METHODS OF SAMPLING AND TESTING
MT 319-17
DETERMINING THE ASPHALT BINDER CONTENT OF PLANT MIX SURFACING (PMS) BY THE IGNITION METHOD
(*Modified AASHTO T 308*)

1 Scope

1.1 This test method covers the determination of asphalt binder content of Plant Mix Surfacing (PMS) mixtures by ignition at temperatures that reach the flashpoint of the binder in a furnace. The means of specimen heating may be the convection method or the direct infrared (IR) irradiation method.

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

AASHTO
M 231 Weighing Devices Used in the Testing of Materials
R 47 Reducing Samples of Hot Mix Asphalt (HMA) to Testing Size
T 308 Determining the Asphalt Binder Content of Asphalt Mixtures by the Ignition Method
T 329 Moisture Content of Asphalt Mixtures by Oven Method

MT Materials Manual
MT 202 Sieve Analysis of Fine and Coarse Aggregates
MT 303 Sampling Bituminous Paving Mixtures
MT 320 Mechanical Analysis of Aggregate Recovered from Ignition Oven Burn

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 PMS and the mass of the residual aggregate. The asphalt content is expressed as mass percent of moisture-free mixture. This method may be affected by the type of aggregate in the mixture. Accordingly, to optimize accuracy, establish correction factors for asphalt binder and aggregate by testing a set of correction factor specimens for each type of PMS.

4 Significance and Use

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

5 Apparatus

Ensure equipment used meets the following requirements:

5.1 *Ignition furnace* – A forced air ignition furnace that heats the specimen by either convection method or direct IR irradiation method. Use a convection-type furnace capable of maintaining a temperature at 578°C (1072°F). Use a furnace containing an internal balance thermally isolated from the furnace chamber and accurate to 0.1 g. The balance must be capable of weighing a 3500 gram specimen in addition to the specimen baskets. A data collection system is included so that the weight can be automatically determined and displayed during the test. The furnace has a built in computer program to calculate change in mass of the specimen and provide for the input of a correction factor. The furnace chamber and basket dimensions must be adequate to

accommodate a specimen size of up to 3500 grams. The furnace provides an audible alarm and indicator light when the specimen mass loss does not exceed 0.01 percent of the total specimen mass for three consecutive minutes. The furnace door is equipped so that the door cannot be opened during the ignition test. The furnace must be vented into a hood or to the outside. The furnace is equipped with a fan capable of pulling the air through the furnace to expedite the test and to reduce the escape of smoke into the laboratory.

5.2 *Specimen basket(s)* – of appropriate size that allows the specimens to be thinly spread and allows air to flow through and around the specimen particles. Ensure sets with 2 or more baskets are nested. Completely enclose the specimen 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 specimen basket(s) so that aggregate particles and melting asphalt binder falling through the screen mesh are caught.

5.4 *Oven* – capable of maintaining mix design compaction temperature.

5.5 *Balance* – of sufficient capacity and conforming to the requirements of AASHTO M 231, Class G2, 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 specimen baskets during the cooling period.

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

6 Sampling

6.1 Obtain samples of freshly produced PMS in accordance with MT 303.

6.2 Obtain the test specimen by splitting a sample taken in accordance with AASHTO R 47.

6.3 If the mixture 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 specimen to separate. Excessive heat may cause asphalt drain down or oxidation to occur, altering the results.

6.4 The size of the test specimen is governed by the nominal-maximum aggregate size of the PMS and must conform to the mass requirement shown in Table 1. Ensure the specimen is no more than 400 grams greater than the minimum recommended specimen mass.

Note 2 – Large specimens of fine mixes tend to result in incomplete ignition of asphalt.

Table 1—Mass Requirements

Nominal Max Agg Size, mm	Sieve Size	Min Mass of Specimen, g
4.75	No. 4	1200
9.5	⅜ in.	1200
12.5	½ in.	2000
19.0	¾ in.	2000
25.0	1 in.	3000
37.5	1½ 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 A4.1. 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. Use the same burn profile as used during the correction factor determination.

7.2 Determine the moisture content of the specimen according to AASHTO T 329 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 specimen basket(s) and catch pan (with guards in place) to the nearest 0.1 gram.

7.5 Prepare the specimen as described in Section 6. Place the specimen basket(s) in the catch pan. Evenly distribute the specimen in the specimen basket(s), 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 specimen, 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 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 specimen basket assembly in the furnace, carefully positioning the specimen basket assembly so it is not in contact with the furnace walls. Close the chamber door, and verify that the specimen mass (including the basket assembly) displayed on the furnace scale equals the total mass recorded in Section 7.6 within ± 5 grams. (Note 4). An indication that the specimen basket assembly is contacting the furnace wall is a difference greater than 5 g or failure of the furnace scale to stabilize.

Initiate the test by pressing the start/stop button. This operation will lock the specimen chamber and start the combustion blower.

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. Specimen ignition typically increases the temperature well above the set point, depending on specimen size and asphalt binder 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 alarm 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 specimen chamber door.

7.10 Open the chamber door, remove the specimen basket assembly, allow specimen to cool to room temperature and weigh. During cooling, ensure specimen basket assembly is protected from contaminates.

7.11 Calculate the corrected asphalt binder content (percent) from the external weighing according to the following equation:

$$Pb,\% = \left[\frac{(Mi - Mf)}{Mi} X100 \right] \pm Cf - MC$$

Where:
Pb = the measured (corrected) asphalt binder content, percent
Mi = the total mass of the PMS specimen prior to ignition, g
Mf = the total mass of aggregate remaining after the ignition, g
Cf = the correction factor, percent by mass of PMS specimen
MC = the moisture content of the PMS

8 Extraction of Residual Aggregate for Gradation

8.1 Cool the contents of the specimen baskets to room temperature prior to performing the gradation analysis. Empty the contents of the baskets into a flat pan, being careful to capture all the material. Use a small wire sieve brush to ensure that any residual fines are removed from the baskets and catch pan.

8.2 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, specimen mass and moisture content (if determined).

ANNEX

A1 Correction Factors

A1.1 Asphalt binder content results may be affected by the type of aggregate in the mixture and the ignition furnace. Accordingly, to optimize accuracy, establish a correction factor by testing a set of correction factor specimens for each type of PMS. Perform this procedure before any acceptance testing is completed. Repeat the process for determining a correction factor each time there is a new or transferred PMS design. Determine a unique correction factor for each ignition furnace in the location where testing is to be performed.

A1.2 Asphalt binder correction factor – Certain aggregate types may result in unusually high correction factors (greater than 1.0 percent). Such mixes must be corrected and tested at a lower temperature, as described below. Determine a unique asphalt binder correction factor for each ignition furnace in the location where testing will be performed.

A1.3 Aggregate correction factor – Due to potential aggregate breakdown during the ignition process, determine a unique aggregate correction factor for each ignition furnace in the location where testing will be performed when the following conditions occur: aggregates that have a proven history of excessive breakdown; or aggregates are from an unknown source.

A2 Correction Factor Procedure

A2.1 According to the requirements of Section 6, prepare a minimum of four correction specimens at the job mix formula design asphalt content and gradation using only virgin material in a buttered bowl. Sample aggregate used for the correction factor specimens from stockpiled material produced and designated for use on the candidate project. An additional “blank” (aggregate only) specimen is provided for aggregate gradation comparison according to MT 320. The washed gradation must fall within the mix design tolerances.

A2.2 Place the freshly mixed specimens directly in the specimen baskets assembly. If allowed to cool, heat the specimens in a conventional oven to compaction temperature. Do not preheat the specimen baskets assembly.

A2.3 Test the specimens in accordance with Sections 7 and 8.

A2.4 After burning the appropriate number of calibration specimens, determine the measured asphalt binder contents for each specimen by calculation or from the printed tickets.

A2.5 If the difference between the measured asphalt binder contents of the 2 specimens exceeds 0.15 percent, repeat the 2 tests and, from the 4 tests, discard the high and low results. Determine the correction factor from the 2 remaining results. Calculate the difference between the actual and measured asphalt binder contents for each specimen. The correction factor is the average of the differences expressed in percent by weight of the asphalt mixture.

A3 Correction Factor Ignition Oven Temperature Adjustment

A3.1 For the convection-type furnace, if the correction factor exceeds 1.0 percent, lower the test temperature to 482 ± 5°C (900 ± 8°F) and repeat test. Use the correction factor obtained at 482°C (900 ± 8°F) even if it exceeds 1.0 percent.

A3.2 For the direct irradiation-type furnace, use Option 2 burn profile 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 specimens that may not burn completely using the DEFAULT burn profile and is appropriate for most of Montana aggregates.

A4 Procedure Temperature

A4.1 For the convection-type furnace, the temperature for testing PMS specimens in Section 7.1.1 is the same temperature selected for testing mixture correction specimens.

A4.2 For the direct IR irradiation-type furnace, the burn profile for testing PMS specimens in Section 7.1.2 is the same burn profile selected for testing mixture correction specimens.

A5 Aggregate Correction Factor

A5.1 Perform a gradation analysis on the residual aggregate in accordance with MT 320. Utilize the results to develop an aggregate correction factor. Calculate and report to the nearest 0.1 percent.

A5.2 From the gradation results, subtract the percent passing for each sieve for each specimen from the percent passing each sieve of the “blank” specimen gradation results from Section A2.1.

A5.3 Determine the average difference for the 2 values. If the difference for a single sieve exceeds the allowable difference for that sieve as listed in Table A1, apply aggregate gradation correction factors (equal to the resultant average differences) for all sieves, to all acceptance gradation test results determined by MT 320, prior to final rounding and reporting. If the 0.075-mm (No. 200) sieve is the only sieve outside the limits in Table A1, apply the aggregate correction factor to only the 0.075-mm (No. 200) sieve.

Table A1 – Permitted Sieving Difference

Sieve Size	Allowable Difference
Sizes larger or equal to 2.36 mm (No. 8)	±5.0%
Sizes larger than 0.075 mm (No. 200) and smaller than 2.36 mm (No. 8)	±3.0%
Sizes 0.075 mm (No. 200) and smaller	±0.5%