

WSDOT FOP for AASHTO T 166¹

Bulk Specific Gravity of Compacted Hot Mix Asphalt Using Saturated Surface-Dry Specimens

1. Scope

- 1.1 This method of test covers the determination of bulk specific gravity of specimens of compacted hot mix asphalt.
- 1.2 Definition:
- 1.3 Bulk specific gravity (of solids) – The ratio of the mass in air of a unit volume of a permeable material (including both permeable and impermeable voids normal to the material) at a stated temperature to the weight in air of equal density of an equal volume of gas-free distilled water at a stated temperature. The form of the expression shall be:

Bulk specific gravity x/y °C

where:

- x = temperature of the material, and
- y = temperature of the water

- 1.4 The bulk specific gravity of the compacted hot mix asphalt may be used in calculating the unit mass of the mixture.
- 1.5 The values stated in English units are to be regarded as the standard.

Note: Method A shall be used for laboratory compacted specimens, and field specimens compacted using gyratory compactor.

Method C shall be used for asphalt pavement cores.

2. Referenced Documents

2.1 AASHTO Standards

M 231 – Weighing Devices Used in the Testing of Materials

T 275 – Bulk Specific Gravity of Compacted Hot Mix Asphalt (HMA) Using Paraffin-Coated Specimens

3. Test Specimens

- 3.1 Test specimens may be either laboratory-molded HMA mixtures or from HMA pavements. The mixtures may be surface, wearing, leveling or base course materials.
- 3.2 Size of Specimens – It is recommended that: (1) the diameter of cylindrically molded or cored specimens, or the length of the sides of sawed specimens, be at least equal to four times the maximum size of the aggregate; and (2) the thickness of specimens be at least one-and-one-half times the maximum size of the aggregate.

¹This Test Method is based on AASHTO T 166-10.

- 3.3 Specimens shall be taken from pavements with core drill, diamond or carborundum saw, or by other suitable means.
- 3.4 Care shall be taken to avoid distortion, bending, or cracking of specimens during and after the removal from pavement or mold. Specimens shall be stored in a safe, cool place.
- 3.5 Specimens shall be free from foreign materials such as seal coat, tack coat, foundation material, soil, paper, or foil.
- 3.6 If desired, specimens may be separated from other pavement layers by sawing or other suitable means. Care should be exercised to ensure sawing does not damage the specimens.

Method A

4. Apparatus

- 4.1 Weighing Device – The weighing device shall have sufficient capacity, be readable to 0.1 percent of the specimen mass, or better, and conform to the requirements of AASHTO M 231. The weighing device shall be equipped with suitable suspension apparatus and holder to permit weighing the specimen while suspended from the center of scale pan of the weighing device.
- 4.2 Suspension Apparatus – The wire suspending the container shall be the smallest practical size to minimize any possible effects of a variable immersed length. The suspension apparatus shall be constructed to enable the container to be immersed to a depth sufficient to cover it and the specimen during weighing. Care should be exercised to ensure no trapped air bubbles exist under the specimen.
- 4.3 Water Bath – For immersing the specimen in water while suspended under the weighing device, equipped with an overflow outlet for maintaining a constant water level.
- 4.4 Thermometric Device – Liquid-in-glass thermometers or other suitable thermometric device, accurate to 1°F (0.5° C).

5. Procedure

- 5.1 Dry the specimen to a constant mass (Note 1). Cool the specimen to room temperature for a minimum of 15 hours and a maximum of 24 hours at $77 \pm 9^{\circ}\text{F}$ ($25 \pm 5^{\circ}\text{C}$) per SOP 731 and record the dry mass as A. Immerse each specimen in water at $77 \pm 1.8^{\circ}\text{F}$ ($25 \pm 1^{\circ}\text{C}$) for 4 ± 1 minute and record the immersed mass as C. Remove the specimen from the water, damp dry the specimen by blotting with a damp towel as quickly as possible (blotting not to exceed 10s), and determine the surface-dry mass as, B. Any water that seeps from the specimen during the weighing operation is considered part of the saturated specimen (Note 1). Each specimen shall be immersed and weighed individually.

Note 1: Constant mass shall be defined as the mass at which further drying at $125 \pm 5^{\circ}\text{F}$ ($52 \pm 3^{\circ}\text{C}$) does not alter the mass by more than 0.05 percent. Specimen saturated with water shall initially be dried overnight at $125 \pm 5^{\circ}\text{F}$ ($52 \pm 3^{\circ}\text{C}$) and then weighed at 2-hour drying intervals. Recently molded laboratory specimens which have not been exposed to moisture do not require drying.

Note 2: If desired, the sequence of testing operations may be changed to expedite the test results. For example, first the immersed mass (C) can be taken, then the surface-dry mass (B), and finally the dry mass (A).

Note 3: Terry cloth has been found to work well for an absorbent cloth. Damp is considered to be when no water can be wrung from towel.

6. Transportation of Warm Specimens

It is not recommended that specimens be transported before they have cooled to room temperature. If however, a specimen must be transported prior to reaching room temperature the following guidelines should be used to transport the specimen:

- a. Place the specimen in a container that has a flat bottom surface to prevent deformation of the bottom of the specimen.

