
Standard Method of Test for

Determining the Asphalt Binder
Content of Hot Mix Asphalt (HMA)
by the Ignition Method

AASHTO Designation: T 308-05



**American Association of State Highway and Transportation Officials
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1. SCOPE

- 1.1. This test method covers the determination of asphalt binder content of hot-mix asphalt (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 T 30.
- 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 Standards:*
- M 231, Weighing Devices Used in the Testing of Materials
 - R 35, Superpave Volumetric Design for Hot Mix Asphalt (HMA)
 - T 2, Sampling of Aggregates
 - T 30, Mechanical Analysis of Extracted Aggregate
 - T 40, Sampling Bituminous Materials
 - T 168, Sampling Bituminous Paving Mixtures
 - T 248, Reducing Samples of Aggregate to Testing Size
 - T 328, Reducing Samples of Hot Mix Asphalt to Testing Size
 - T 329, Moisture Content of Hot Mix Asphalt (HMA) by Oven Method
- 2.2. *Other Document:*
- Manufacturer's Instruction Manual

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. This procedure covers two methods. Method A requires an ignition furnace with an internal balance. Method B requires an ignition furnace with an external balance.

- 3.2. The asphalt binder content is calculated as the difference between the initial mass of the HMA and the mass of the residual aggregate, with adjustments for an asphalt binder correction factor and the moisture content. The asphalt binder content is expressed as a mass percent of the moisture-free mixture. This method may be affected by the type of aggregate in the mixture. Accordingly, to optimize accuracy, correction factors for asphalt binder and aggregate will be established with the testing of a set of correction factor specimens for each type of HMA. Correction factors must be established before any acceptance testing is completed.

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 T 30.

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 chamber dimensions shall be adequate to accommodate a sample size of 3500 g. The furnace door shall be equipped so that the door cannot be opened during the ignition test. A method for reducing furnace emissions shall be provided. The furnace shall be vented into a hood or to the outside and, when set up properly, shall have no noticeable odors escaping into the laboratory. 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.
- 5.1.1. For Method A the furnace shall also 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 g 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 for aggregate loss. The furnace shall provide a printed ticket with the initial sample mass, sample mass loss, temperature compensation, correction factor, corrected asphalt binder content (percent), test time, and test temperature. 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 shall also allow the operator to change the ending mass loss percentage to 0.02 percent.
- 5.2. *Sample Basket Assembly* — consisting of sample basket(s), catch pan, and an assembly guard to secure sample basket(s) to catch pan
- 5.2.1. *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.
- 5.2.2. *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.

- 5.3. *Oven*—capable of maintaining $125 \pm 5^{\circ}\text{C}$ ($257 \pm 9^{\circ}\text{F}$).
- 5.4. *Balance*—of sufficient capacity and conforming to the requirements of M 231, Class G 2.
- 5.5. *Safety Equipment*—safety glasses or face shield, dust mask, high temperature gloves, long sleeve jacket, 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.
- 5.6. *Miscellaneous Equipment*—a pan larger than the sample basket(s) for transferring sample after ignition, spatulas, bowls, and wire brushes.

6. SAMPLING

- 6.1. Obtain samples of freshly produced HMA in accordance with T 168.
- 6.2. The sample shall be the end result of reducing a larger sample in accordance with T 328.
- 6.3. 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 $125 \pm 5^{\circ}\text{C}$ ($257 \pm 9^{\circ}\text{F}$) until it is workable. Do not leave the sample in the oven for an extended period of time. Excessive heating may cause detrimental effects such as asphalt drain down or aging.
- 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. When the mass of the sample exceeds the capacity of the equipment used, the sample may be divided into suitable increments, tested, and the results appropriately combined for calculation of the asphalt binder content (weighted average).

Note 2—Large samples of fine mixes tend to result in incomplete ignition of asphalt binder.

