ASPHALT PLANT

LEVEL 1

Module 5: Bulk Specific Gravity

FM 1-T 166

Specification Year: January 2015
This module covers the Florida Test Method for Bulk Specific Gravity of Compacted Specimens FM 1-T 166. This test method will be used to measure the density of both compacted gyratory specimens and also roadway cores. This test method along with the Maximum Specific Gravity Test (FM 1-T 209) is used to calculate air voids of compacted gyratory pills and the percent density of the roadway cores. It is also used to determine partial payment for lab compacted mix, via air void calculation.
This is the basic equipment needed to conduct this test.
This is a picture of a typical underwater scale setup. The scale can be used for conventional weighing on the top of the platform. It also has a wire attached under it that is used for underwater weighing. There are a wide variety of setups that one may see.
Test specimens can be cores

One of the most common uses for this test is for evaluating the density of cores taken from the completed pavement.
If samples are cores, they are trimmed (cut, bottom only) so that the top and bottom are approximately parallel. The majority of the lift is to be tested.

The core drill takes a complete cross-section of the asphalt pavement since the layers are bonded together. They are separated with a wet saw. It is important to cut along the bond, and not cut off too much of the layer you are trying to test.

If samples are cores, they are trimmed (saw cut, bottom only) so that the top and bottom are approximately parallel. The majority of the lift is to be tested.
The test method can also be used to measure the density of gyratory compacted specimens. The steps used to obtain the different weights used in the test method are in a different order depending on the condition of the sample.
There are some minimum requirements for testing specimens. This generally applies to roadway cores more than compacted specimens since the latter is designed to meet these minimum requirements. The core is a nominal 6" diameter and the thickness should be as close to the layer thickness as possible.
CTQP Training Videos
FM 1-T 166 – Testing Order

• If sample is initially dry (lab compacted):
  1. Dry weight
  2. Under water weight
  3. SSD weight

Florida Method of Test for Bulk Specific Gravity of Compacted Hot Mix Asphalt (HMA) Specimens FM 1-T 166
Laboratory Compacted HMA Mixtures
Laboratory compacted specimens shall be cooled to room temperature (77 ± 9°F) after removal from the compaction mold prior to testing.

Record the dry mass of the specimen.
Immerse the specimen in the water bath for 4 ± 1 minutes and record the immersed mass.
Remove the specimen from the water, damp-dry the specimen by rolling the specimen on its side one complete roll and blotting each face once with a damp towel as quickly as possible (the entire operation is not to exceed 15 seconds) and determine the saturated surface-dry mass.
For a lab compacted specimen (dry) specimen, the sample can be weighed once it has cooled to room temperature. This is the first step. The rule of thumb is that if the specimen can be handled with bare hands, it is cool enough.

Weigh the dry sample in air. If taken from the gyratory, cool to room temperature.
Weight in water.
Place sample in holder in 77 ± 2°F water bath for 4 ± 1 minutes.
Record weight.

The specimen is placed in the holder attached to the wire support and submerged. The sample must remain submerged for three to five minutes before the weight is taken.

The wire support that breaks the surface of the water should be as thin as possible. For a lab compacted sample, this is the second step.

Weight in water: Place sample in holder in 77 ± 2°F water bath for 4 ± 1 minutes. Record weight.
Remove the specimen from the water bath and damp the excess water with a damp towel. The objective is not to remove all the water from the pores in the sample, just the surface. Make sure the towel is damp before removing the sample. Quickly remove the sample, blot the surface dry, and weigh. Record the weight. For a lab compacted sample, this is the last step.

Weigh saturated surface dry in air. Remove from water. Blot surface dry with damp towel. Record weight.
In most cases, cores will be wet from coring and trimming.

**From the Florida Method of Test for Bulk Specific Gravity of compacted Asphalt Specimens:**
Immerse the specimen in the water bath for 4 \( \pm 1 \) minutes and record the immersed mass.
From the Florida Method of Test for Bulk Specific Gravity of Compacted Asphalt Specimens:
Dry the specimen to a constant mass. The old way.

Samples saturated with water shall initially be dried in front of a fan for a minimum of four hours at room temperature (77 ± 9°F) and then weighed at 15 minute intervals, while still continuing to dry the samples in front of a fan, until a constant mass is achieved.

Stand the core on end (or place the core on a wire rack) and position the fan so that airflow will surround the core and blow across both faces of the core equally. Do not lay the core flat on a table or drying rack during the fan drying period. It is critical that the entire core be exposed to fan drying for the minimum four hour fan drying period.
The new way. The use of vacuum devices, such as the one shown above, is another method to obtain a dry weight of a roadway core in lieu of an fan dry method. This will now be done as the first step in the procedure, prior to obtaining the wet and SSD weights. These devices use a vacuum and multiple cycles to extract moisture and dry the core. This operation takes typically under 30 minutes. Read and follow the manufacturer's recommendations for operation and maintenance. Place sample in the unit. Make sure the lid is tightly sealed. Press that start button. The machine will sound when the sample is dry. Remove the sample from the machine and weigh it.

From the Florida Method of Test for Bulk Specific Gravity of Compacted Asphalt Specimens:

As an alternative to fan drying, commercially manufactured devices that dry a specimen by subjecting it to high vacuum conditions, causing the moisture in the specimen to vaporize, are an acceptable alternative to fan drying. The device shall have an electronic desiccation system, shall maintain the specimen at room temperature during the drying process and shall determine the dry condition automatically. The device shall dry the specimen to the same degree as the fan drying method discussed above. The CoreDry device manufactured by InstroTek, Inc. has been found to meet these requirements.
FM 1-T 166 Calculations

• Calculations:

\[
\text{Bulk Specific Gravity} = \frac{A}{B - C}
\]

A = Dry weight in air
B = Saturated Surface Dry (SSD) weight
C = Underwater weight

Report to 3 decimal places

The calculation is very straightforward and is illustrated in the slide. It is important to report results to 3 decimal places.
An example calculation is illustrated in the slide. It is important to report results to 3 decimal places.
FM 1-T 166 Calculations

Precision values for Gmb Laboratory compacted

Acceptable range of two tests
Single-operator  0.011
Multi-laboratory  0.022

Precision Values for Gmb Laboratory Compacted
Acceptable Range of Two Test Results
Single-operator  0.011
Multi-laboratory  0.022
Precision Values for Gmb Pavement Cores  
Multi-Laboratory Precision  
Acceptable Range of Two Test Results  
Fine-graded mixtures 0.015

For multi-laboratory precision, a test result is defined as the $G_{mb}$ of a single roadway core. The precision value stated above is the maximum allowable difference between two test results, where each test result is the $G_{mb}$ of the same roadway core.

*Also see the Table for Between-Laboratory Precision Values in Specification 346.*
QUESTIONS?