Note: A flat piece of wood, rigid aluminum or reinforced cardboard may be used to create a flat surface in an HMA sample box.

- b. Make sure the specimen is not deformed in handling.
- c. Do not stack anything on top of the specimen container.
- d. Transport the container in the cab of the vehicle or secure it in the vehicle bed to prevent movement during transit.

7. Calculation

- 7.1 Calculate the bulk specific gravity of the specimens as follows (round and report the value to the nearest three decimal places):

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

Where:

- A = Mass in grams of specimen in air
- B = Mass in grams of surface-dry specimen in air
- C = Mass in grams of specimen in water.

- 7.2 Calculate the percent water absorbed by the specimen (on volume basis) as follows:

$$\text{Percent Water Absorbed by Volume} = \frac{B - A}{B - C} \times 100$$

- 7.3 If the percent water absorbed by the specimen in Section 5.1 exceeds 2 percent, use T 275 (Bulk Specific Gravity of Compacted Hot Mix Asphalt (HMA) Using Paraffin-Coated Specimens) to determine the bulk specific gravity.

Method B

WSDOT does not use Method B and has removed this section from the procedure.

Method C (Rapid Test)

8. Procedure

8.1 This procedure can be used for testing specimens which are not required to be saved and which contain substantial amount of moisture. Specimens obtained by coring or sawing can be tested the same day by this method.

8.2 The testing procedure shall be the same as given in Sections 5 except for the sequence of operations. The dry mass (A) of the specimen is determined last as follows.

Note 4: A microwave oven can be used to speed up the process by initially heating the sample so that it can be broken into small pieces prior to placing it into the drying oven.

8.3 Place the specimen in a large flat bottom drying pan of known mass. Place the pan and specimen in a $325 \pm 25^\circ \text{F}$ ($164 \pm 14^\circ \text{C}$) oven. Leave the specimen in the oven until it can be easily separated to the point where the particles of the fine aggregate-asphalt portion are not larger than $\frac{1}{4}$ in (6.4 mm). Place the separated specimen in the 325°F (164°C) oven and dry to a constant mass. The test sample shall be initially dried for a minimum of 90 minutes, and it's mass determined. Then, at 30 minute intervals until constant mass is achieved.

Note: If samples are placed in the oven overnight for a minimum of 6 hours at 230°F , then the 90 minute weighting is not necessary.

8.4 Cool the pan and specimen to room temperature at $77 \pm 9^\circ \text{F}$ ($25 \pm 5^\circ \text{C}$). Determine the mass of the pan and specimen, subtract the mass of the pan and record the dry mass of the pan and record the dry mass, A.

9. Calculations

9.1 Calculate the bulk specific gravity per Sections 7.1.

10. Report

10.1 The report shall include the following:

10.1.1 Bulk Specific Gravity reported to the nearest thousandth (0.001).

10.1.2 Absorption reported to the nearest hundredth (0.01).

11. Precision

11.1 See AASHTO T 166 for precision statement.

Performance Exam Checklist

WSDOT FOP for AASHTO T 166

Bulk Specific Gravity of Compacted Hot Mix Asphalt Using Saturated Surface Dry Specimens

Participant Name _____ Exam Date _____

Procedure Element	Yes	No
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- | | | |
|--|--------------------------|--------------------------|
| 1. The tester has a copy of the current procedure on hand? | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. All equipment is functioning according to the test procedure, and if required, has the current calibration/verification tags present? | <input type="checkbox"/> | <input type="checkbox"/> |

Method A (For use with laboratory compacted specimens.)

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|--|--------------------------|--------------------------|
| 1. Compacted specimen cooled to room temperature (refer to WSDOT SOP 731, Procedure #5g), $77 \pm 9^\circ$ F, and record the dry mass. | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Immerse each specimen in water at $77 \pm 1.8^\circ$ F for 3 to 5 minutes and record the immersed mass to the nearest 0.1 gram? | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Remove sample from water, surface dry with damp towel and weigh the specimen in air at $77 \pm 9^\circ$ F to the nearest 0.1 gram? | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Calculated the bulk specific gravity of the specimens per Section 7.1? | <input type="checkbox"/> | <input type="checkbox"/> |

Method C (For use with pavement cores and chunks.)

- | | | |
|---|--------------------------|--------------------------|
| 1. Immerse specimen in water at $77 \pm 1.8^\circ$ F for 3 to 5 minutes and record the immersed weight to the nearest 0.1 gram? | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Remove sample from water, surface dry by blotting with damp towel and immediately weigh specimen in air at $77 \pm 9^\circ$ F to the nearest 0.1 gram? | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Place specimen in container (noting the empty container weight), then into an oven set at $325 \pm 25^\circ$ F until sample can be broken into small pieces? | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Return container to oven until it has reached a constant weight? | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Remove container and sample from oven and allow to cool to room temperature, $77 \pm 9^\circ$ F? | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Weigh pan with sample and record to nearest 0.1 gram, deducting known weight of pan to arrive at oven-dried sample weight? | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Calculated the bulk specific gravity of the specimen per Section 6.1? | <input type="checkbox"/> | <input type="checkbox"/> |

First Attempt: Pass Fail

Second Attempt: Pass Fail

Signature of Examiner _____

Comments: