ASPHALT PLANT

LEVEL 1

Module 4: Gyratory Compaction

AASHTO T 312

Specification Year: January 2015
The test method used to prepare samples for determining the bulk specific gravity of compacted samples is a national standard written by the American Association of Highway and Traffic Officials (AASHTO). In 2010, changes in some of the requirements were implemented.
There are a number of different models of Gyratory compactors used in Florida. The majority of them are either Troxler 4140’s or Pine G1’s. All are capable of meeting the specification requirements.
Gyratory Molds

6” diameter mold

4” diameter mold
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Common Equipment Requirements

• Ram: 600 ± 18 kPa perpendicular to axis
• Angle: 1.16 ± 0.02° (internal)
• Speed: 30 ± 0.5 gyrations/minute
• Height: measured every gyration

Note this next sequence of slides shows equipment and setup for a specific type of machine. Follow manufacturers’ recommendations on how to calibrate and maintain specific equipment to ensure proper operation and results. Note the specifications shown on this slide apply to all Superpave Gyratory Compactors.

Shown on the slide are the requirements for the gyratory compactor. These are the original specifications that were used to design the various makes and models of gyratory compactors found in the field today. Due to differences between various makes of machines noted over the years, additional research has focused on the “internal” angle of the machine. Equipment has been developed to measure this. As of January 2010, an internal angle of 1.16° ± 0.02° is the requirement. By using the internal angle instead of the external angle measurement, we should see better reproducibility between gyratory compactors.
Pressure Calibration

Ram: 600 ± 18 kPa perpendicular to axis

Shown here is the load cell (arrow) being placed under the hydraulic ram to calibrate the pressure of the machine.
Internal Angle Calibration

Note this shows equipment and setup for a specific type of machine. Follow manufacturers’ recommendations on how to calibrate and maintain specific equipment to ensure proper operation and results.

The current AASHTO specification adopted in Florida in 2010 requires an internal angle calibration of $1.16^\circ + 0.02^\circ$. 
The height is calibrated using a standard calibration block of a known height.
Because each machine is designed slightly differently, each manufacturer has developed a set of requirements for their equipment to ensure proper operation. In addition, each laboratory has a Quality Systems Manual (QSM) that details calibration procedures and frequencies for the equipment used in the laboratory. It is important to remember that this equipment operates under tight tolerances and something as small as sand grains or tape under a platen or mold could affect the results. Make sure the machine is clean and well maintained to optimize performance and maximize up time.
Gyratory molds are expensive and are machine specific. Over time, molds can wear internally due to the abrasive action of the aggregate and this wear can affect the test results. Molds need to be checked periodically (more often if heavily used) to make sure they meet specifications. Paper discs are used at the top and bottom of the mold to prevent the mix from sticking to the platens and to ease the extraction of the compacted specimen.
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Equipment

- Oven
  - Set at compaction temperature
- Thermometer
- Gloves
- Pans
- Spoon

Other equipment needed for gyratory use is shown here.
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Test Preparation

• Lubricate
  • Any bearing surface as needed
  • Surface of rotating base and rollers
• Computer/controller
  • Turn on and enter required information
• Height measurements
  • Turn on and check units

Steps to prepare the gyratory for use are shown here.
AASHTO T 312 Preparation

• Place molds and base plate in oven at compaction temperature
  • 30 to 60 minutes
  • Place mix in shallow, flat pan in oven

• Additional requirements
  • Bring mix to compaction temperature for 1 hour ± five minutes and mix to be within ± 20°F of the roadway compaction temperature.

It is important to pre-heat the molds prior to use to maintain the mix heat while the sample is being compacted. The molds should be clean prior to use. The mix must also be brought up to the proper compaction temperature.

From the specifications…Prior to testing volumetric samples, condition the test-sized sample for one hour ± five minutes at the target roadway compaction temperature in a shallow, flat pan, such that the mixture temperature at the end of the one hour conditioning period is within ± 20°F of the roadway compaction temperature.
Remove mold and plate from oven.
Place paper disk in bottom of mold.
Place mix in mold in one lift.
Place paper disk on top of mix.

Once the mold is hot, remove it from the oven and drop in a paper disk. Immediately after removing the mold from the oven, remove the mix, making sure that it is at the proper compaction temperature. The mold is then “charged” with the mix in one effort or lift. Quickly scrape out the remaining particles in the pan. Cover with paper disk.

Remove mold and plate from oven. Place paper disk in bottom of mold. Place mix in mold in one lift. Place paper disk on top of mix.
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Compaction Procedure

• Enter number of gyrations according to Traffic Level (per the specifications)
• Load mold into the compactor
• Center mold under ram
• Begin gyrations

The steps for compacting the specimen are shown.
Wait 5 to 10 minutes before extruding the sample for lean, rich, or tender mixes.

Once the sample is complete, the ram will be raised and the mold can be removed from the machine. Normally, it is a good idea to let the mix cool off slightly before extracting the sample, especially if the mix is tender. If the mix is too hot, it can be damaged while moving it to the cooling area.

Be sure that the sample is cooled enough prior to full extraction from the mold to avoid distortion. Allow for proper cooling before testing.

Wait five to ten minutes before extruding the sample for lean, rich, or tender mixes.
Finally the compacted sample (pill) is placed in an area to cool down, often a fan is used to speed the cooling. As soon as possible, the sample should be properly marked to avoid confusion later. This is very important, especially in a busy lab with many different mixes and technicians working at the same time. Some technicians mark the paper disk and place the disk under the sample until it is cool enough to mark. Always make sure the sample is properly marked.

Remove paper from both ends. Cool sample under fan prior to testing.
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Density Measurements

• Record height every gyration (done automatically)
  • Nearest 0.1 mm
• Adjust batch weights to produce pills 115mm ± 5mm high after compaction
• Determine bulk specific gravity
  • FM 1-T 166

The next step is to record the height of the specimen in the bulk specific gravity section of the worksheet. Bulk specific gravity is covered in next module.
Reporting always comes at the end. The job is not complete until the paperwork is done.
QUESTIONS?