ASPHALT PLANT

LEVEL 1

Module 3: Sampling Bituminous Paving Mixtures
FM 1-T 168

Specification Year: January 2015
This module covers FM 1-T 168 Sampling Bituminous Paving Mixtures. Loose mix samples are obtained from the haul truck at the asphalt plant. These samples are used to prepare gyratory compacted samples, approximate the asphalt content by either extraction or ignition oven, run aggregate gradations, and determine the maximum specific gravity.

Cores are taken from the finished roadway surface. These samples are used to determine the bulk specific gravity (density) of the pavement. The results from this testing are commonly used to develop a correction factor for density gauge readings (used for process control).

Asphalt Plant Level 1 will only cover sampling from the truck, with a brief introduction to random sampling. Random sampling is covered in more detail in both the Asphalt Plant 2 and Asphalt Paving Level 2 courses. Coring will be covered in the Asphalt Paving Level 1 course.
Representative and random are two terms that are used to describe proper sampling. First, when sampling for acceptance (QC tests), we need to use random sampling to ensure the entire LOT has an equal chance of being sampled. If we selected just the first truck of each day to sample, we would get a different result than if the tests were truly random in nature. Random is what the specifications are designed around.

We have a procedure to randomly select the location in the LOT. It is discussed briefly in the following slides. Representative samples ensure that we get both a sufficient quantity to test and it adequately represents the mix being produced at that time. A procedure for obtaining the representative sample out of the randomly selected truck is described later in this module.
Random Sampling

- The number of test locations are defined by the size and number of LOTs
- Standard LOT = 2,000 or 4,000 tons
  - Sublot = 500 or 1,000 tons
- Random numbers are computer generated by the Plant Level 2 Verification Technician

Section 334 of the specifications covers Superpave and discusses LOT size and random sampling for the majority of the mixes we will be testing. The only mix that does not fall under this umbrella specification is FC-5. It has a fixed LOT size of 2,000 tons and specific testing requirements (tested for gradation and asphalt content only). For all other mix types (SP-9.5, SP-12.5, SP-19, FC-9.5, and FC-12.5), the mix will be tested in either 2,000 ton or 4,000 ton LOTs. These LOTs are subdivided into 4 equal sublots (either 500 tons or 1,000 tons). The random number program generates a random number (ton) for each sublot. We then take a representative sample from the truck that contains the random ton.
The Plant Verification Technician is charged with generating and printing the random numbers for the LOT. The process includes the two sheets (plant and roadway). The roadway form is typically sealed in an envelope and shipped on the next truck to the jobsite for the roadway inspector/VT. The plant random number form is secured by the technician to make sure the numbers are not known.
Shown on the left and the right are screen shots from the computer generated random number table that is developed at the beginning of each LOT. It generates random numbers that select when the plant samples are to be taken for testing and also where the roadway cores are to be located. The middle four graphics represent each of the sublots broken down into 20-ton truckloads of mix. The green circles represent the cores, the red circles represent the plant samples, and the yellow circles represent the sublot that is verified by the Department. Verification is a process of running split plant samples and re-testing the cores from that particular sublot (covered extensively in Plant Level 2). If these values compare to the contractor’s values within established tolerances, the Department considers the entire LOT to be verified and they use the contractor’s data for pay. If they do not compare, there is a resolution process that is used to resolve the issue. This is covered in much more detail in Plant Level 2.
Shown here is a another graphic illustration of the Plant sampling process. In each subplot a random number is generated and the truck containing the random number is sampled. That sample is a three way split sample. Each split contains enough mix to run a complete set of laboratory tests (about 35 pounds). These three splits are called: QC – Quality Control; VT – Verification Test; and RT – Resolution Test. The QC sample is tested immediately. The VT and RT samples are boxed and saved. At the end of the LOT, the Verification Technician pulls a randomly selected subplot and tests the VT sample. The VT test results are compared to the QC test results. If they compare (within established limits), the LOT is accepted. If they do not compare on any test, the RT samples are sent to the District Lab for resolution testing. This process is further explained in the Asphalt Level 2 courses. The Asphalt Plant and Paving Level 1 courses cover the sampling and testing.
Sample Size

• The following sample sizes are required:
  • Quality control – 35 lb
  • Verification testing – 35 lb
  • Resolution testing – 35 lb

Additional details on sample size explained.
Sample Size

• The verification and resolution samples are to be stored in boxes. These boxes are to be 12”x8”x4”. They are to be labeled, taped, signed by the VT technician, and safely stored in a manner agreed upon by the Engineer for future testing. The Contractor can retain additional split samples at their option.

