



OHD L-14

ODOT Standard method of test for bulk specific gravity, percent density, and longitudinal joint density of compacted asphalt mixtures.

1. SCOPE

- 1.1 This method of test covers the determination of percent density for compacted asphalt mixtures.
- 1.2 This method includes two different methods of determining the roadway density. Method 1 details the procedure for using cut cores for determining percent density. Method 2 details a procedure for utilizing a nuclear density gauge for determining percent density.
- 1.3 The determination of longitudinal joint density is given in Method 3.
- 1.4 Several test methods must be performed to obtain the information necessary to calculate percent density.

2. REFERENCED DOCUMENTS

2.1 AASHTO Standards

- R 79, Standard Practice for Vacuum Drying Compacted Asphalt Specimens
- T 166, Standard Method of Test for Bulk Specific Gravity (Gmb) of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens
- T 209, Standard Method of Test for Theoretical Maximum Specific Gravity (Gmm) and Density of Hot Mix Asphalt (HMA)
- T 269, Standard Method of Test for Percent Air Voids in Compacted Dense and Open Asphalt Mixtures

- T312, Standard Method of Test for Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyrotory Compactor
- T 343, Density of In-Place Hot Mix Asphalt Pavement by Electronic Surface Contact Devices
- T 355, Standard Method of Test for In-Place Density of Asphalt Mixtures by Nuclear Methods

2.2 Department Test Methods

- OHDL 45, Determining the Specific Gravity and Unit Weight of Compacted Bituminous Mixtures Using an Automatic Drying Unit Apparatus Such as the CoreLok™ or ADU.
- OHDL 56, Random Selection of Bituminous Mixture Samples. Referenced: **Random Number Worksheet (.xls)**

3. TERMINOLOGY

3.1 Detailed definition for many of the terms used in this standard are given in the referenced documents.

3.2 Terms and abbreviations are common to many of the referenced documents. The following terms will govern.

3.2.1 G_{mb} – bulk specific gravity of a compacted asphalt mixture.

3.2.2 G_{mm} – maximum specific gravity of an asphalt mixture. Sometimes referred to as the theoretical maximum or specific gravity/gravity mix maximum as in T 209.

3.2.3 P_a – percent air voids.

3.2.4 PG_{mm} – percent density of compacted asphalt specimen, also can be referred to as percent maximum specific gravity of an asphalt mixture, or percent maximum theoretical density in ODOT Standard Specifications and Special Provisions.

METHOD 1 – Density of Compacted Asphalt Specimens

4. SIGNIFICANCE AND USE

4.1 The in-place roadway density is one of the most important properties, affecting long term durability and performance of asphalt pavement. It is usually considered in the acceptance criteria and pay factor determinations.

- 4.2 The volumetric properties of laboratory compacted asphalt mixtures may be expressed as percent air voids or lab-molded density.

5. TEST SPECIMENS

- 5.1 Compact laboratory compacted specimens in accordance with T 312 and the mix design.
- 5.2 Obtain roadway density specimens (cores) in accordance with AASHTO R 67 with the following exceptions / additions.
- 5.2.1 Determine core locations in accordance with OHD L-56.
- 5.2.2 When obtaining more than one core per location, cut the cores parallel to the traffic direction. Cores should not be less than 2 inches nor more than 6 inches apart.
- 5.2.3 Core holes should be filled as soon as possible but within 24 hours of cutting.
- 5.2.4 Fill core holes using the following procedure as a guideline:
- 5.2.4.1 Dry the core hole and using an approved material, tack the inside of the hole completely.
 - 5.2.4.2 When the tack is 'broke', fill the hole in no more than 3 inch layers using HMA/WMA or patching material, compacting each layer before adding additional material. Use an appropriate tamping device to compact each layer.
 - 5.2.4.3 Continue filling and compaction until the material is just above the adjoining surface. Finally tack the top of the compacted material to ensure the surface is sealed.

6. PROCEDURE

- 6.1 Determine the Bulk Specific Gravity (G_{mb}) of the compacted asphalt specimen in accordance with AASHTO T166 – Method A, with the following exceptions.
- 6.1.1 If the percent absorption is more than the limit shown in T 166 Section 10.3, use OHD L 45 to determine the bulk specific gravity (G_{mb}).
- 6.1.2 Mixtures which by design contain open and interconnected air voids shall be tested using OHD L-45. Examples include PFC, UTBWC, etc.

- 6.1.3 As an alternative to oven drying the roadway cores to a constant mass, vacuum dry the cores to a constant mass in accordance with AASHTO R 79 with the following exception: Perform the vacuum drying procedure at least twice, with a mass determination after each cycle. Verify constant mass is achieved in accordance with the constant mass definition in T 166 Section 3.1.2.
- 6.1.4 If the sequence of testing has been changed to determine the dry mass last and the specimens are not required to be saved, the specimens may be dried to a constant mass at $230^{\circ} \pm 9^{\circ}\text{F}$ [$110^{\circ} \pm 5^{\circ}\text{C}$].

NOTE: This higher drying temperature will typically damage the core. If it is discovered after drying that the core has greater than 2% absorption, the core will not be suitable for further testing using OHD L-45 as required, rendering the samples unsuitable for acceptance or pay factor determination.

