A Very Boring Article:
(New Requirements for Superpave Gyratory Compactor Molds)

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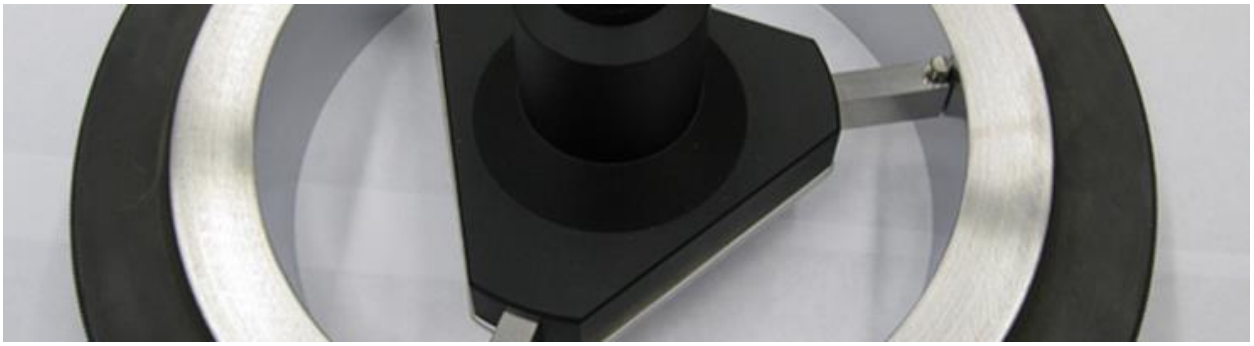


What's Changed?
AASHTO T 312, *Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor*, was modified in 2011 to include some new requirements for specimen molds. One of the major changes includes new diameter tolerances. New molds must still be manufactured to have a tolerance of 149.90 to 150.00 mm. However, in-service molds are allowed to have a diameter from 149.90 to 150.20 mm. In addition, a detailed procedure for measuring the inside diameter of the molds using a three-point bore gauge has been added and can be found in Annex A of T 312 (2011 version).

A Typical Trigger-Handled Three-Point Bore Gauge

What is a Bore Gauge?
A bore gauge is an instrument that is used to make internal diameter measurements of an object, such as a mold. They are commonly used by machinists to take accurate measurements of mechanical components and tools. A three-point bore gauge consists of three measuring anvils attached to a sliding plunger that connects to a micrometer or dial indicator. When used properly, bore gauges can be used to take accurate diameter measurements of gyratory molds. T 312 requires a bore gauge that has a minimum resolution of 0.0025 mm (0.0001 in).

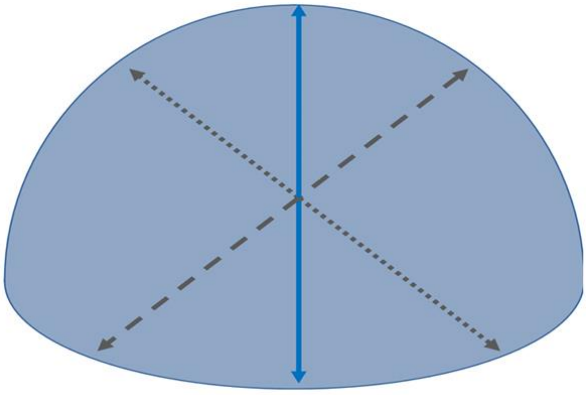
Bore gauges are required to be standardized before each use with a calibrated master ring. The master ring is used to set the reference for the bore gauge, and must have a diameter that is the same as the nominal mold diameter, or 150 mm. A Class Z master ring meeting the requirements of ANSI/ASME B89.1.6 is acceptable for this purpose. T 312 requires that the ring be calibrated at a minimum interval of 36 months to a resolution of at least 0.001 mm. Detailed instructions on how to standardize the bore gauge with the master ring are provided in Annex A of T 312. During the standardization, the bore gauge is reset (or zeroed) while placed in the master ring. When used to measure the diameter of a mold, the bore gauge measures the difference in mold diameter from that of the master ring. (Learn more about the difference between calibration and standardization.)

