

**METHODS OF SAMPLING AND TESTING**  
**MT 319-13**  
**METHOD OF TEST FOR DETERMINING THE ASPHALT BINDER CONTENT**  
**OF HOT MIX ASPHALT (HMA) BY THE IGNITION METHOD**  
*(Modified AASHTO T 308)*

**1 Scope:**

- 1.1** This test method covers the determination of asphalt binder content of HMA mixtures by ignition at temperatures that reach the flashpoint of the binder in a furnace. The means of sample heating may be the convection method or the direct infrared (IR) irradiation method. The aggregate remaining after burning can be used for sieve analysis using MT 320.
- 1.2** The values in metric units are to be regarded as the standard.
- 1.3** 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 consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

**2 Referenced Documents:**

**2.1 AASHTO:**

M 231 Weighing Devices Used in the Testing of Materials  
T 308 Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method

**MT Manual:**

MT 202 Sieve Analysis of Fine and Coarse Aggregates  
MT 303 Method of Sampling Bituminous Paving Mixtures  
MT 309 Reducing Samples of Hot Mix Asphalt to Testing Size  
MT 312 Method of Determining Moisture Content of Bituminous Mixtures  
MT 320 Mechanical Analysis of Aggregate Recovered from Ignition Oven Burn  
MT 325 Method of Determining Moisture Content of Bituminous Mixtures or Aggregate Using Microwave Ovens

**3 Summary of Test Method:**

- 3.1** The asphalt binder in the paving mixture is ignited using the furnace equipment applicable to the particular method. The asphalt binder content is calculated as the difference between the initial mass of the hot-mix asphalt and the mass of the residual aggregate. The asphalt content is expressed as mass percent of moisture-free mixture.

**4 Significance and Use:**

- 4.1** This method can be used for quantitative determinations of asphalt binder content and gradation in HMA mixtures and pavement samples for quality control, specification acceptance, and mixture evaluation studies. This method does not require the use of solvents. Aggregate obtained by this test method may be used for gradation analysis according to MT 320.

## 5 Apparatus:

**5.1** *Ignition furnace* - A forced air ignition furnace that heats the samples by either convection method or direct IR irradiation method. The convection-type furnace must be capable of maintaining the temperature at 578°C (1072°F). The furnace shall have an internal balance thermally isolated from the furnace chamber and accurate to 0.1 g. The balance shall be capable of weighing a 3500 gram sample in addition to the sample baskets. A data collection system will be included so that the weight can be automatically determined and displayed during the test. The furnace shall have a built in computer program to calculate change in mass of the sample baskets and provide for the input of a correction factor. The furnace chamber dimensions shall be adequate to accommodate a sample size of 3500 grams. The furnace shall provide an audible alarm and indicator light when the sample mass loss does not exceed 0.01 percent of the total sample mass for three consecutive minutes. The furnace door shall be equipped so that the door cannot be opened during the ignition test. The furnace shall be vented into a hood or to the outside. The furnace shall have a fan with capability to pull air through the furnace to expedite the test and to reduce the escape of smoke into the laboratory.

**5.2** *Sample basket(s)* - of appropriate size that allows the samples to be thinly spread and allows air to flow through and around the sample particles. Sets with two or more baskets shall be nested. The sample shall be completely enclosed with screen mesh, perforated stainless steel plate, or other suitable material.

**Note 1** - *Screen mesh or other suitable material with maximum and minimum opening of 2.36 mm (No. 8) and 600 microns (No. 30), respectively, has been found to perform well.*

**5.3** *Catch Pan* - of sufficient size to hold the sample basket(s) so that aggregate particles and melting asphalt binder falling through the screen mesh are caught.

**5.4** *Oven* - capable of maintaining 125 ± 5°C (257 ± 9°F).

**5.5** *Balance* - of sufficient capacity and conforming to the requirements of M 231, Class G 2, for weighing specimen in basket(s).

**5.6** *Safety Equipment* - face shield, high temperature gloves, a heat resistant surface capable of withstanding 650°C (1202°F) and a protective cage capable of surrounding the sample baskets during the cooling period.

**5.7** *Miscellaneous Equipment* - a pan larger than the sample basket(s) for transferring sample after ignition, spatulas, bowls, wire brushes, and other manufacturer's equipment.

## 6 Sampling:

**6.1** Obtain samples of freshly produced hot-mix asphalt (HMA) in accordance with MT 303.

**6.2** The test specimen shall be the end result of quartering a larger sample taken in accordance with MT 309.

**6.3** If the HMA is not sufficiently soft to separate with a spatula or trowel, place it in a large flat pan or glass dish in an oven (conventional or microwave). Heat the sample to separate. Excessive heat may cause asphalt drain down.

**6.4** The size of the test sample shall be governed by the nominal maximum aggregate size of the HMA and shall conform to the mass requirement shown in Table 1. Specimen sizes shall not be more than 400 grams greater than the minimum recommended specimen mass.

**Note 2** - *Large samples of fine mixes tend to result in incomplete ignition of asphalt.*

**6 Sampling: (continued)**

Table 1—Mass Requirements

Nominal Max Agg Size, mm	Sieve Size	Min Mass of Specimen, g
4.75	No. 4	1200
9.5	3/8 in.	1200
12.5	1/2 in.	2000
19.0	3/4 in.	2000
25.0	1 in.	3000
37.5	1 1/2 in.	4000

**7 Test Procedure:****7.1 Test Initiation:**

**7.1.1** For the convection-type furnace, preheat the ignition furnace to 538°C (1000°F) or as determined in ANNEX A1.9.1. Manually record the furnace temperature (set point) prior to the initiation of the test if the furnace does not record automatically.

**7.1.2** For the direct IR irradiation-type furnace, preheat furnace to 420°C (788°F) or manufacturer's recommendation.

**7.2** Determine the moisture content of the sample according to MT 312 or MT 325 at the beginning and middle of each production day and as needed.

**7.3** Apply the correction factor for the specific mix to be tested as determined in ANNEX A1 in the ignition furnace.

**7.4** Weigh and record the mass of the sample basket(s) and catch pan (with guards in place).

**7.5** Prepare the sample as described in Section 6. 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.

**7.6** Weigh and record the total mass of the sample, basket(s), catch pan, and basket guards. Calculate and record the initial mass of the specimen (total mass minus the mass of the specimen basket assembly).

**7.7** Input the initial mass of the specimen to 0.1 of a gram for direct IR irradiation-type furnace or 1 gram for convection-type furnace into the ignition furnace controller. Verify that the correct mass has been entered.

**7.8** Open the chamber door, and place the sample baskets in the furnace. Close the chamber door, and verify that the sample mass (including the basket(s)) displayed on the furnace scale equals the total mass recorded in Section 7.6 within  $\pm 5$  g. (Note 4). Differences greater than 5 g or failure of the furnace scale to stabilize may indicate that the sample basket(s) are contacting the furnace wall. Initiate the test by pressing the start/stop button. This will lock the sample chamber and start the combustion blower.

**7 Test Procedure: (continued)**

**Note 3** - The furnace temperature will drop below the set point when the door is opened, but will recover with the door closed and when ignition occurs. Sample ignition typically increases the temperature well above the set point, depending on sample size and asphalt content.

**Note 4** - The weights obtained from external weighing take precedence over those obtained from the internal balance.

- 7.9** Allow the test to continue until the stable light and audible stable indicator indicate the test is complete (the change in mass does not exceed 0.01 percent for three consecutive minutes). Press the start/stop button. This will unlock the sample chamber door.
- 7.10** Open the chamber door, remove the sample basket(s), and allow them to cool to room temperature (approximately 30 minutes) and weigh. During cooling, make sure sample basket(s) are protected from contaminants.
- 7.11** Calculate the corrected asphalt binder content (percent) from the external weighing according to the following equation:

$$Pb, \% = \left[ \frac{(Mi - Mf)}{Mi} \times 100 \right] \pm Cf - MC$$

<b>Pb</b>	=	<b>the measured (corrected) asphalt binder content, percent</b>
<b>Mi</b>	=	<b>the total mass of the HMA specimen prior to ignition, g</b>
<b>Mf</b>	=	<b>the total mass of aggregate remaining after the ignition, g</b>
<b>Cf</b>	=	<b>the correction factor, percent by mass of HMA specimen</b>
<b>MC</b>	=	<b>the moisture content of the HMA</b>