Additional details on sample size explained.
This photo shows the truck being loaded in multiple drops from the silo. This helps to keep the mix uniform and segregation free. The plant operator would be notified a couple trucks ahead when a sample would be needed. The selected truck would proceed from silo load out, pick up the ticket, and then move to the sample rack for sampling.
CTQP Training Videos
Using a square-tipped shovel, obtain approximately equal portions from at least three well-separated locations in the truck immediately after the truck completes loading and moves to an accessible position. Samples shall be taken from a depth of approximately 12 inches or greater below the surface. Take care to avoid contamination and segregation. Samples shall be shoveled from the truck directly into metal buckets of approximately five gallons in size. The hot mix asphalt shall be transported back to the laboratory in the metal buckets.

As the truck is about to be sampled, the VT needs to notify the QC technician to allow time to suspend what they are testing and allowing them time to get to the sample stand when the truck arrives. It is best not to hold up the truck anymore than necessary to sample. It is very important that everyone follows the correct sampling techniques to ensure a representative sample is secured. One sample is composed of three 4-gallon buckets (each holding at least 35 pounds of mix).
Once the truck reaches the sample rack, the contractor’s technician will level out several areas to take samples from. It’s important to dig into the mix and not just sample off the top.

Sample about 12 inches below the surface.
Shown here is the mix leveled off ready for sampling to begin. The three sample buckets should be positioned on the sample rack/stand as close as possible to the truck to minimize spillage of mix off the shovel.
Dig down below the leveled area to remove sample.
A minimum of 1.5 feet from the sides of the bed.

Three approximately equal size samples from three well-separated locations.

Total sample about 35 lbs. x 3 (QC, VT, RT).

Sampling begins with full shovelfuls of mix from three well separated areas (again you are trying to get representative samples). From the first area, place a shovelful of mix into each bucket. Move to the next location and repeat, placing a shovelful into each bucket from each area, and so on. A shovelful of mix will be approximately 10-18 pounds, depending on how full it is. You are trying to achieve is at least 35 pounds of mix per bucket. Three shovelfuls per bucket generally is plenty.
Sampling complete: Three buckets each filled with mix from three areas.
Method #2: QC/VT Use Bucket and Boxes to Obtain Sample

• In lieu of filling storage boxes in the laboratory, storage boxes may be filled directly at the truck sampling location.
• Each storage box shall contain equal portions from the three (or more) well-separated sampling locations in the truck.

In lieu of filling storage boxes in the laboratory, storage boxes may be filled directly at the truck sampling location. Each storage box shall contain equal portions from the three (or more) well-separated sampling locations in the truck. Be careful when moving these boxes as they are not as stiff as a bucket. Also, make sure the boxes are sealed to avoid any dust from the site to contaminate the sample.
The next step in the sampling process is processing the bucket of mix into the required sample sizes for the various tests to be run. Leave one bucket aside to be boxed later for the VT sample, and the third bucket for the RT sample. Start processing the first bucket for QC. This is covered in Florida Test Method FM 1-T 168 and described in the following slides.
Step 1. Scooping (thieving).
Mix portions together by rolling mix.

The first step is to dump the bucket of mix onto several layered sheets of brown Kraft-type paper. Alternatively grabbing opposite corners, “roll” the mix to mix and combine, taking care not to lose mix off the paper.
Step 2. Gyratory pills.

Scoop straight through the center of the mix for the first pill.

Keep the scoop on the paper.

Remix (roll) and scoop again for the second pill.

The first samples to be taken are for the gyratory samples (commonly called pills). Have a scale nearby with a flat pan tared (zero’d) out on the scale. With paper laid flat and the mix mounded in the middle, slide the scoop straight through the middle, keeping the scoop against the paper. Move the mix directly to the pan until the desired pill weight is achieved. Tare out another pan and repeat the process by first remixing the remaining mix on the paper by rolling. These two test samples are conditioned in the oven prior to testing.
Step 3. Quartering. Maximum Gravity (Gmm) and AC Content / Gradation.

