ALDOT-403

ROADWAY CORE BULK SPECIFIC GRAVITY DETERMINATION

1. Scope

1.1. This method describes a procedure for testing roadway cores for calculating the bulk specific gravity of roadway cores. It may be used to calibrate a non-destructive density testing device.

2. Referenced Documents

2.1. AASHTO Standards

- AASHTO T 166 Bulk Specific Gravity of Compacted Hot-Mix Asphalt Mixtures Using Saturated Surface-Dry Specimens
- AASHTO T 275 Bulk Specific Gravity of Compacted Hot-Mix Asphalt (HMA) Using Paraffin-Coated Specimens
- AASHTO T 331 Bulk Specific Gravity and Density of Compacted Hot-Mix Asphalt (HMA) Mixtures Using Automatic Vacuum Sealing Method

2.2. ALDOT PROCEDURES

- ALDOT 210 Selecting Samples by the Random Numbers Method
- ALDOT 349 Hot Mix Asphalt Field Testing Equipment

2.3. BMT FORMS

- BMT 135 Worksheet to Determine Pay Factors When They Cannot Be Determined From Verification Samples
- BMT 193 Inspector's Daily Roadway Core Density Report

3. Coring Procedure

3.1. The Engineer will use ALDOT 210 to identify and mark random core locations for the purpose of determining the roadway mat density pay factors. The contractor shall extract each core within six inches, in any direction, of the marked core location as approved by the Engineer. The Engineer will observe the extraction of each core and immediately take possession of it.

3.2. The size of each core shall be as follows:

3.2.1. The core diameter shall be at least four times the maximum aggregate size of the mix to be tested. The core shall be either four inches or six inches in diameter.

3.2.2. The core thickness shall be at least one and one-half (1.50) times the maximum aggregate size of the mix to be tested.

3.2.3. If the average core thickness, measured in inches, is not at least 0.008 times the rate in pounds per square yard (0.375 times the rate in kilograms per square meter for an average core thickness measured in millimeters), an extra core shall be

extracted at a location determined by the Engineer as being suitable for the determination of roadway density..

3.3. The Engineer and the Contractor shall agree to extract a second core within one foot of the original marked location in the event of a damaged core.

3.4. The Engineer will transport the cores to either a State or Contractor laboratory, whichever is more conveniently located, for testing. The Engineer will take the necessary precautions for the safe transport and protection of each core. This includes:

3.4.1. Using a padded cooler to protect the cores.

3.4.2. Securing the padded cooler in the vehicle so that it does not move.

3.4.3. Transporting the cores to the laboratory as soon as possible to prevent cores from being damaged by environmental conditions.

3.5. If the Contractor requests that the core be saw-trimmed, the contractor shall be responsible for providing the saw.

3.6. The Contractor shall perform the saw-trimming operation while the Engineer is present.

3.7. The bottom of each core may be saw-trimmed at the discretion of the Contractor or the Engineer prior to testing. If saw-trimming is performed, it must be done prior to the determination of any bulk specific gravity. Necessary precautions shall be taken to separate the layers without damaging the core.

3.8. The Contractor shall fill the core holes with HMA and compact it thoroughly. Each compacted layer of HMA shall be no more than three inches thick. The filling of the core holes shall be done while traffic control items are still in place.

4. Methods of testing

4.1. Quick Method

4.1.1. If requested by the Contractor, the Engineer will determine a preliminary roadway density using this Quick Method. This method determines the roadway density in accordance with AASHTO T 166, Method A, modified as follows:

4.1.2. Calibration weights lighter and heavier than the average core sample shall be used to check the calibration of the scale every time the scale (or the vehicle hauling the scales) is moved. These weights must be traceable to the National Institute of Standards and Technology (NIST). A shift test shall be performed as part of the calibration check (shifting the weights to the edge of the weighing platform) to ensure that the scale is level. The scale shall be accurate to within 0.2 gram or 0.1% of the weight of the sample. If the scale does not meet this level of accuracy, it must be calibrated. As required by ALDOT-349, the scale shall be calibrated by a reputable scale company every six months.

4.1.3. If the sample and/or water bath temperature is not within 77 ± 1.8 °F (25 ± 1 °C), then correct the measured bulk specific gravity with the temperature correction factors found in Appendix A. If the temperature of the sample and water bath is 77 °F (25 °C), then no correction is needed.

4.1.4. Take the weight of the sample underwater (C) and the saturated surface dry (SSD) weight (B) first to expedite the process.

4.1.5. The sample shall be dried by the fan method using fans and low heat not to exceed 130 °F (55 °C). Do not heat the sample until it becomes malleable. If the sample is to be re-tested all caution should be taken to avoid any damage to specimen during the drying process. Then weigh the sample to determine the dry weight of the sample (A). To determine that the sample is dry, the difference between two weight measurements taken at two-hour intervals shall be equal or less than 0.05 percent.

4.1.6. Calculate the bulk specific gravity as follows:

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

Where:

A = Weight of the dry sample in air
B = Weight of the SSD sample in air
C = Weight of the sample in water

4.1.7. The Engineer will furnish the results of the bulk specific gravity by the Quick Method to the Contractor as soon as practical. The Engineer will emphasize that these results are preliminary.

4.1.8. Test results will be reported on ALDOT worksheet BMT 193.

4.2. AASHTO T 166 Method

4.2.1. Determine the bulk specific gravity of the core using AASHTO T 166, Method A modified as follows:

4.2.2. Determine the underwater weight and the saturated surface-dry weight before determining the dry weight.

4.2.3. Oven-dry the core according to the AASHTO T 166. Using the formula in Item and substituting the oven dry weight for “A”, recalculate the bulk specific gravity. Provide the final results to the Contractor as soon as practical.

4.2.4. Test results will be reported on ALDOT worksheet BMT 193.

4.2.5. If the cores are tested in the contractor’s laboratory, a dedicated oven shall be used to dry the cores.

4.2.6. If the water absorption is less than or equal to 2.05%, furnish the results to the Contractor as soon as practical and substitute them in place of the Quick Method results. If the absorption exceeds 2.05% determine the bulk specific gravity using section 4.3 of this procedure.

4.3. High Absorption Method

4.3.1. If the water absorption using AASHTO T 166, Method A exceeds 2.05%, the cores shall be tested by the Engineer using AASHTO T 275 (paraffin coated) or AASHTO T 331 (Corelok). The contractor has the choice of which method is used. The Contractor may have a representative present when the cores are tested.

4.4. Referee Testing:

4.4.1. The Contractor may dispute the core bulk specific gravity and request referee

testing. The Contractor shall make the request in writing to the appropriate Division Materials Engineer stating the reason the bulk specific gravity is disputed.

4.4.2. The Contractor shall be made aware that no referee testing will be allowed if the cores are tested using the procedure in AASHTO T 275.

4.4.3. The Contractor's representative may be present for the referee testing.

4.4.4. If referee testing is requested, a technician other than the technician who originally tested the core will determine the core bulk specific gravity per Section 4.2 of this procedure.

4.4.5. The new density result determined by the referee testing will be final.

4.4.6. Referee test results will be reported on BMT 135.

5. Core Storage

5.1. The cores shall be stored until the pay item is complete.

5.1.1. The Engineer will mark the cores identifying the location of where the core came from.

5.1.2. The Engineer will store the cores in such a manner to prevent damage or loss.

5.1.3. Only authorized ALDOT personnel will have access to the cores.

6. Reporting

6.1. Report core bulk specific gravity test results on Form BMT 193.

6.2. If referee testing was performed, the following information should accompany the report:

6.2.1. Form BMT 193 with the original test data.

6.2.2. A copy of the letter from the Contractor to the Division Materials Engineer stating the reason for disputing the core bulk specific gravity results obtained from testing in accordance with Section 4.2 of this procedure, and

6.2.3. A copy of the referee test results if the Contractor's referee test request was granted.

6.3. All documentation will be sent to the Project Engineer.

APPENDIX A
ABSOLUTE DENSITY OF WATER AND
CONVERSION FACTOR "K" FOR VARIOUS TEMPERATURES

Temperature ° F	Temperature ° C	Absolute Density of Water	Correction Factor K
50.0	10	0.999728	1.002661
51.8	11	0.999634	1.002567
53.6	12	0.999526	1.002458
55.4	13	0.999406	1.002338
57.2	14	0.999273	1.002204
59.0	15	0.999129	1.002060
60.8	16	0.998972	1.001903
62.6	17	0.998804	1.001734
64.4	18	0.998625	1.001555
66.2	19	0.998435	1.001364
68.0	20	0.998234	1.001162
69.8	21	0.998022	1.000950
71.6	22	0.997801	1.000728
73.4	23	0.997569	1.000495
75.2	24	0.997327	1.000253
77.0	25	0.997075	1.000000
78.8	26	0.996814	0.999738
80.6	27	0.996544	0.999467
82.4	28	0.996264	0.999187
84.2	29	0.995976	0.998898
86.0	30	0.995678	0.998599

Bulk specific gravity at 77 ^{0}F (25^{0}C) = K * measured bulk specific gravity.

This calculation is valid if the temperature of the water is between 71.6 – 82.4^{0}F (22 – 28^{0}C). For temperatures outside this range, a correction to the amount of water displaced shall also be made using the following equation:

Correction = (25^{O}C – water temperature) * ($6*10^{-5}$ mL/mL/^{O}C) * (B-C)
Where (B-C) is the volume of water displaced in mL and ($6*10^{-5}$ mL/mL/^{0}C) is the coefficient of cubical thermal expansion for bituminous concrete.