**8 Gradation:**

- 8.1** Allow the specimen to cool to room temperature in the sample baskets.
- 8.2** Empty the contents of the baskets and the catch pan into a flat pan. Use a small wire sieve brush to ensure that any residual fines are removed from the baskets. Take care to retain all material.
- 8.3** Weigh the specimen and perform the gradation analysis according to MT 320.

**9 Report:**

- 9.1** Report the corrected asphalt binder content to the nearest 0.01%, correction factor, temperature compensation factor (if applicable), total percent loss, sample mass and moisture content (if determined).

**ANNEX****A1 Correction Factor:**

- A1.1** This method may be affected by the type of aggregate in the mixture. Accordingly, to optimize accuracy, a correction factor will be established with the testing of a set of correction factor samples for each type of HMA. This procedure must be performed before any acceptance testing is completed. Certain aggregate types may result in an unusually high correction factor (>0.5 percent) and erroneous gradation results due to aggregate breakdown. Such mixes should be corrected and tested as described in ANNEX A1.8.

**ANNEX: (continued)**

- A1.2** The process for determining a correction factor should be repeated each time there is a new or transferred HMA design. Each ignition furnace shall have its own, unique correction factor determined in the location where testing will be performed.
- A1.3** According to the requirements of Section 6, prepare a minimum of four correction samples at the job mix formula design asphalt content and gradation using only virgin material in a buttered bowl. Aggregate used for the correction factor specimens shall be sampled from stockpiled material produced and designated to be used on the candidate project. An additional “blank” (aggregate only) specimen shall be provided, if aggregate degradation is apparent according to MDT personnel, for aggregate gradation comparison according to MT 320. The washed gradation shall fall within the mix design tolerances.

**Note 5** - *This is performed in the Helena Mix Design Laboratory for MDT testing.*

- A1.4** The freshly mixed specimens may be placed directly in the sample baskets. If allowed to cool, the samples must be preheated in a conventional oven to compaction temperature. Do not preheat the sample baskets.
- A1.5** Test specimens in accordance with Sections 7 and 8.
- A1.6** Determine the measured asphalt binder contents for each sample by calculation or from the printed tickets, after the appropriate number of calibration samples have been burned.
- A1.7** If the difference between the measured asphalt binder contents of the two samples exceeds 0.15 percent, repeat the two tests and, from the four tests, discard the high and low results. Determine the correction factor from the two remaining results. Calculate the difference between the actual and measured asphalt binder contents for each sample. The correction factor is the average of the differences expressed in percent by weight of the asphalt mixture.
- A1.8** Correction Factor Temperature Adjustment:
- A1.8.1** For the convection-type furnace, if the correction factor exceeds 1.0 percent, lower the test temperature to  $482 \pm 5^{\circ}\text{C}$  ( $900 \pm 8^{\circ}\text{F}$ ) and repeat test. Use the correction factor obtained at  $482^{\circ}\text{C}$  even if it exceeds 1.0 percent.
- A1.8.2** For the direct irradiation-type furnace, the Option 2 burn profile should be used for most materials. Option 1 is designed for very soft aggregate (such as dolomites) that typically require a large aggregate correction factor (greater than 1%). Option 2 is designed for samples that may not burn completely using the DEFAULT burn profile and is appropriate for most of Montana aggregates.
- A1.9** Test Temperature:
- A1.9.1** For the convection-type furnace, the temperature for testing HMA samples in Section 7.1.1 shall be the same temperature selected for testing mixture correction samples.
- A1.9.2** For the direct IR irradiation-type furnace, the burn profile for testing HMA samples in Sections 7.1.2 shall be the same burn profile selected for testing mixture correction samples.
- A2** [Burn Oven Worksheet](#)