Specification Year: 2015
This module covers the Asphalt Content by the Ignition Oven Method, FM 5-563. This test method is used to determine the asphalt content of the mix.

The asphalt content will provide the basis for the acceptance of the mixture and composes 25% of the pay for the mix for dense graded mixtures and 40% of the pay for the mix for open graded friction course mixtures (FC-5). This method replaces the time consuming solvent extraction method that was used in the past. The ignition oven has proven to be a very effective quality control tool.
Video is played in classroom.
There are several manufacturers of this equipment. The general design concept uses a high temperature oven with a built in scale that measures the sample weight as the asphalt binder is burned off the aggregate. When the sample weight stops decreasing, the asphalt has been burned off.
Shown here are some of the specifications on the oven.
FM 5-563 Apparatus

- Baskets
  - Minimum of 2 tempered stainless steel baskets
  - Perforated sheet or mesh
    - Holes small enough to minimize loss of sample during the burn off
- Baskets
  - Nest together
  - Place in catch pan approximately 1 inch deep
    - Has handles for placement and removal
  - Bottom of lower basket > 1.6 inches above catch pan

Shown here is additional information on the wire mesh baskets used to contain the sample while in the oven.
Photo of assembled basket. A minimum of two mesh baskets is required.
FM 5-563 Apparatus

- Balance
  - Capacity > 8 kg
- Conventional oven
  - Capable of maintaining 149 + 5°C (300 + 9°F)
- Miscellaneous
  - Wire and soft bristle brushes, spatulas and bowls, as needed

Additional equipment needed for the test.
Safety

- Face shield
- High temp gloves
- Long sleeve jacket

It's very important to observe and follow all safety precautions when working around this device. In addition, always assume the baskets are hot and handle carefully.

**Safety:**
- Face shield
- High temperature gloves
- Long sleeve jacket
Safety

- Heat resistant surface
- Protective cage

There are a variety of different types of heat shields to be placed over the baskets once they are removed from the oven. Regardless of the type, they need to be used and in place.

**Safety:**
- Heat resistant surface
- Protective cage
Oven is hot.
Do not open during testing.
Do not disengage safety features.
Use all safety items.
These ovens operate at very high temperatures (1,000ºF) and must be properly vented. Follow all local code requirements when installing these devices.

Safety:
- Good ventilation
- Properly vented to outside
Safety

Make sure the door is completely closed.

These doors have an indicator to ensure the door is locked during a test.

**Safety:**

Make sure the door is completely closed.
There is a standard procedure to calibrate these ovens with all the mix design used on FDOT projects. A calibration factor is developed for each mix design and is shown on the mix design sheet. It starts with hand batching a mix design with a known asphalt content and comparing it to the results from the oven. The steps are summarized in the slide. Two identical mix batches are made up for the calibration procedure.
The photos show the steps. A “buttered” bowl (top left) is a bowl that has a thin film of asphalt mix left on it. This is commonly used in the mix design procedure and here as well. The trick is to leave the same amount in the bowl. If a clean bowl was used for calibration, it is impossible to get all the asphalt out of the bowl and it will affect the calibration. Top right shows the mix design aggregate being added to the bowl followed by the correct binder content (lower left). The final step shown here is mixing thoroughly (bottom right).
Here is an example. Two batches were created and tested in the oven. The results are averaged and subtracted from the known asphalt content resulting in calibration factor. This positive calibration factor indicates that not all the asphalt cement was removed from the sample.
Here is another example. Two batches were created and tested in the oven. The results are averaged and subtracted from the known asphalt content resulting in a calibration factor. This negative calibration factor indicates that all the asphalt cement and some of the aggregate was lost from the sample. It is common for softer aggregates to breakdown slightly and have some of the very fine material leave the oven through the exhaust system.
FM 5-563
Aggregate Calibration Factor

• The ignition test can affect the gradation of some types of aggregate
• Therefore – if the binder calibration factor exceeds 0.50%, aggregate correction factors for the % passing #8 and #200 sieves are to be determined by the solvent extraction method (FM 5-544)

Some aggregates (mainly soft limestones) will break down under excess heat. The limit for determining the calibration factor by this test method is 0.5%. If it exceeds this amount, the solvent extraction procedure must be used. Very few mixes used in Florida require the use of this alternative procedure.
FM 5-563
Aggregate Calibration Factor

• The aggregate calibration factor for the % passing the #8 sieve and #200 sieve is determined as follows:

\[ CF[P-8] = P-8 \text{ [Solvent]} - P-8 \text{ [Ignition]} \]

\[ CF[P-200] = P-200 \text{ [Solvent]} - P-200 \text{ [Ignition]} \]

Shown here is the procedure to develop an aggregate correction factor. This is not normally used.
In looking at the slide, the majority of the mixes used in Florida will fall under a sample size of 1,500 grams. Only the SP-19 mm mix would require a larger sample of 2,000 grams, but it is not used much anymore.
Once the calibration procedure is complete, normal testing can begin. As shown earlier, the sample of mix will be obtained in accordance with FM 1-T 168.
Weigh the entire basket assembly including catch pan and guards.

Place bottom basket in catch pan. Weigh and record weight of the baskets and catch pan with the guards in place.
Add the mix to the baskets with roughly equal amounts in each basket. Keep the mix approximately 1 inch away from the edges. Spread the mix into an even layer. Be careful of buildup on the spatula. Scrape the build up into the baskets as you go.

Note: Some baskets only have two levels, not three.
FM 5-563
Testing Procedure

- Add mix then reweigh assembly
- Subtract weight of just assembly to get mix weight $W_i$

Once all the baskets are charged, reassemble and weigh. Subtract the weight of the assembly to get the mix weight.
The oven should be preheated well before the time to load the sample. Enter 0.00 for the calibration factor and enter the actual mix weight.

Preheat oven to 538°C (1,000°F).
Enter:
- Calibration factor of 0.00.
- Actual weight of mix (nearest gram).
Although not shown in this picture, it is recommended to wear long sleeves to protect the skin against the heat of the oven.

**With safety equipment on:**
- Open door.
- Place sample basket assembly in furnace.
- Basket should not be touching the sides of the oven.
- Close door.
- Start test.
The test will continue until the weight loss stabilizes. The alarm will sound. Print out the results and attach it to the gradation data sheet.

Allow test to continue until alarm sounds or indicator shows test is finished. Press start/stop button to get printout of results.
Carefully remove the basket, set it on a heat resistant plate, and cover with the protective cage. Allow a minimum of 30 minutes to cool before processing. Weigh the basket assembly.

**With safety equipment on:**
- Open door.
- Remove the sample baskets.
- Place the basket assembly on a heat resistant counter.
- Cover the basket assembly with a protective cage.
- Allow to cool to room temperature.
- Wait a minimum of 30 minutes.
- Determine the weight left in baskets, $W_f$. 

With safety equipment on:
- Open door.
- Remove sample baskets.
- Place on heat resistant counter.
- Cover with protective cage.
- Allow to cool to room temp
  - Minimum of 30 minutes
- Determine weight left in baskets, $W_f$. 

FM 5-563 Calculations

- Calibrated AC Content:

\[ AC_{\text{calibrated}} = AC_{\text{measured}} + CF \]

\( AC_{\text{measured}} \) is that shown in the printout

Do not use external weights for this calculation*

*If the furnace printout is not available due to an equipment issue, and if approved by the Engineer, the measured AC content may be calculated manually.

The calibrated asphalt content will be the measured AC content from the printout plus the correction factor.
FM 5-563
Example

• CF = -0.02
• Measured AC = 5.42

\[ AC_{\text{calibrated}} = 5.42 + (-0.02) = 5.42 - 0.02 = 5.40 \]

The example shown here adds a negative correction factor to the measured asphalt content yielding a final AC content of 5.40 %.
Shown here are the acceptable ranges between two test results for a plant produced mix. Values are given for single operator and multi-lab.

<table>
<thead>
<tr>
<th>Precision</th>
<th>Acceptable Range of Two Test Results, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Operator</td>
<td>0.32</td>
</tr>
<tr>
<td>Multi-laboratory</td>
<td>0.44</td>
</tr>
</tbody>
</table>
Shown here are the acceptable ranges between two test results for lab created samples. These values are slightly tighter than those for the plant produced samples. Values are given for single operator and multi-lab.

<table>
<thead>
<tr>
<th>Precision</th>
<th>Acceptable Range of Two Test Results, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Operator</td>
<td>0.13</td>
</tr>
<tr>
<td>Multi-laboratory</td>
<td>0.35</td>
</tr>
</tbody>
</table>
The difference between the two tests (single operator) shown on the slide is 0.14%. If the mix was plant produced, the results would be acceptable (less than or equal to 0.32%). If the mix was lab created, the results would not be ok (not less than or equal to 0.13%).
FM 5-563
Precision

• Tech in field lab tests material
• Tech in agency lab tests same material
  • Field: AC% = 5.13
  • Agency: AC% = 5.27

• Difference = 0.14%

Are Results OK?

In this example, we show two different labs. Use the multi-lab precision. For plant produced mix, the difference allowed is 0.44%. For lab produced mix the difference allowed is 0.35%. In both causes, the actual (0.14%) is well within the allowable tolerances.
Again, the job is not complete until the paperwork is done. This is the information that is needed.
Once the final weight is obtained, the material left in the baskets will be cleaned out carefully and a gradation analysis will be performed. This is discussed in the next module.
FM 5-563
Potential Problems

- Problems caused by:
  - Specific aggregate types
  - Moisture

- Moisture problems identified by:
  - Loud popping during heating
  - Scale reading will be jumping
  - Pan will be moved
  - Can prevent by oven drying mix prior to testing

Shown here are some potential problems that may arise; generally attributed to the aggregate and its condition.

Moisture trapped in an aggregate subject to extreme heat turns to steam. The aggregate could fracture and may even cause the basket assembly to move in the oven.
QUESTIONS?