

**1810 BULK SPECIFIC GRAVITY (GMB), DENSITY AND PERCENT  
ABSORBED WATER OF COMPACTED BITUMINOUS SPECIMENS**  
AASHTO Designation T 166 (MN/DOT Modified)

**1810.1 SCOPE**

This test method determines the bulk specific gravity (Gmb), the density at 25 °C (77 °F), and the percent of absorbed water in compacted bituminous specimens. This method should not be used with samples that contain open or interconnecting voids.

**Note 1:** This procedure differs from the AASHTO procedure in that AASHTO T 166 provides three different methods for determining Gmb and percent moisture absorbed while Mn/DOT only allows the use of test method's "A" and "C". In Method "A" this method differs only in that it requires the dry weight of a specimen (low heat oven) be determined first. In Method "C" Mn/DOT requires: the recording of an "initial air-dry" weight of the field core prior to immersion and obtaining the final dry weight.

**1810.2 APPARATUS**

- A. Balance** - Conforming to the requirements of AASHTO M 231 having a readability & sensitivity of 0.1 grams and an accuracy of 0.1 grams or 0.1% and having a minimum capacity of 5000g. The balance shall be equipped with suitable apparatus for suspending the sample container in water from the center of the weighing platform or pan of the balance.
- B. Water Tank** - A watertight tank into which the sample is placed while suspended below the balance, equipped with an overflow outlet for maintaining a constant water level and of sufficient capacity so that the sample and container cannot touch the sides of the tank and there is at least 25mm (1") of water above and below the container.

**Note 2:** Since the water in the tank must be maintained at  $25 \pm 1$  °C ( $77 \pm 1.8$  °F) it is recommended that it be equipped with an immersion heater/circulator capable of maintaining that temperature.

- C. Oven** - Capable of maintaining a temperature of  $110 \pm 5$  °C. ( $230 \pm 9$  °F.) and  $52 \pm 3$ °C. ( $125 \pm 5$  °F.).
- D. Absorption Toweling** – Terry cloth has been found to work well.

**1810.3 TEST SPECIMENS**

Test specimens may be either laboratory-molded or cores drilled from bituminous pavements. Field cores should be free from any foreign material such as: soil, paper, seal coats, etc.

If individual lifts (wear, non-wear, binder, etc.) need to be examined, the lifts will have to be separated. Determine the lift division point by observation (it looks like a thin line) or find out from the submitter the thickness of each paving lift. Mark each division point clearly, with a marking crayon, for an inch or two around the side of the core. The preferred method of separating the lifts is the use of a core saw. An alternative method is to freeze the core and separate the lifts with a hammer and a chisel. Hammering will often damage an older core. Try it and if there's any damage the cores need to be sawed. When sawing it is not necessary to freeze the core.

#### 1810.4 TEST METHOD "A"

This method can be used for testing specimens which for any reason need to be saved or for recently molded laboratory samples

- A.** Dry the specimen in a low temp oven  $52 \pm 3$  °C ( $125 \pm 5$  °F) to a constant mass (weight).

**Note 3:** A constant mass shall be defined as the mass at which no further drying at  $52 \pm 3$  °C ( $125 \pm 5$  °F) does not alter the mass by more than 0.05 percent. (For example a 0.05% loss in a 1000g sample would equal 0.5g.)

Samples saturated with water shall initially be dried overnight at  $52 \pm 3$  °C. ( $125 \pm 5$  °F.) and weighed. Return the specimen to the oven at  $52 \pm 3$  °C. ( $125 \pm 5$  °F.) for an additional two hours and re-check the weight. If the loss is still greater than 0.05% continue the two-hour drying intervals until a constant weight has been achieved. Recently molded laboratory samples which have not been exposed to moisture do not require drying.

- B.** Cool the specimen to room temperature  $25 \pm 5$  °C. ( $77 \pm 9$  °F.) and record this dry mass as **A** (sample weight in air).
- C.** Immerse the specimen in water at  $25 \pm 1$  °C. ( $77 \pm 1.8$  °F.) for 3 to 5 minutes and record this mass as **C** (immersed weight).
- D.** Immediately after obtaining the immersed weight, remove the specimen from the water and then immediately surface dry by rolling and blotting on a damp towel. Weigh the specimen and record the Saturated Surface-Dry weight (SSD) as **B**. This entire step of obtaining an SSD and then weighing shall be completed within 15 seconds of removal from the water bath. After the specimen has been surface-dried any water that seeps from the specimen during the weighing operation is considered part of the SSD weight.

