

WSDOT FOP for AASHTO T 308¹

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

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 specimen 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 FOP for AASHTO T 27/T11.
- 1.2 The values in English 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 whoever uses 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
- T 2 Sampling of Aggregates
- T 30 Mechanical Analysis of Extracted Aggregate
- T 40 Sampling Bituminous Materials
- T 110 Moisture or Volatile Distillates in Hot-Mix Asphalt (HMA)
- T 168 Sampling Bituminous Paving Mixtures
- T 248 Reducing specimens of Aggregate to Testing Size

2.2 *Manufacturer's Instruction Manual*

2.3 *WSDOT Standards*

- FOP for AASHTO T 329 *Moisture Content of Asphalt (HMA) by Oven Method*
- FOP for WAQTC T27/11 *Sieve Analysis of Fine and Coarse Aggregates*
- FOP for AASHTO T 168 *Sampling Bituminous Paving Materials*
- WSDOT 712 *Reducing Samples of Hot Mix Asphalt to Testing Size*
- SOP 728 *Method for Determining Ignition Furnace Calibration Factor*

¹ This FOP is based on AASHTO T 308-08 and has been modified per WSDOT standards. To view the redline modifications, contact WSDOT Quality Systems Manager at (360) 709-5412.

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.
- 3.2 The asphalt binder content is calculated as the difference between the initial mass of the asphalt mixture and the mass of the HMA residual aggregate, with adjustments for the calibration factor, and the moisture content. 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 specimens 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 27/11.

5. APPARATUS

- 5.1 Ignition Furnace—A forced-air ignition furnace that heats the specimens by either the convection 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 specimen 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 the capability to pull air through the furnace to expedite the test and 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 specimen in addition to the specimen baskets. A data collection system will be included so that the mass can be automatically determined and displayed during the test. The furnace shall have a built-in computer program to calculate the change in mass of the specimen baskets and provide for the input of a correction factor for aggregate loss. The furnace shall provide a printed ticket with the initial specimen mass, specimen 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 specimen mass loss does not exceed 0.01 percent of the total specimen 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 Specimen Basket Assembly—consisting of specimen basket(s), catch pan, and an assembly guard to secure the specimen basket(s) to the catch pan.
- 5.2.1 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. Sets with two or more baskets shall be nested. The specimen 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 openings of 2.36 mm (No. 8) and 0.600 mm (No. 30), respectively, has been found to perform well.
- 5.2.2 Catch Pan—of sufficient size to hold the specimen basket(s) so that aggregate particles and melting asphalt binder falling through the screen are caught.
- 5.3 Oven—Capable of maintaining $110 \pm 5^\circ\text{C}$ ($230 \pm 9^\circ\text{F}$).
- 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 specimen baskets during the cooling period.
- 5.6 Miscellaneous Equipment—a pan larger than the specimen basket(s) for transferring the specimen after ignition, spatulas, bowls, and wire brushes.

6. SAMPLING

- 6.1 Obtain specimens of freshly produced hot-mix asphalt in accordance with WAQTC FOP for AASHTO T 168.
- 6.2 The test specimen for asphalt content determination shall be the end result of a larger specimen taken in accordance with FOP for AASHTO T 168.
- 6.3 If the mixture is not sufficiently soft to separate for testing, carefully heat the mixture in an oven until sufficiently soft, not to exceed 350 F or the recommended mixing temperature from the mix design verification report. Do not leave the specimen in the oven for an extended period of time.
- 6.4 The size of the test specimen shall be governed by the nominal maximum aggregate size of the mixture and shall conform to the mass requirement shown in Table 1. Specimen sizes shall not be more than 500 g greater than the minimum recommended specimen mass. The maximum specimen size including basket shall not exceed the capacity of the balance.
- Note 2:* Large specimens of fine mixes tend to result in incomplete ignition of asphalt binder.

Nominal Max. Agg. * Size	Class of HMA		Minimum Mass of Specimen, g	Maximum Mass of Specimen, g
	Superpave	Other		
US No. 4			1200	1700
3/8 in.	3/8 In.	Class G & D	1200	1700
1/2 in.	1/2 In.	Class A, B, & ATB	1500	2000
3/4 in.	3/4 In.		2000	2500
1 in.	1 in.	Class E	3000	3500
1 1/2 in.			4000	4500

* For aggregate, the nominal maximum size, (NMS) is the largest standard sieve opening listed in the applicable specification, upon which any material is permitted to be retained. For concrete aggregate, NMS is the smallest standard sieve opening through which the entire amount of aggregate is permitted to pass.

Note: For an aggregate specification having a generally unrestrictive gradation (i.e. wide range of permissible upper sizes), where the source consistently fully passes a screen substantially smaller than the maximum specified size, the nominal maximum size, for the purpose of defining sampling and test specimen size requirements may be adjusted to the screen, found by experience to retain no more than 5% of the materials.