Standardizing a Bore Gauge with a Mater Ring

The Benefits of Using a Bore Gauge
The interior of a gyratory mold, where the compaction actually takes place, is difficult to measure with calipers or by other means. Over time and with increased use, the interior or the mold is prone to wear and distortion. Excessive mold wear can affect achievable densities, and may in turn affect the mix design properties or final product acceptance of asphalt mixtures. T 312 requires that the internal diameter of molds be checked at least annually or after a maximum of 80 hours of use. Regular inspection of gyratory molds can ensure consistency in the compactive effort and volumetric properties of laboratory-compacted asphalt mixtures.

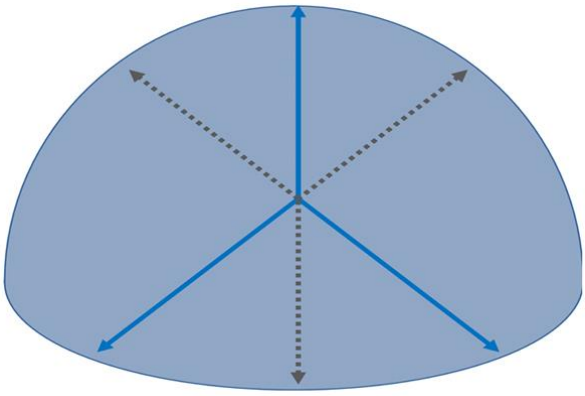
Three Points are Better Than Two… Usually

When measuring mold diameters, T 312 limits the type of bore gauge to be used to three-point systems, and does not allow the use of two-point gauges. Two-point bore gauges have several limitations that make them an undesirable tool in measuring gyratory mold diameters. The wear typically seen on gyratory molds is not even, and thus the molds are not perfectly round after repeated use. Over time the molds tend to exhibit lobing effects, or out-of-roundness. If a mold exhibits lobing, it is possible to miss the maximum and minimum diameters when using a two-point measurement system. In the image below, depicting a trilobed deformation, each lobe is located directly across from a flat area. If a two-point bore gauge is used to measure a mold with this shape, each measurement consistently produces the same diameter. Alternatively, if a three-point system is used, the effective diameter of the mold is easily obtained.



Trilobing is not easily detected when using a two-point bore gauge.

Three-point bore gauges have their limitations, too. If a mold deforms into an oval shape, a two-point bore gauge is more likely to detect its true dimensions than a three-point system. However, most molds do not deform in a perfectly trilobed or oval manner. Realistically, molds tend to wear unevenly and form lobes of varying degrees. Industry experts decided that a three-point system would be best-suited for measurement of gyratory molds because it offers the best average result.



The effective diameter of a trilobed mold is easily detected by use of a three-point bore gauge.

The Procedure

When inspecting gyratory molds, internal diameter measurements are taken at three elevations, or heights. At each height, three diameter measurements are taken at 90 degree increments, for a total of nine measurements taken per mold. **Each individual measurement must be within the specified measurement tolerance**. Additional details are provided in the Annex of T 312, and are illustrated in *Figure A3.2* (2011 version).

Three-point bore gauges can be quite costly. Therefore, if a laboratory does not want to inspect their molds in-house, it may be possible to contract with an outside agency to complete the work. Check with your gyratory equipment manufacturer or supplier to see if they inspect gyratory molds as part of their regular maintenance and calibration service. Be sure to inquire with the agency to ensure that the measurements are taken in accordance with the new requirements of Annex A.

Where to Buy a Bore Gauge

For laboratories that prefer to purchase their own bore gauge, there are several options. Many construction materials testing suppliers offer bore gauges for purchase. In addition, gyratory compactor supply companies and manufacturers may be able to provide recommendations. When purchasing a bore gauge, be sure that the cost of the master ring is included in the estimated total. For additional questions regarding the use of bore gauges, please contact us.

References

- Newton, Dennis and Fred V. Fowler III, “How Do You Choose the Right Bore Gauge?,” Fred V. Fowler Co., Inc.,<http://www.fvfowler.com/boregagestory.html> (September 9, 2011)

Editor’s Note: This article was updated in June 2016 to ensure the more accurate information is presented.