Table 1—Mass Requirements

Nominal Maximum Aggregate * Size, mm (in)	Minimum Mass of Sample, g	Maximum Mass of Sample, g
4.75 (No. 4)	1200	1700
9.5 (3/8)	1200	1700
12.5 (1/2)	1500	2000
19.0 (3/4)	2000	2500
25.0 (1)	3000	3500
37.5 (1 1/2)	4000	4500

* Nominal Maximum Aggregate Size- one sieve size larger than the first sieve to retain more than 10 percent.

TEST METHOD A – INTERNAL BALANCE

7. TEST PROCEDURES

- 7.1. Test Initiation:
- 7.1.1. For the convection-type furnace, preheat the ignition furnace to 538°C (1000°F) or as determined by the correction factor process in “Annex.” 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 IR direct irradiation-type furnace, use the same burn profile as used during the correction factor determination.
- 7.2. Oven dry the HMA sample to constant mass according to T 329, or determine the moisture content of a companion sample according to T 329.
- 7.3. Enter into the ignition furnace or record the asphalt binder correction factor for the specific mix to be tested, as determined by the correction factor process in “Annex.”
- 7.4. Determine and record the mass of the sample basket assembly to the nearest 0.1g.
- 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 sample.
- 7.6. Determine and record the total mass of the sample and sample basket assembly to the nearest 0.1g. Calculate and record the initial mass of the sample, M_i , (total mass minus the mass of the sample basket assembly).
- 7.7. Input the initial mass of the sample M_i , in whole grams into the ignition furnace controller. Verify that the correct mass has been entered.
- 7.8. Open the chamber door, and gently place the sample basket assembly in the furnace. Carefully position the sample basket assembly so it is not in contact with the furnace walls. Close the chamber door, and verify that the sample mass (including the basket assembly) displayed on the furnace scale equals the total mass recorded in Section 7.6 within ± 5 g. Differences greater than 5 g or failure of the furnace scale to stabilize may indicate that the sample basket assembly is contacting the furnace wall.
- Note 3**— Due to the extreme heat of the furnace, the operator should wear safety equipment – high temperature gloves, face shield, fire-retardant shop coat – when opening the door to load or unload the sample.
- 7.9. Initiate the test by pressing the start/stop button. This will lock the sample chamber and start the combustion blower. Do not attempt to open the furnace door until the asphalt binder has been completed burned off.
- Note 4**—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 binder content.

- 7.10. 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 and cause the printer to print out the test results.
- Note 5**—An ending mass loss percentage of 0.02 may be substituted when aggregate that exhibits an excessive amount of loss during ignition testing is used. The precision and bias statement was developed using 0.01 percent. Both precision and accuracy may be adversely affected by using 0.02 percent.
- 7.11. Open the chamber door, remove the sample basket assembly, and place on a cooling plate or block. Place protective cage over the sample basket assembly and allow it to cool to room temperature (approximately 30 minutes).
- 7.12. Determine and record the total mass after ignition of the sample and sample basket assembly to the nearest 0.1g. Calculate and record the final mass of the sample, M_f , (total mass minus the mass of the sample basket assembly).
- 7.13. Use the corrected asphalt binder content (percent) from the printed ticket, if not corrected, subtract the asphalt binder correction factor. If a moisture content has been determined, subtract the percent moisture from the asphalt binder content on the printed ticket, and report the resultant value as the corrected asphalt binder content.
- Note 6**—Asphalt binder content percentage can also be calculated using the formula from “Method B.”

TEST METHOD B – EXTERNAL BALANCE

8. TEST PROCEDURES

- 8.1. Preheat the ignition furnace to 538°C (1000°F) or as determined by the correction factor process in “Annex.”
- 8.2. Oven dry the HMA sample to constant mass according to T 329, or determine the moisture content of a companion sample according to T 329.
- 8.3. Record the asphalt binder correction factor for the specific mix to be tested as determined by the correction factor process in “Annex.”
- 8.4. Determine and record the mass of the sample basket assembly to the nearest 0.1g..
- 8.5. Prepare the sample as described in Section 6. Place the sample baskets in the catch pan. Evenly distribute the sample in the basket(s) taking care to keep the material away from the edges.
- 8.6. Determine and record the total mass of the sample and sample basket assembly to the nearest 0.1g. Calculate and record the initial mass of the sample, M_i , (total mass minus the mass of the sample basket assembly).
- 8.7. Burn the HMA sample in the furnace for at least 45 minutes.