Mix the remaining material together by rolling.

After the two pills are removed, remix (re-roll) the remaining mix and then lay the paper flat.
Weigh out the first Gmm sample from first quarter. Rotate paper and weigh out the second Gmm sample from the opposite quarter.

Firmly press the quartering device into the mix. Using opposite corners, sample for maximum specific gravity. Obtain the Gmm test samples (1,000-1,100 grams each multiplied by 2).

Mix is scooped from opposite quarters to obtain sample for Gmm. Sample for AC content/gradation. See next slide.
The sample for AC / gradation testing is obtained from the remaining quarters.

From the opposite corners, fill the tared ignition oven mesh basket with the proper amount of mix (for instance, 1,500 grams), split into the two baskets. Try to get close to the minimum amount required, but do not try and hit the number exactly. Be careful during this sampling process to keep the scoop clean, using a spatula as needed to scrape off any accumulations. This material tends to be the asphalt coated sand and dust size particles. If improperly handled, it can affect the mix results. Keeping the tools clean as you go is the best practice. The next modules go into the actual tests for the samples that have just been taken.
Open-Graded Mixes

• Special treatment to avoid sticking.
• Silicone coated non-stick paper must be used for the quartering/reducing process. No wax paper.
• Silicone coated non-stick boxes must be used for sample storage. Or can use silicone coated non-stick paper to line regular boxes.

For all polymer modified mixtures and non-polymer modified open-graded mixtures, silicone coated non-stick paper must be used for the quartering/reducing process.

Wax paper is not an allowable substitute. Silicone coated non-stick boxes must be used for sample storage. Silicone coated non-stick paper may be used to line the interior of conventional boxes in lieu of using silicone coated non-stick boxes.
Sampling Procedure
Open-Graded Mixes

• Refer to FM 1-T 168.
• Quarter sample – obtain AC content and gradation ½ from quarter number 1 and ½ from quarter number 4 for each test method.
• Discard remaining quarters 1 and 4.
• Re-roll to combine quarters 2 and 3.
• Re-quarter and box alternate sides – quarters 5 and 8 for VT and quarters 6 and 7 for RT.

Refer to illustration, next slide.
Obtain the composite sample.

Place the composite sample on the paper for quartering. With the use of a quartering device, divide the sample in four approximately equal size portions.

Obtain a single sample for testing (asphalt content and gradation), by scooping a sample of the appropriate size directly into the scale pan or tared ignition oven basket. Approximately one half of the scoop sample should be taken from each of No. 1 and No. 4 portions of the quartered pile. Discard the remainder of portions No. 1 and No. 4.

Combine portions No. 2 and No. 3 by rolling on the quartering paper to form a uniform pile and insert the quartering device into the mix.

Remove opposite quarters, portions No. 5 and No. 8, and box together, or separately if preferred, for Verification testing of asphalt content and gradation.

Remove opposite quarters, portions No. 6 and No. 7, and box together, or separately if preferred, for Resolution testing of asphalt content and gradation.
Open-Graded Mixes
Checking the Temperature of the Mix in the Truck

- In Module 1, we discussed temperature measurement applications performed in the laboratory.
- Checking the temperature of the mix in the truck at the plant before it is transported to the jobsite is also a specification requirement.
Quick reading probe thermometers can be either dial-type or digital. The thermometer on the top right is a digital version shown inserted in the side of truck bed. The bottom right has an 8 inch probe and a 1-3/4 inch dial also shown inserted.

The thermometer is inserted into a hole located in the middle third of truck bed. Wait until reading has stabilized before taking the final reading. There should be some resistance when inserting the probe. If not, you might be reading an air gap and get an improper reading. Also, when checking temperatures against other thermometers that have different length probes, always measure to a consistent depth.

Thermometers are required to be calibrated and it is a good idea to carry a spare in case one is damaged. A quick check in the field would be to insert two different thermometers into the a shovelful of mix and compare the results.
Mix Temperature

- Quick reading probe thermometer
- Hole in both sides of truck
- Frequency:
  - Each mix, each day, first 5 loads
  - One out of every 5 loads thereafter
  - Mark temperature on delivery ticket

Determine the temperature of the completed mixture using a quick-reading thermometer through a hole in the side of the loaded truck. Locate a 1/4 inch hole on both sides of the truck body within the middle third of the length of the body, and at a distance from 6 to 10 inches above the surface supporting the mixture. If a truck body already has a hole located in the general vicinity of the specified location, use this hole. At the Engineer’s discretion, the Contractor may take the temperature of the load over the top of the truck in lieu of using the hole in the side of the truck.

The normal frequency for taking asphalt mix temperatures will be for each day, for each design mix on the first five loads and one out of every five loads thereafter. Take the temperature of the asphalt mix at the plant and at the roadway before the mix is placed at the normal frequency. Record the temperature on the front of the respective delivery ticket. The Engineer shall review the plant and roadway temperature readings and may take additional temperature measurements at any time.
Example delivery ticket from a project. Note ticket shows Project information, Financial ID number, Job Number, Mix Type and Mix number as well as gross weight (truck plus asphalt) and net weight (asphalt only).

Temperatures, when taken, should be written on the front of the truck ticket. All tickets must be accounted for and turned in.
Mix Temperature (continued)

- Master range is $\pm 30^\circ$ F from the target temperature on the mix design sheet
- Two target master ranges
  - Asphalt plant (mixing temperature)
  - Roadway (compaction temperature)
- Reject any load or portion of a load outside this temperature range

If any single load at the plant or at the roadway is within the master range but does not meet the criteria for single measurements or the average of five consecutive measurements, the temperature of every load will be monitored until the temperature falls within the specified tolerance range. At this time the normal frequency may be resumed.

Reject any load or portion of a load of asphalt mix at the plant or at the roadway with a temperature outside of its respective master range. Notify the Engineer of the rejection immediately.

For warm mix asphalt, the Contractor may produce the first five loads of the production day and at other times when approved by the Engineer, at a hot mix asphalt temperature not to exceed 330°F for purposes of heating the asphalt paver.
Mix Temperature (continued)

<table>
<thead>
<tr>
<th>Location</th>
<th>Acceptable Temperature Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant</td>
<td>Mixing Temperature ±30°F</td>
</tr>
<tr>
<td>Roadway</td>
<td>Compaction Temperature ±30°F</td>
</tr>
</tbody>
</table>

An example problem follows.
Classroom Example:

- First 5 loads (°F):
  300, 290, 285, 290, 295
- Plant target = 295°F
- Are all within +/-30°F from the target?
  Yes
- **Mix is acceptable**

First, are all five temperatures are within the plus or minus 30°F from the target? In our example above, they all are, so this step is OK and the mix is accepted with respect to temperature.
Classroom Example (Cont.)

Step 2: Are all within +/- 25°F from the target?
Temperature furthest from the target (285)
295-285=10°F. Less than 25°F. OK.

Step 3: Is the average of 5 less than +/- 15°F from the target?
Average = (300+290+285+290+295) / 5 = 292°F
295-292 = 3°F. Less than 15°F. OK.

Additional process control checks. If any of the established tolerances are exceeded, action is required (notifying the plant and increasing the frequency of testing) until these tolerances are met.

The second step is to determine if all the temperatures are within plus or minus 25°F from the target. In this example, they are.

The third step states that the average must be within plus or minus 15°F from the target. Calculate the average of the 5 loads of mix. Add up the temperatures and divide by 5. Then, subtract the average from the target and determine the difference. In this case it is 3°F, which is well within the tolerance.
What happens if Step 2 or Step 3 in the previous example does not pass?

If any single load at the plant or at the roadway is within the master range but does not meet the criteria for single measurements or the average of five consecutive measurements, the temperature of every load will be monitored until the temperature falls within the specified tolerance range; at this time the normal frequency may be resumed.
Analysis: 300, 295, 290, 290, 285

Target (295 °F)
• 295-292 = 3°F and is less than 15°F for average of 5 loads. OK.
• 295 – 285 = 10°F and is less than 25°F for single load. OK.
• Document and continue.

Table 320-3
Mix Temperature Tolerance From Verified Mix Design

<table>
<thead>
<tr>
<th></th>
<th>±25°F</th>
<th>±15°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any Single Measurement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average of Any Five Consecutive Measurements</td>
<td></td>
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</tr>
</tbody>
</table>

Table 320-3
Mix Temperature Tolerance From Verified Mix Design

Any Single Measurement   ±25°F
Average of Any Five Consecutive Measurements ±15°F