**Note 4:** Prior to obtaining the SSD weight the towel should be brought to a damp state by lightly spraying with water. This helps to prevent any excessive wicking of water from the specimen.

**1810.5 CALCULATION - TEST METHOD "A"**

Calculate the bulk specific gravity ( $G_{mb}$ ) of the specimen as follows:

$$\text{Bulk specific gravity } (G_{mb}) = \frac{A}{B - C} \quad (\text{Record to the nearest 0.001})$$

Calculate the percent water absorbed by the specimen as follows:

$$\% \text{ Absorbed Water} = \frac{B - A}{B - C} \times 100 \quad (\text{Record to the nearest 0.1\%})$$

Calculate the density of the specimen as follows:

$$\text{Density (lbs/ft}^3\text{)} = \text{Bulk Specific Gravity} \times 62.3$$

$$\text{Density (kg/m}^3\text{)} = \text{Bulk Specific Gravity} \times 998.0$$

**1810.6 TEST METHOD "C" (RAPID TEST METHOD for CORES)**

This method can be used for testing specimens that do not need to be saved and which contain a substantial amount of moisture. Specimens obtained by coring can be tested the same day by this method.

- A.** If the core has been frozen allow it to come to room temperature.
- B.** At room temperature ( $25 \pm 5$  °C. [ $77 \pm 9$  °F.]) weigh and record the initial air-dry mass of the specimen as "Air Dry<sub>initial</sub>" (weight in air prior to immersion).

**Note 5:** The term "Air-Dry" is defined as the equivalent condition to which a specimen's surface moisture has been evaporated. To attain this condition place the specimen in front of a fan for at least 30 minutes.

- C.** Immerse the specimen in water at  $25 \pm 1$  °C. ( $77 \pm 1.8$  °F.) for 3 to 5 minutes and record this mass as "C" (immersed weight).
- D.** Immediately after obtaining the immersed weight remove the specimen from the water and then immediately surface dry by rolling and blotting on a damp towel. Weigh the specimen and record the Saturated Surface-Dry weight (SSD) as **B**. This entire step of obtaining an SSD and the weighing shall be completed within 15 seconds of removal from the water bath. After the specimen has been surface-dried any water that seeps from the specimen during the weighing operation is considered part of the SSD weight.

**Note 6:** Prior to obtaining the SSD weight the towel should be brought to a damp state by lightly spraying with water. This helps to prevent any excessive wicking of water from the specimen.

**E.** Place the core specimen in a drying pan of known weight. Place the pan and specimen in a  $110 \pm 5$  °C. ( $230 \pm 9$  °F.) oven and dry to a constant weight. The minimum initial drying time is 3 hrs.

**Picture #1**



**CORE**

(Place in Pan & Dry for minimum 3 Hours)

**Picture #2**



**CORE – AFTER DRYING**

(Cracking Does Not Indicate a Dried State)

Picture #3



**AFTER 1 to 1 ½ HOURS OF DRYING – CHOP CORE UP**  
(Continue Drying & Check at 15 Minute Intervals)

- F.** After three hours chop the sample carefully with a spatula or knife.  
**OR**  
After at least 1 to 1 ½ hours of drying, when the core has softened, carefully chop with a spatula or knife and continue drying for the remaining 3 hrs.

**Note 7:** The point at which the sample becomes easily separated should not be deemed the final dry weight. This is only establishing a condition at which time the core is able to lose its entrapped moisture. Additional 15-minute checks are needed to determine the true “constant weight” as described in the first paragraph of NOTE 3, above.

- G.** After the initial 3 hours of drying remove pan and chopped core from oven, weigh and record an initial oven-dry weight.
- H.** Return the sample to the oven and continue drying for at least 15 minutes.
- I.** Check the weight every 15 minutes until further drying does not alter the weight by more than 0.05 percent.

**Note 8:** For example a 0.05 percent change in weight on 1000 grams would equate to 0.5 grams.

- J.** Within 20 minutes of determining a constant mass record this weight minus the pan weight as “A” (the final oven dry weight).

## 1810.7

### CALCULATION

Calculate the Bulk Specific Gravity (Gmb) of the specimen as follows.

$$\text{Bulk specific gravity (Gmb)} = \frac{A}{B - C}$$

Report to the nearest 0.001.