Note 7—The appropriate time for the initial burn of an HMA sample is dependent on the sample size. For large samples, the time could be significantly longer than 45 minutes. See manufacturer’s manual for guidelines.

- 8.8. Remove the sample and sample basket assembly from the furnace after ignition, and allow it to cool to approximately room temperature (at least 30 minutes).
- 8.9. Determine and record the mass of the sample and sample basket assembly after ignition to the nearest 0.1 g.
- 8.10. Place the sample and sample basket assembly back into the furnace.
- 8.11. Burn the sample for at least 15 minutes after the furnace reaches the set temperature.
- 8.12. Remove the sample and sample basket assembly from the furnace and allow it to cool to approximately room temperature (at least 30 minutes).
- 8.13. Determine and record the mass of the sample and sample basket assembly after ignition to the nearest 0.1 g.
- 8.14. Repeat Sections 8.10 through 8.13 until the change in measured mass after ignition does not exceed 0.01 percent of the initial sample mass M_i .

Note 8—An ending mass loss percentage of 0.02 may be substituted when aggregate exhibits an excessive amount of loss during ignition testing. Both precision and accuracy may be adversely affected by using 0.02 percent. After the time required to obtain the specified mass loss has been established for each mixture, repeated mass determinations may not be necessary.

- 8.15. Calculate and record the final mass of the sample, M_f , (total mass minus the mass of the sample basket assembly).
- 8.16. Calculate the asphalt binder content of the sample as follows:

$$P_b \% = \left[\frac{(M_i - M_f)}{M_i} \times 100 \right] - C_F - MC \quad (1)$$

where:

- P_b = the measured (corrected) asphalt binder content;
- M_i = the total mass of the HMA sample prior to ignition, g;
- M_f = the total mass of aggregate remaining after ignition, g;
- C_F = the asphalt binder correction factor, percent by mass of HMA sample; and
- MC = the moisture content of HMA sample.

- 8.17. If moisture content has been determined per T 329, subtract the percent moisture from the asphalt binder percent, and report the resultant value as the corrected asphalt binder content (P_b).

9. GRADATION

- 9.1. Empty the contents of the baskets into a flat pan being careful to capture all material. Use a small wire sieve brush to ensure that any residual fines are removed from the baskets.
- 9.2. Perform the gradation analysis according to T 30.

10. REPORT

- 10.1. *Report*—the test method (A or B), corrected asphalt binder content, correction factor, temperature compensation factor (if applicable), total percent loss, sample mass, moisture content (if determined per T 329) and test temperature. If Method A is performed, attach the original printed ticket to the report.

11. PRECISION AND BIAS

- 11.1. *Precision*—Precision was determined in an NCAT round-robin study for surface mixes using Test Method A. Precision has not yet been determined for Test Method B. (See Table 3.)

Table 3—Precision

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

Note 9—The precision estimates are based on four aggregate types, four replicates, and 12 laboratories participating with zero laboratory results deleted as outlying observations. All four aggregates were tested in surface mixes and had relatively low absorption values.

- 11.2. *Bias*—The bias for Test Methods A and B has not been determined.

ANNEX

(Mandatory Information)

CORRECTION FACTORS

A1. ASPHALT BINDER AND AGGREGATE

- A1.1. Asphalt binder content results may be affected by the type of aggregate in the mixture and by the ignition furnace. Asphalt binder and aggregate correction factors must, therefore, be established by testing a set of correction specimens for each Job Mix Formula (JMF) mix design. Correction factor(s) must be determined before any acceptance testing is completed, and repeated each time there is a change in the mix ingredients or design. Any changes greater than 5 percent in stockpiled aggregate proportions should require a new correction factor.