Test Method A

7. TEST PROCEDURES

7.1 Test Initiation

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

7.2 Determine the moisture content of the specimens according to FOP for AASHTO T 329 *Moisture Content of Asphalt (HMA) by Oven Method*.

7.3 Enter the calibration factor for the specific mix to be tested.

7.4 Weigh and record the mass of the specimen basket(s) and catch pan (with guards in place) to the nearest 0.1g.

7.5 Prepare the specimen as described in Section 6. Evenly distribute this specimen in the specimen 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 Determine and record the total mass of the specimen, basket(s), catch pan, and basket guards to the nearest 0.1g. 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 in whole grams into the ignition furnace controller. Verify that the correct mass has been entered.

- 7.8 Tare or zero furnace balance, open the chamber door, and gently set the specimen baskets in the furnace. Close the chamber door, and verify that the specimen mass (including the basket(s)) displayed on the furnace scale equals the total mass recorded in Section 7.6 within ± 6 g. Differences greater than 6 g or failure of the furnace scale to stabilize may indicate that the sample basket(s) are 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 specimen.
- 7.9 Initiate the test by pressing the start/stop button. This will lock the specimen chamber and start the combustion blower.
- Note 4:* The furnace temperature will drop below the setpoint 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 setpoint, depending on specimen size and asphalt content.
- WSDOT Safety Note:* Do not attempt to open the furnace door until the binder has been completely burned off.
- 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 operation will unlock the specimen chamber and cause the printer to print out the test results.
- 7.11 Open the chamber door, remove the specimen basket assembly and place it on a heat resistance surface. Place the protective cage over the specimen basket assembly, and allow specimen to cool to room temperature (approximately 30 minutes).
- 7.12 Use the corrected asphalt binder content (0.01 percent) from the printed ticket. If a moisture content (0.01 percent) has been determined, subtract the percent moisture from the printed ticket corrected asphalt content, and report the resultant value as the corrected asphalt binder content to 0.1 percent.

Test Method B

8. Test Procedure

WSDOT does not use Method B and has deleted it from the procedure.

9. GRADATION

- 9.1 Allow the specimen to cool to room temperature in the sample baskets.
- 9.2 Empty the contents of the baskets into a flat pan. Use a small wire sieve brush to ensure that any residual fines are removed from the baskets. Determine and record the total mass of the specimen to the nearest 0.1g.
- 9.3 Perform the gradation analysis according to FOP for WAQTC T 27/T11.

10. REPORT

- 10.1 Report the test method (A), corrected asphalt binder content, calibration factor, temperature compensation factor (if applicable), total percent loss, specimen mass, moisture content (if determined) and the test temperature. Attach the original printed tickets to the report for units with internal balances.
- 10.2 The asphalt percentage and aggregate gradation shall be reported on WSDOT Form 350-560 or other report approved by the State Materials Engineer.

11. PRECISION AND BIAS

- See AASHTO T 308 for Precision and Bias

Performance Exam Checklist

Determining the Asphalt Cement Content of Hot Mix Asphalt (HMA) by the Ignition Method for AASHTO T 308

Participant Name _____

Exam Date _____

Procedure Element

- | | Yes | No |
|--|--------------------------|--------------------------|
| 1. The tester has a copy of the current procedure on hand? | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present? | <input type="checkbox"/> | <input type="checkbox"/> |

Procedure

- | | | | |
|--|--------------------------|--------------------------|--|
| 1. Oven at correct temperature 538 C? | <input type="checkbox"/> | <input type="checkbox"/> | |
| 2. Mass of <u>specimen</u> baskets and catch pan recorded? | <input type="checkbox"/> | <input type="checkbox"/> | |
| 3. <u>Specimen</u> evenly distributed in basket? | <input type="checkbox"/> | <input type="checkbox"/> | |
| 4. Mass of <u>specimen</u> recorded? | <input type="checkbox"/> | <input type="checkbox"/> | |

Method A

- | | | | |
|--|--------------------------|--------------------------|--|
| 5. Enter calibration factor for specific mix design? | <input type="checkbox"/> | <input type="checkbox"/> | |
| 6. Initial mass entered into furnace controller? | <input type="checkbox"/> | <input type="checkbox"/> | |
| 7. <u>Specimen</u> correctly placed into furnace? | <input type="checkbox"/> | <input type="checkbox"/> | |
| 8. Test continued until stable indicator signals? | <input type="checkbox"/> | <input type="checkbox"/> | |
| 9. Binder content obtained on printed ticket? | <input type="checkbox"/> | <input type="checkbox"/> | |
| 10. Binder content corrected for moisture? | <input type="checkbox"/> | <input type="checkbox"/> | |
| 11. All calculations performed correctly? | <input type="checkbox"/> | <input type="checkbox"/> | |

First attempt: Pass Fail

Second attempt: Pass Fail

Signature of Examiner _____

Comments: