

## GDT 125 – DETERMINING ASPHALT CONTENT BY IGNITION

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### A. Scope

This test measures the asphalt cement content of asphaltic concrete mixtures, Reclaimed Asphalt Pavement (RAP), and Reclaimed Asphalt Shingles (RAS) by burning away the asphalt binder in a high-temperature furnace. The aggregate remaining may be used for sieve analysis using AASHTO T-30 or [GDT 38](#). The method includes the procedure for determining the calibration factor and notes on calibrating mixtures containing hydrated lime and fiber additives.

For a complete list of GDTs, see the Table of Contents (GDT Table of Contents in The Source, on line).

### B. Apparatus

#### 1. Ignition furnace

The test requires an ignition furnace designed for determining asphalt cement content. The furnace may heat the sample by convection or radiant heating. It must be equipped with an internal balance thermally isolated from the furnace chamber. The internal balance must be capable of weighing a 3500 gram sample in addition to the sample baskets, and it must be calibrated and certified as meeting the requirements of AASHTO T-308. Calibration and certification must be performed every twelve months using certified NIST-traceable weights or by an independent calibration service. Additional calibrations may be required when error is suspected. Maintain records of all calibrations and certifications, including those for certified NIST-traceable weights, if used.

The furnace must incorporate an internal data collection system which automatically prints and displays ignition chamber temperature, weight loss, and per cent weight loss each minute during the test. The data system shall provide for the input of the Calibration Factor and shall issue a printed record of each test, listing the initial sample weight in grams, the Calibration Factor (%), calibrated asphalt content (%), elapsed time, and chamber temperature (°C). The furnace shall be equipped with an audible alarm and indicator light which signals when the weight loss does not exceed 0.1% of the sample weight for three consecutive minutes. The sample door must be equipped with an automatic lock to prevent its being opened during the ignition test. The furnace must heat the sample sufficiently to ignite and completely vaporize the liquid asphalt, and it must be equipped with an exhaust filtration system to vaporize or remove airborne particles. The furnace must be vented to the outside via an exhaust system capable of maintaining sufficient draft to prevent the escape of smoke and strong odors into the laboratory. The exhaust must not be vented near flammable materials.

#### 2. Sample basket assembly

A complete sample basket assembly designed for the furnace is required, consisting of two baskets with covers, a catch pan, and a retaining bracket, all made of a high-temperature alloy. The basket must enclose the sample completely with perforated sheet metal to allow air and combustion gases to flow through and around the sample with no measurable removal of dust particles. The baskets and catch pan must fit together in a stack, so that the catch pan will receive all particles that may fall from the baskets. In addition, a special lifting fork designed by the manufacturer for lifting the basket assembly must be provided.

#### 3. Laboratory oven

Provide a laboratory oven to loosen and dry samples. It must maintain a temperature of 260° F (125° C).

#### 4. Laboratory balance

Provide a laboratory balance with a capacity of at least 6,500 grams meeting the requirements of AASHTO M-231, Class G-2 (i.e., readability and sensitivity to 0.1 g and accuracy of 0.2 g or 0.1 percent). The balance must be calibrated and certified to meet these requirements every twelve months using certified NIST-traceable weights, if owned, or by an independent calibration service. Maintain records of all calibrations and certifications, including those for certified NIST-traceable weights, if used.

#### 5. Safety equipment

The operator must wear high-temperature protective apparel including forearm covers, apron, gloves, and safety glasses or face shield. Provide a heat resistant surface capable of withstanding 1200 °F (650 °C), and a protective cage to surround the sample baskets.

#### 6. Miscellaneous equipment for gradation analysis

Provide a metal pan larger than the sample baskets for transferring samples after ignition. Provide a plastic wash bottle, trowel, spoon, spatula, bowl, quartering device, 2-inch paint brush, and a wire sieve brush.

### C. Procedure

#### 1. Prerequisites.

- a. Use the Calibration Factor (CF) established for the mixture to be tested. (Here *mixture* means a formulation of ingredients from specific sources according to an approved mix design.) *Use the mix designer's CF when available, or as provided in E.1 below.* See E.1 for the requirements for calibrating mixtures.
  - b. The technician-operator must be thoroughly familiar with the operating manual provided by the manufacturer of the furnace, especially with the safety information. A copy of the manual shall be available for reference.
  - c. Inspect the ignition furnace for cleanliness, safety, and correct alignment of the internal balance. The ceramic tubes which support the sample platform must be centered in the holes in the bottom of the chamber. Refer to the manufacturer's instructions for cleaning and maintenance. Clean the flue filter as recommended by the manufacturer or if the lift test reading is below the limit established by the manufacturer.
  - d. Ensure that the furnace is set to print out all data points; **do not use the abbreviated print-out.** Ensure that the paper tape supply is sufficient to complete the test.
2. Preparation of samples

Obtain samples according to GSP-15. Samples may consist of loose material or cores heated and broken down. Ensure that samples are dried to a constant weight, as necessary. Take normal precautions in handling to avoid segregating the mix. Refer to the table below to determine the correct sample weight for the type of mix to be tested. Samples of loose mix must be reduced by splitting or quartering to fall within the specified range. When sampling loose mix, ensure that the weight collected will obtain a weight within the specified range after it is split or quartered. Note that the quartered or split sample must not exceed the specified size. If a sample cannot be separated with a trowel or quartering device, heat it in a laboratory oven at not more than 260 °F (125 °C) until it becomes workable. Avoid heating longer than necessary. Heat and separate roadway core samples in the same manner. Obtain core samples in sufficient numbers for the tested layer to fall within the weight range specified in the table below.

<b>Sample Weights for Ignition Tests, in grams</b>		
<b>Mix Type</b>	<b>Minimum weight</b>	<b>Maximum weight</b>
25 mm Superpave	2500	3500*
19 mm Superpave	2000	3000*
12.5 mm Superpave	1500	2500*
9.5mm Superpave	1200	2200*
4.75 mm Mix	1000	2000*
9.5 mm OGFC	1000	2000*
12.5 mm OGFC	1200	2200*
12.5 mm PEM	1200	2200*
19 mm SMA	2000	3000*
12.5 mm SMA	1500	2500*
9.5 mm SMA	1200	2200*

\*Check for signs of incomplete burning when sample size approaches maximum weight.

NOTE: Steps 3 through 12 below describe how to operate a typical furnace. Ignition furnaces from different manufacturers vary in the arrangement and functions of manual controls, although the test method is essentially the same. The following instructions are written primarily for convection furnaces, which are the most common models. For models programmed to display menus and instructions, follow the programmed prompts. Refer to the manufacturer's handbook for instructions on the particular type and model to be used.

3. Temperature

If the furnace is of the convection type, pre-heat it to the "set point" temperature of 1000 °F (538°C). (When testing an aggregate which fractures in high heat, it may be necessary to select a lower set point or temperature profile according to the manufacturer's instructions. Refer to E.4 below for requirements for the Aggregate Gradation

Correction Factor.) To set, press “Temp” and enter the target temperature (“set point”) of 1000 °F (538 °C). Press “Enter” and note the temperature displayed before starting the test.

### 4. Settings

Ensure that the "Test Stability Threshold" setting is set to 0.1g.

If the device features more than one automatic cutoff mode ("burn mode"), select a mode which stops the test when the incremental weight loss falls below the cutoff limit for three minutes. Do not set burn time manually for routine tests.

### 5. Enter Calibration Factor (CF)

For convection furnaces, enter the CF ("% Correction"), by pressing "% Correction". The display will read "0.00". Enter the Calibration Factor for the specific mix to be tested, as determined by the procedure in section E below, and press "Enter". *To enter a negative calibration factor, press "% Correction" twice, then enter the numerals.* The Calibration Factor will be displayed with a negative sign in the window.

Alternatively, the CF may be set to zero; this is recommended where multiple mix designs will be tested, to reduce the possibility of incorrect entries. Either value may be used for step D.2 below.

### 6. Weigh the basket assembly

Weigh the empty sample baskets and catch pan on the laboratory balance with covers and retaining bracket in place and record the total weight of the assembly (tare weight) on the worksheet provided below. Note: Record all weights on the worksheet to 0.1 gram.

### 7. Load the sample

Fit the lower sample basket onto the catch pan. Using a spatula or trowel, spread about half of the sample into the lower basket in an even layer, taking care to keep the material away from the sides. Fit the upper basket in place over the lower one. Spread the remainder of the sample into the upper basket in an even layer, and install the basket cover and guard.

### 8. Record combined and net weights

Using the laboratory balance, measure and record the initial combined weight of the assembly and sample, to 0.1 gram. Subtract the empty weight of the assembly determined in step 6 above and record the initial net weight of the sample, **W**.

