FHWA Updated – April 04, 2001

Issue – Greater than allowable precision[1] differences in bulk specific gravities (G_{mb}) between specimens compacted in different Superpave gyratory compactors (SGCs) have been reported in the field.

The precision stated in AASHTO T166 of 0.02 equates to a difference in calculated air voids of approximately 0.8 percent. This could be the difference between passing and failing test results.

Causes – Many of the differences reported can be attributed to differences in testing procedures. Leeway within AASHTO specifications can manifest into measurable differences. Uniform sampling, splitting, and handling practices are critical for obtaining repeatable and comparable results.

The TRB Mixture/Aggregate Expert Task Group (ETG) has developed a standard practice to address within-procedure differences.[2]

However – Measurable differences in gravities (G_{mb}) have been attributed to differences in compaction equipment. Currently, SGCs have to comply with AASHTO T312-01 (TP4)[3], where calibration is a function of pressure, speed, and angle of gyration. The angle is defined by the mold wall angle relative to a fixed reference plane. The upper and lower platens are assumed to be parallel. Compliance issues within the equipment affect parallel-ness.

Angle Validation Kit (AVK) –FHWA has developed an AVK to measure the internal angle of gyration in any SGC. The AVK is designed to operate inside a standard mold, during compaction, with hot-mix asphalt (HMA). The TRB Superpave Mixture/ Aggregate ETG is overseeing this research.[4]

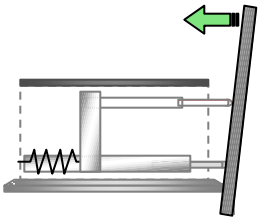

Figure. The AVK uses a springed LVDT to measure the movement between the mold wall and the end platen.

Several issues need to be addressed before the AVK can be considered in standard practice:

- The AVK must be validated and NIST-traceable.
- A target and tolerance for internal angle measure must be established.
- An AASHTO procedure must be developed.

Efforts are underway to address all of these issues. In the interim, the TRB Superpave Mixture/ Aggregate ETG recommends the use of the standard practice to address within-procedure difference.

[1] AASHTO T166-00 precision states that duplicate specific gravity results by the same operator should not be considered suspect unless they differ by more than 0.02.

[2] Standard Practice for the Evaluation of Different Superpave Gyratory Compactors (SGCs) Used in the Design and Field Management of Superpave Mixtures.

[3] Method for Preparing and Determining the Density of Hot-Mix Asphalt (HMA) Specimens by Means of the SHRP Gyratory Compactor

[4] The working group consists of: Gerry Huber – group leader (The Heritage Group), Larry Michael (Maryland SHA), Erv Dukatz (Mathy Construction), Julie Nodes (Arizona DOT), Mike Anderson (Asphalt Institute), George Merritt (Indiana DOT), and Tom Harman (FHWA).

Most of the issues related to the AVK should be addressed by summer 2001. The final product of this research is the refinement of AASHTO T312 (TP4) to include tolerances on parallel-ness and an internal angle. It is not the intent of FHWA to mandate the use of the AVK in the calibration of all SGCs.

Commercial Availability of the AVK – The AVK was developed in partnership between the FHWA and the TestQuip Corporation. The three parties involved are: Tom Harman (FHWA), Tom Brovold (TestQuip), and Paul Fuchs (FHWA contract staff). TestQuip has developed a commercial version of the AVK that is now being marketed. However, until the AVK can be validated and standards can be developed with the appropriate tolerances, these commercial units are only appropriate for research activities.

Patent – FHWA has filed for a patent for the AVK. Currently, the patent is pending. The patent lists the three parties involved in the development. It is FHWA's intent to license this technology. The majority of any royalties born of licensing will be returned to the FHWA asphalt pavement team to fund additional research.

Field Trials – The Maine DOT, like many agencies, has several models of SGC within its borders. This past construction season, Maine identified measurable differences in compactive effort, which they felt could not be fully attributed to handling practices. Working with SGC manufacturers and one of the commercial AVKs, Maine adjusted several SGCs to similar internal angles of gyration. The results of this study look promising. Setting the internal angles improved the comparability of the SGCs.

The Maryland State Highway Agency is currently in the process of benchmarking all the SGCs in their State using one of the prototype AVKs. The goal is to see what differences in internal angles exist under the current AASHTO T312 (TP4) procedure.

Caution – To set an SGC with an AVK you need a target and a tolerance. We currently do not know what is an appropriate internal angle of gyration. An issue of compliance – the parallel-ness of the platens – has always existed, including the research device used by the SHRP researchers and the production models used to validate the current compaction table.

Arbitrarily setting the internal angle to the external angle specified in AASHTO T312 (TP4) (1.25°) draws into question the appropriateness of the N_{design} table.

ETG Goal – To revise AASHTO T312 (TP4) such that differences in G_{mb}'s between to compactors are no greater than 0.015 (2DS).

ETG Recommendations –

The ETG recognizes equipment differences may exist. Owners and producers should investigate splitting, handling, testing variations, and equipment operation issues, according to the appended recommended practice.

The ETG supports the continued development of a device like the AVK. The ETG may recommend the use of the AVK once appropriate target and tolerance are established.

It is not the intent of the ETG to specify the AVK as the only method of angle validation for SGC's. The goal is to refine AASHTO T312-01 (TP4) to include tolerances on parallel-ness and an internal angle. The AVK may be a viable method for measurement of compliance.

Questions – If you have any additional questions regarding the **AVK**, please contact Tom Harman at tom.harman@fhwa.dot.gov or (202) 493-3072.

If you have questions regarding the TRB Superpave Mixture/Aggregate ETG, please contact John Bukowski at john.bukowski@fhwa.dot.gov or (202) 366-1287.

If you have questions regarding the TRB Superpave Binder ETG, please contact John D'Angelo at john.d'angelo@fhwa.dot.gov or (202) 366-0121.