration factor obtained with the first sample.

2. Oven-cure the freshly mixed sample for 2 hours, per IM 510, prior to testing. 1 hour into curing, remove the sample, thoroughly stir and place back into the oven for the remainder of

the curing time.

3. After oven curing, test the specimen using the same procedure as outlined in the Testing Section.
4. Once the calibration specimen has been burned, determine the measured asphalt binder content for the calibration sample by calculation and/or from the printed tickets.
5. The difference between the target binder content and the binder content determined from the ignition oven is the calibration factor for that mix (see Example A for an example calculation).

Testing

1. Preheat the ignition oven to 1000°F (538°C). Manually record the oven temperature (set point) prior to the initiation of the test if the oven does not record automatically.

NOTE: If the calibration factor for a given mixture is determined at any temperature other than 1000°F (538°C), production samples for that mixture must be tested at that sample temperature.

2. If using an ignition oven with a built in scale, enter the calibration factor for the specific mix to be tested, as determined in the Establishing a Mixture-Specific Calibration Factor Section, in the ignition oven, if desired.
3. Split out a test sample according to Table 1 using the procedure in IM 357. If the mixture is not sufficiently soft to separate with a spatula or trowel, place it in a large flat pan in an oven at 275°F ± 5°F (135°C ± 3°C) until it is workable.

NOTE: Care should be taken with production samples suspected of containing moisture. Samples with moisture can cause variations in the P_b obtained from the ignition oven. If the sample may contain moisture, split out an additional sample (min. 500g) and determine and record the moisture content by drying to a constant weight in an oven at 275°F.

4. Evenly distribute this sample in the sample basket(s) that have been placed in the catch pan, taking care to keep the material away from the edges of the basket. Use a spatula or trowel to level the specimen to an even depth.
5. Weigh and record the initial weight of the sample to the nearest 0.1 g and the total weight of the sample and basket to the nearest 0.1 g.
6. If using an ignition oven with a built in scale, input the initial weight of the sample in whole grams into the ignition oven controller. Verify that the correct weight has been entered.
7. Open the chamber door, and place the sample basket(s) in the oven. Close the chamber door. If using an ignition oven with a built in scale, verify that the weight displayed on the

oven scale equals the total weight recorded in #6 above within ± 5 g. Differences greater than 5 g or failure of the oven scale to stabilize may indicate that the sample basket(s) are contacting the oven wall. Immediately initiate the test by pressing the start/stop button. This will lock the sample chamber and start the combustion blower.

NOTE: The oven temperature will drop below the setpoint when the door is opened, but will recover when the door is closed and when ignition occurs. Sample ignition typically increases the temperature well above the setpoint, depending on sample size and binder content.

8. If using an ignition oven with a built in scale, allow the test to continue until the stable light and audible stable indicator indicates the test is complete. If the ignition oven does not indicate that testing is complete when 1 hr \pm 2 min has elapsed, stop the test. If using an ignition oven without a built in scale, stop the test when 1 hr \pm 2 min has elapsed.
9. Press the start/stop button. This will unlock the sample chamber and, if using an ignition oven with a built in scale, will cause the printer to print out the test results.

NOTE: Testing **must** be completed within 1 hr. Testing performed after this time can cause the material to breakdown.

10. Open the chamber door, remove the sample basket(s), and allow them to cool to room temperature (approximately 30 minutes).
11. If the aggregate calibration factor had been entered into the ignition oven prior to testing, use the corrected asphalt binder content (percent) from the printed ticket. If the aggregate calibration factor had not been entered into the ignition oven prior to testing, adjust the production sample binder content as shown in Example B and report the corrected binder content. Correct for moisture if needed.

Gradation

1. After allowing the sample to cool to room temperature in the sample baskets, empty the contents of the basket(s) into a clean, dry flat pan. Use a small wire sieve brush to ensure that any residual fines are removed from the basket(s).
2. Perform the gradation analysis according to IM 331.

DOCUMENTATION

Report the following information to the appropriate laboratory:

- Target binder content
- Corrected binder content
- Ignition oven binder content
- Target aggregate gradation

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- Ignition oven aggregate gradation
 - Calibration Factor
 - Duration of test
 - Total Percent loss
 - Initial weight
 - Test Temperature
 - Temperature compensation factor

EXAMPLE A

Determine the Calibration Factor for a mix.

Given: Target binder content = 5.50%
Ignition oven binder content_(calibration sample) = 5.72%

Calibration Factor = Target binder content - Ignition oven binder content_(calibration sample)

$$\text{Calibration Factor} = 5.50 - 5.72 = -0.22\%$$

NOTE: The Calibration Factor is normally a negative number.

EXAMPLE B

Determine the corrected binder content for a production sample.

Given: Ignition oven binder content_(production sample) = 5.75%
Calibration Factor = -0.22%

Corrected binder content = Ignition oven binder content_(production sample) + Calibration Factor

$$\text{Corrected binder content} = 5.75 + (-0.22) = 5.75 - 0.22 = 5.53\%$$