

1811 BULK SPECIFIC GRAVITY (GMB) AND DENSITY OF COMPACTED BITUMINOUS SPECIMENS USING PARAFFIN OR PARAFILM
ASTM Designation D 1188 (MN/DOT Modified)

1811.1 SCOPE

This test method covers the determination of the bulk specific gravity of coated compacted bituminous mixtures and/or of bituminous cores used for pavement density determination. This test method should be used with samples that contain open or interconnecting voids and/or absorb more than 2.0% of water by volume. The bulk specific gravity of the compacted bituminous mixtures may be used in calculating the unit weight of the mixture.

1811.2 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 1: Since the water in the tank must be maintained at 25 ± 1 °C (77 ± 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 temperatures of 52 ± 3 °C. (125 ± 5 °F.).
- D. Paraffin - Any commercially available paraffin coating wax.
- E. Hot Plate - (When paraffin is used) to melt paraffin wax.
- F. Parafilm - An elastomeric film obtainable from most scientific suppliers.
- G. Polyurethane Foam Mat. - (When Parafilm is used) A foam mat approximately 51cm x 51cm (20" x 20") shall be used as a working surface.

- H. Aluminum Cylinder - (When Parafilm is used) An approximate 100mm (4.0") diameter x 64mm (2.5") height cylinder is used to determine the specific gravity of the parafilm.

1811.3 TEST SPECIMENS

Test specimens may be molded from laboratory mixtures or be cored from bituminous pavement. If desired specimens may be separated by lifts.

The diameter of cylindrically molded or cored specimens should be at least equal to four times the maximum size of the aggregate and the thickness of specimens be at least one and one half times the maximum aggregate size.

Care shall be taken to avoid distortion, bending or cracking of the specimen during and after the removal from pavement or mold. Store specimens in a safe, cool place.

Specimens shall be free of foreign matter such as tack coat, seal coat, soil, paper, or other similar material. When any of these are visually evident they shall be removed.

1811.4 METHOD "A" – PARRAFIN COATED TEST

- A. Dry the specimen in a low temp oven 52 ± 3 °C (125 ± 5 °F) to a constant mass (weight). Weigh to the nearest 0.1g and record as mass "A".

NOTE 2: A constant mass shall be defined as the mass at which no further drying at 52 ± 3 °C (125 ± 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 ± 3 °C. (125 ± 5 °F.) and weighed. Return the specimen to the oven at 52 ± 3 °C. (125 ± 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. Coat the test specimen on all surfaces with melted paraffin wax sufficiently thick to seal all surface voids. Allow the coating to cool in air at room temperature for approximately 30 minutes and then weigh the coated specimen to the nearest 0.1g. and record as mass "D".

NOTE 3: If it is desired to use the specimen for further testing which requires the removal of the paraffin wax coating the specimen may be dusted with powdered talc prior to coating.

NOTE 4: Application of the paraffin wax may be accomplished by chilling the specimen in a refrigerating unit to a temperature of approximately 4.4 °C (40 °F) for 30 minutes and then dipping the specimen in warm paraffin 5.6°C (10°F) above the melting point of the wax. It may be necessary to brush the surface of the paraffin with additional hot wax in order to fill any pinholes.

- C. Immerse the coated specimen in a water bath at 25 ± 1 °C. (77 ± 1.8 °F.) for 3 to 5 minutes. Weigh to the nearest 0.1g and record as mass “**E**”.
- D. Determine the specific gravity of the paraffin wax at 25 ± 1 °C. (77 ± 1.8 °F.) if unknown and record this as “**F**”.

1811.5 METHOD “B” – PARAFILM (SHEET) COATED TEST

- A. Dry the specimen in a low temp oven 52 ± 3 °C (125 ± 5 °F) to a constant mass (weight). Weigh to the nearest 0.1g and record as mass “**A**”. (See Note 2.)
- B. Cut the Parafilm sheeting into three pieces. For example: to wrap a 100mm (4”) diameter X 64mm (2.5”) thick specimen cut two 100 X 100mm (4 X 4”) and one 100 X 200mm (4 X 8”) pieces of the Parafilm from the roll sheeting with a razor blade or sharp knife.

NOTE 5: The Parafilm pieces will need to be trimmed accordingly to the size and shape of the specimen.

- C. Peel the backing off one of the 100 X 100mm (4 X 4”) pieces and stretch it out to approximately a 150 X 150mm (6 X 6”) square. To accomplish this grasp opposite ends of the film and stretch carefully, repeat the stretching with the other two sides until the 150 X 150mm (6 X 6) square has been achieved. Take care not to create any holes in the film.
- D. Place the stretched film over one end of the specimen and press the sides of the film around the sample. Turn the specimen over and place it on a foam mat.
- E. Stretch out the other 100 X 100mm (4” x 4”) piece and apply it to the specimen’s other end.
- F. After both ends have been wrapped (and working on the foam mat) place another piece of foam (approximately the same size and shape as the specimen) on top of the specimen. Use another specimen of similar size, press down on top of the foam to eliminate all air pockets from both surfaces.

- G. Use a razor blade or sharp knife to trim the excess film from around the sides of the specimen. There should be approximately 13mm (0.5") of film remaining on the side of the specimen at each end.
- H. Next peel the backing off the remaining 100 X 200mm (4 X 8") piece of film, grasp the film at the ends and stretch it out to about 400mm (16").
- I. Place one end of the stretched film on the side of the specimen and roll it over the foam so that the film is stretched tightly over the surface. Fold and press the edges around and over the edges of the specimen.
- J. Weigh the coated specimen in air to the nearest 0.1g and record this mass as "D".
- K. Immerse the coated specimen in a water bath at 25 ± 1 °C. (77 ± 1.8 °F.), weigh to the nearest 0.1g and record this as mass "E".
- L. Determine the specific gravity of the parafilm sheet wax at 25 ± 1 °C. (77 ± 1.8 °F.) if unknown and designate this as "F".

1811.5**DERMINATION OF THE APPARENT SPECIFIC GRAVITY OF PARAFILM**

- A. Determine the specific gravity of the aluminum cylinder (G_{al}) by first weighing it in air, designate this mass as A_{al} . Immerse the cylinder in a water bath at 25 ± 1 °C. (77 ± 1.8 °F.), and designate this weight as B_{al} . Calculate the specific gravity of the cylinder as follows:

$$\text{Cylinder Specific Gravity } (G_{al}) = \frac{A_{al}}{A_{al} - B_{al}}$$

- B. Wrap the aluminum cylinder with the stretched Parafilm sheeting as described above. Determine the dry wrapped mass and designate as D_{al} . Immerse the wrapped cylinder and designate this weight as E_{al} . Determine the specific gravity of the Parafilm (F) as follows:

$$F = \frac{D_{al} - A_{al}}{D_{al} - E_{al} - (A_{al} \div G_{al})}$$

1811.6 CALCULATION OF BULK SPECIFIC GRAVITY AND DENSITY

Calculate the bulk specific gravity as follows:

Where:

A = Mass of dry specimen (From Section 1811.4A)

D = Mass of dry coated specimen (From Section 1811.4B or J*)

E = Mass of immersed coated specimen (From Section 1811.4C or K*)

F = Specific gravity of the coating at 52 °C (77 °F) (From Section 1811.4D or L*)

*Depending on which method is used.

$$\text{Bulk Specific Gravity} = \frac{A}{(D - E) - ([D - A] \div F)}$$

Calculate the density of the specimen as follows:

Density (lbs/ft³) = Bulk Specific Gravity X 62.3

Density (kg/m³) = Bulk Specific Gravity X 998.0

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