- 6.2 Determine Percent Density (PG_{mm}) of compacted asphalt specimens as shown in equation 1. Report to the nearest 0.1.

$$\text{(eq. 1)} \quad PG_{mm} = 100 \left(\frac{G_{mb}}{G_{mm}} \right)$$

Where G_{mm} is determined in accordance with AASHTO T 209 from a sample representing the same lot or unit of production as the compacted specimens.

- 6.3 Determine Percent Air Voids (P_a) in accordance with AASHTO T 269. Alternatively percent air voids can be computed by subtracting PG_{mm} from 100 to obtain P_a .

METHOD 2 – In-Place Density of asphalt mixture by the nuclear Method

7 SIGNIFICANCE AND USE

- 7.1 A nuclear density gauge is a non-destructive method of determining in-place density of compacted asphalt pavement. To be used for acceptance purposes for roadway density, the nuclear density gauge readings must be corrected with a correlation factor.
- 7.2 This method is also suitable for use as a quality control tool, and for establishing rolling patterns.
- 7.3 Specific use for longitudinal joint density is given in Method 3.

8 PROCEDURE

- 8.1 Determine in-place density in accordance with AASHTO T 355 with the following exceptions.
- 8.1.1. It is the preferred method to utilize a nuclear density gauge specifically designed for measuring asphalt pavement, typically referred to as a “thin lift gauge”.
- 8.1.2. If this procedure will be used for acceptance purposes, an acceptable correlation with cores must be established in accordance with Appendix X1 of T 355. The initial correlation must include at least ten core locations prior to the possible elimination of specific core sites as defined in Appendix X1.

METHOD 3 – Longitudinal Joint Density

9 APPARATUS

- 9.1 A nuclear density gauge meeting the requirements of Section 8, or an electromagnetic-density testing gauge meeting the requirements in AASHTO T 343 can be used to determine the in-place unit weight of the compacted asphalt pavement.
- 9.2 A thin-lift nuclear density gauge is the preferred method. It has the added benefit of being an acceptable method of determining percent density at the longitudinal joint site if a suitable correlation has been established. This could eliminate cores at joints if joint testing indicates a density determination is required. The electromagnetic gauge is not suitable for and is not allowed as an acceptance method of determining percent density.

10 PROCEDURE

- 10.1 Perform longitudinal joint density tests at stations identified for roadway density testing.
- 10.2 Conduct nuclear density testing in accordance with Method 2 except as revised below. Conduct electromagnetic density testing in accordance with AASHTO T 343.
- 10.3 At each station, determine the unit weight using a density-testing gauge at the following locations:
- At a point centered 8 inches from the joint. Note that a lane may have two longitudinal joints.
 - At the point in the lane where the density is to be determined for roadway density testing.

- 10.4 Position nuclear density gauge so that the length is parallel to the direction of traffic. At each test point, average two readings, without moving the gauge, using a minimum of one minute counts each. Two or four minute counts may be used if variability in the one minute count reading is high. Alternatively, at each test point using an electromagnetic density gauge, document the unit weight reading. Because electromagnetic density gauges read continuously, no averaging is necessary.
- 10.5 Determine the difference between the unit weights at the random testing point in the lane and 8 inches from the joint(s).
- 10.6 If the difference is less than the allowable limit or unit weight of the 8 inch joint offset location is greater than the density core's unit weight, the joint density meets specifications.
- 10.7 If the difference is greater than the allowable limit, determine the percent density, PG_{mm} , at the location 8 inches from the joint. The PG_{mm} can be computed using either a core or a correlated nuclear density gauge following the procedure outlined in Method 2 to determine bulk specific gravity. Electromagnetic density gauges are not acceptable for computation of PG_{mm} .
- 10.8 If the joint density is greater than the minimum requirement, the joint density meets specifications.

11 APPENDIX A

Removed

12 APPENDIX B

Removed. See Method 3, Section 9 and 10

NOTE: This Document has been Replaced

Revision Date	Revision Description
8/15/2018	<p>Major revision / Substantial formatting change.</p> <p>Replaced nuclear density gauge sections with reference to T 355 including measurement and correlation procedures.</p> <p>Replaced Electromagnetic density gauges sections with reference to T 343 including measurement and correlation procedures.</p> <p>Removed outdated, unnecessary equations.</p> <p>Removed reference to AASHTO T275, wax method is no longer allowed.</p> <p>Removed references to ASTM D 2950, D 3549, E 178.</p> <p>Added Coring procedures.</p> <p>Removed Appendixes A & B</p>
8/21/2014	<p>Updated page 3, section V(B), to reflect D 2950 limits for radiation source location limit.</p> <p>Removed Note 4 on page 4. NNGs “are” allowed for longitudinal joint density only.</p>
8/15/2014	<p>Test method completely rewritten. Method references AASHTO T 166 with a few exceptions.</p> <p>Removed non-nuclear gauge for acceptance.</p> <p>Changed nuclear density gauge counts and orientation.</p> <p>Added additional requirements for nuclear gauge correlations. AASHTO T 275 removed as an acceptable test method. Though not detailed in the test method except here, T 275 is allowed in-lieu-of OHD L-45 for a grace period until 12/31/14</p>