- A1.1.1. Asphalt binder correction factor: A correction factor must be established by testing a set of correction specimens for each Job Mix Formula (JMF). Certain aggregate types may result in unusually high correction factors (> 1.0 percent). Such mixes should be corrected and tested at a lower temperature as described below. Each ignition furnace will have its own unique asphalt binder correction factor determined in the location where testing will be performed.
- A1.1.2. Aggregate correction factor: Due to potential aggregate breakdown during the ignition process, an aggregate correction factor will be determined for each ignition furnace in the location where testing will be performed, when the following conditions occur:
- A1.1.2.1. Aggregates that have a proven history of excessive breakdown, or
- A1.1.2.2. Aggregates from an unknown source.

A2. CORRECTION FACTOR PROCEDURE

- A2.1. Obtain samples of aggregate in accordance with T 2.
- A2.2. Obtain samples of asphalt binder in accordance with T 40.
Note 10 — Include other additives that may be required by the JMF.
- A2.3. Prepare an initial, or “butter,” mix at the design asphalt binder content. Mix and discard the butter mix prior to mixing any of the correction specimens to ensure accurate asphalt content.
- A2.4. Prepare two correction specimens at the JMF design asphalt binder content and gradation. Aggregate used for correction specimens shall be sampled from material designated for use in production. An additional “blank” specimen shall be batched at the JMF gradation. Determine an aggregate gradation in accordance with T 30 on the “blank” specimen.
- A2.5. Place the freshly mixed specimens directly into the sample basket assembly. If specimens are allowed to cool prior to placement in the sample basket assembly, the specimens must be dried to constant mass according to T 329. Do not preheat the sample basket assembly.
- A2.6. Test the specimens in accordance with Method A or Method B of the procedure.
- A2.7. Once both of the correction specimens have been burned, determine the asphalt binder content for each specimen by calculation or from the printed oven tickets, if available.
- A2.8. If the difference between the asphalt binder contents of the two specimens exceeds 0.15 percent, repeat with two more specimens and, from the four results, discard the high and low result. Determine the correction factor from the two original or remaining results, as appropriate. Calculate the difference between the actual and measured asphalt binder contents for each specimen. The asphalt binder correction factor, C_F , is the average of the differences expressed as a percent by mass of HMA.
- A2.8.1. If the asphalt binder correction factor exceeds 1.0 percent, the test temperature must be lowered to $482 \pm 5^\circ\text{C}$ ($900 \pm 8^\circ\text{F}$).
Note 11 — The temperature for determining the asphalt binder content of HMA samples by this procedure shall be the same temperature determined for the correction samples.

- A2.9. Perform a gradation analysis on the residual aggregate in accordance with T 30, if required. The results will be utilized in developing an “Aggregate Correction Factor” and should be calculated and reported to 0.1 percent.
- A2.9.1. From the gradation results subtract the percent passing for each sieve, for each sample, from the percent passing each sieve of the “Blank” specimen gradation results from Section A2.4.
- A2.9.2. Determine the average difference of the two values. If the difference for any single sieve exceeds the allowable difference of that sieve as listed in Table 4, then aggregate gradation correction factors (equal to the resultant average differences) for all sieves shall be applied to all acceptance gradation test results determined by T 30, prior to final rounding and reporting. If the 75 μm (No. 200) is the only sieve outside the limits in Table 4, apply the aggregate correction factor to only the 75 μm (No. 200) sieve.

Table 4—Permitted Sieving Difference

Sieve	Allowable Difference
Sizes larger than or equal to 2.36 mm (No. 8)	± 5.0 percent
Sizes larger than or equal to 75 μm (No. 200) and smaller than 2.36 mm (No. 8)	± 3.0 percent
Sizes 75 μm (No. 200) and smaller	± 0.5 percent