### 9. Enter initial sample weight in furnace

- Press "Weight" and key in the *net weight W* of the sample. (The furnace accepts only a four-digit whole number.) The "Percent Loss" window will briefly display the sample weight. Immediately press "Enter."
- Press "Weight" again and **verify the sample weight**. The results printed on the ticket will be calculated from this initial sample weight and the loss measured by the internal balance.
- Tare the internal balance by pressing the zero key.

### 10. Install baskets

Using the special lifting fork, place the sample basket assembly into the ignition chamber. Important: The assembly must be placed gently on the sample platform to avoid dislodging the ceramic tubes which support the platform. Ensure that the basket assembly does not contact the sides and that the door latch is secure. The convection furnace will display the total weight of the assembly in the window marked "Balance Indicator." As a check before proceeding, confirm that this weight does not differ from the total weight recorded in step 8 by more than 5.0 grams. Failure of these weights to agree within 5.0 grams indicates a malfunction or an error in weighing, recording, or entering. In this event, re-weigh the sample on the external scale and, wearing the prescribed protective apparel, *confirm visually that the sample platform and ceramic tubes in the furnace are properly positioned and not bound by loose particles and that the assembly is not touching the walls of the chamber.*

### 11. Start test

Press the "Start/Stop" button. This will lock the ignition chamber door, actuate the combustion blower, and start the test. The test will continue until the weight of the sample has stabilized, during which time the apparatus will record the progressive loss of weight from the sample and the changes in chamber temperature. (Note: It is normal for the temperature to decrease below the set temperature initially and to rise well above it as the sample fully ignites.)

### 12. End of Test

When the weight of the sample has stabilized, this will be indicated by a light and audible signal. Press the "Start/Stop" button again to unlock the chamber and cause the printer to print the test results. Wearing the prescribed protective apparel, use the special lifting fork to gently move the assembly to a safe location for cooling. Place the protective cage over the basket assembly during cooling.

### 13. Record final weight of burned sample and basket assembly

When the sample and basket assembly have cooled to a safe temperature for handling, return them to the laboratory balance. Record the final combined weight on the worksheet where indicated.

### 14. Gradation.

Empty all contents of the sample basket assembly into a flat pan, using a brush to dislodge any fines remaining on the baskets and catch pan. Re-weigh the sample. As a check, compare with weight obtained in step 13 above, minus weight of basket assembly obtained in step 6. (Do not re-weigh the empty basket assembly.) Perform a gradation analysis according to AASHTO T-30 or [GDT 38](#), as required. A washed gradation must be performed for every test; however, the 2.36 mm sieve and above may be omitted unless otherwise required. Record results on the worksheet below.

## D. Calculation and report.

Use the worksheet below for recording and calculating all data. For acceptance and project record purposes, report results on Form DOT 159-5 and store the worksheet and the complete print-out with the project records. The steps indicated in the worksheet follow the instructions below. Note: Users may obtain the electronic version of the worksheet from the State Asphalt Design Engineer. Alternatively, a contractor may use a modified version of the worksheet which has been approved by the State Asphalt Design Engineer. The modified version shall include all information required in the original worksheet and may include additional information useful to the contractor.

1. Calculate the asphalt content of the sample as follows: Subtract the combined weight of sample and basket assembly after burning from the initial combined weight from step C.8. Record as "Loss,  $W-W'$ ." Divide this by the initial net weight  $W$ , multiply by 100 per cent, and record as the Percent Loss. Subtract the approved CF for the mix design. Record this result on the worksheet as Calculated Asphalt Content.  
**For acceptance testing:** Use Calibrated Asphalt Content from printed ticket for the acceptance result. Follow Part D.2 below to compare "Calibrated Asphalt Content" from printed ticket with "Calculated Asphalt Content" from calculation above. (If no CF was entered in furnace, first apply the CF to the result on ticket.) Add completed worksheet form below and printed ticket to project records. *Worksheet must show both results.*
2. Compare Calculated Asphalt Content to result from printed ticket: In the spaces provided on the worksheet, re-enter Calculated Asphalt Content (from line 8) and the "Calibrated Asphalt Content" from the furnace's print-out. (If the CF entered in the furnace is zero, re-enter Percent Loss from line 7 step D.1.) If the difference between the two exceeds **0.15%**, a malfunction or weighing error may have occurred. Re-check the furnace and calculations and re-weigh the sample. If difference is not resolved, notify the State Asphalt Design Engineer, District TMOS and area Technical Service Engineer and record the date and time, project number, lot number, both results, and the name of the technician performing the test in the Plant Diary. The District TMOS and area Technical Service Engineer may be contacted to request assistance in resolving the discrepancy. These parties shall always be contacted for their concurrence prior to burning the opposite quarters.
3. Always attach the original printout to the worksheet.
4. Adjustment for un-calibrated mixtures containing lime: In some cases (e.g., for testing RAP) it is necessary to determine the asphalt content of a mixture for which no CF can be determined. It has been established through field studies that mixtures containing 1% hydrated lime required an average adjustment of -0.28%. Where permitted, use this value in place of the calibration factor for mixtures known to contain 1% lime.

## E. Calibration procedure

### 1. Requirements

An approved CF is required for each new mix design; it shall remain in effect for the design unless, upon verification, it is found to be inaccurate by the State Bituminous Construction Engineer. A new approved calibration is required when the mix design CF is found to be inaccurate or when the dosage rate of hydrated lime, cellulose fiber, or other combustible ingredient is changed. For mix designs approved prior to this requirement, an approved CF must be obtained for use in acceptance testing. Calibrations, verifications, and re-calibrations must be performed according to the procedure below, either by or under the supervision of a certified Superpave Mix Design Technician. Submit printouts and the calibration worksheet, bearing the name and certification number of the technician who performed or directly supervised the work, to the State Bituminous Construction Engineer for approval.

A new calibration is not warranted for an adjustment in the Job Mix Formula except upon adjustment of the dosage rate of hydrated lime, cellulose fiber, or other combustible ingredient. However, verification of a CF may be requested if inaccuracy is suspected.

### 2. Preparation of samples

Prepare three samples at the gradation and asphalt content of the mix design, using the ingredients from the sources and stockpiles from which the mix will be produced. Ensure that aggregate ingredients have been dried to a constant weight. Batch size should exceed the minimum weight in the table of Section III by not less than 300g. Mix and discard one of the three samples as a “butter mix” to prepare the mixing vessel.

The following special requirements shall apply when calibrating mixtures containing Recycled Asphalt Pavement (RAP): Do not use the average asphalt content of the RAP stockpile for batching. Prior to batching, split a sufficient quantity of RAP using a sample splitter or quartering device, as described in AASHTO T-328. Determine the actual asphalt cement content of one portion by ignition or solvent extraction and use this value in the batching calculations. (Refer to D.4 above.) Avoid segregating the RAP in handling. If RAP constitutes more than 15 % of the mix, break it down in a screen shaker (e.g., Gilson shaker) and re-combine the sizes in the same manner as the virgin aggregate.

The coating of asphalt cement and fines on the tools and mixing vessel should not be allowed to accumulate from sample to sample. Perform the following check after mixing the samples: Average the two net weights (**W** on line 3 of the calibration worksheet) of the calibration samples, divide by their batch weight, and subtract the result from 1. Do not use the samples if the difference exceeds 0.005.

Note: Loss of sample weight in mixing may be excessive in mixes with high film thickness, such as open-graded mixes and SMA. If this loss cannot be controlled, the calibration samples may be batched at an asphalt content 0.5% below optimum.

3. Test and calculation

Test the mixture specimens in the ignition furnace, following the test procedure above, steps C.3 through C.13. In Step C.5 enter a calibration value of zero. Using the Calibration Worksheet below, calculate the percent weight loss of each sample based on the initial and final weighings. Record results in the columns for samples A and B. If the two samples differ in percent loss by more than 0.15 %, prepare and test two additional samples. Calculate the percent loss for each of these samples and enter results in the columns for samples C and D. Omitting the highest and lowest percent loss, subtract the as-mixed asphalt content from the two remaining. Calculate and record the algebraic average of the two results as the CF for the mix design.

4. Aggregate Gradation Correction Factor.

When testing materials with a history of excessive breakdown during heating, determine and apply the Aggregate Gradation Correction Factor according to Sections A.2.1 through A.2.9 of AASHTO T-308. The calibration worksheet and printed tickets should be submitted with the mix design to the State Bituminous Construction Engineer for approval.

**F. Verification of CF**

For quality control and acceptance testing, the accuracy of the CF must be verified at certain intervals for each mix design to be produced. Requirements for verifications are set forth in [SOP 2](#).

**WORKSHEET FOR GDT-125 - ASPHALT CONTENT BY IGNITION**

Test date \_\_\_\_\_ Technician preparing report: \_\_\_\_\_  
 Mix identification no. & source of mixture \_\_\_\_\_ Source code \_\_\_\_\_  
 Project no./contract id: \_\_\_\_\_ Comparison with (IA samples only) \_\_\_\_\_

**A. CALCULATED ASPHALT CONTENT**

**Initial weight:** (See C.9b) (1) basket assembly \_\_\_\_\_ g  
 (2) sample + basket assembly \_\_\_\_\_ g  
 (3) initial weight of sample, (2) – (1) \_\_\_\_\_ g (**W**)  
**Weight after burn:** (4) sample + basket assembly \_\_\_\_\_ g  
 (5) final weight of sample, (4) – (1) \_\_\_\_\_ g (**W'**)  
**Weight Loss:** (6)  $W - W' =$  \_\_\_\_\_ g  
**Percent Loss:** (7)  $\frac{(W - W')}{W} \times 100\%$  \_\_\_\_\_ %  
**Subtract** calibration factor. \_\_\_\_\_ %  
**(8) ASPHALT CONTENT** \_\_\_\_\_ %

**B. CHECK RESULTS**

**Record** "Calibrated Asphalt Content" from printed ticket. \_\_\_\_\_ %  
**Subtract** Asphalt Content (8) or Percent Loss (7) if furnace CF is set to zero.. \_\_\_\_\_ %  
**Difference** \_\_\_\_\_ %

If difference exceeds 0.15%, check furnace, re-weigh sample, and review test for errors. If difference is not resolved, see step D.2 of procedure. **Attach print-out to this worksheet. Use Calibrated Asphalt Content from printed ticket for Acceptance**

**C. GRADATION BY GDT 38 AND AASHTO T-11:**

Sieve size, in. (mm)	Wt. retained	Cumulative wt. retained, R	Percent passing P=100%[1-R/T]	Job Mix Formula	deviation
1½ (37.5)					
1 (25)					
¾ (19)					
½ (12.5)					
3/8 (9.5)					
#4 (4.75)					
#8 (2.36)					
#16 (1.18)					
#30 ( 0.600 mm)					
#50 (0.300 mm)					
#100( 0.150 mm)					
#200( 0.075 mm)					
Pan					

**Check: Percent passing #200 versus weight from pan + amount removed by washing:**

pan +loss by washing	g	-----	%

**Notes:** \_\_\_\_\_

**WORKSHEET FOR GDT-125 – Determining Calibration Factor (CF)**

For Mix design No. \_\_\_\_\_ Optimum AC \_\_\_\_% Batch weight \_\_\_\_\_ g

Attach batch sheet from mix design. List here the percentages of lime, cellulose fiber, rubber, and other special ingredients, as applicable: \_\_\_\_\_

	Sample A	Sample B	Sample C*	Sample D*
(1) Wt. of basket assembly				
(2) Initial wt. of basket assembly & sample				
(3) <b>W</b> = Initial net wt of sample, (2) – (1)				
(4) Wt. of sample & basket assembly after ignition				
<b>W'</b> = Wt of sample after ignition (4) – (1)				
Enter loss, <b>W – W'</b> , (2) – (4)				
<b>P'</b> , Per cent loss: <b>P' = [(W – W') ÷ W] x 100%</b>				
Minus <b>P</b> , the % AC as mixed				
Difference <b>Δ = P' – P</b> (record negative sign if <b>P</b> is greater.)				

\* Samples C and D will be needed only if **P'** of A and **P'** of B differ more than 0.15%. If so, prepare and test Samples C and D. Ignore highest and lowest of the four Δ's.

**Calibration factor.** Average the two Δ's: \_\_\_\_% **This is the CF.** (Be sure to take the *algebraic* average. For example, the algebraic average of 0.06 and - 0.10 is - 0.02.) Round to two decimal places.

**Check: Compare CF to value from printed tickets.**

**Average** "Calibrated Asphalt Content" from the two printed tickets. \_\_\_\_\_%

**Average** the two Percent Losses from table above and subtract. \_\_\_\_\_%

**Difference** \_\_\_\_\_%

If these values differ more than 0.15%, check furnace, re-weigh sample, and review test for errors. If difference is not resolved, repeat the calibration procedure. **Attach all print-outs to this worksheet.**

**Notes**

1. In mixtures containing lime, the CF for a lime mix is normally negative. Other ingredients, such as cellulose fibers and rubber, have an opposite but lesser effect.

2. The CF normally will fall between 0.10% (without lime) and – 0.38% (with lime). A CF which is outside this range or differs substantially from CF's for mixes with the same ingredient sources should be suspect. Check weights and calculations for error. If not corrected, the CF should be verified by repeating the calibration.

Date \_\_\_\_\_

Certified Mix Design Technician who performed or supervised the calibration \_\_\_\_\_