10.10 Bulk Specific Gravity of Compacted Bituminous Mixtures Test

10.10.1 General requirements

10.10.1.1 Scope

This test provides a method of measuring the compaction of a compacted bituminous mixture in terms of its bulk specific gravity. The bulk specific gravity may be used in calculating the unit mass of the mixture.

The specimen may be a laboratory moulded bituminous mixture or from bituminous pavements. The mixture may be wearing course, binder course, hot mix or levelling course.

10.10.1.2 Apparatus

a) Balance, capable of weighing a sample in air and water and of ample capacity appropriate for the sample weights. The balance should be capable of weighing to an accuracy of at least 0.0001 kg.

b) Water bath, for immersing the specimens in water while suspended under the balance, equipped with an overflow outlet for maintaining the water level constant.

c) Thermometer, for measuring the temperature of the water in the water bath.

d) A steel wire brush.

e) Volumeter, calibrated to 1200 ml or appropriate capacity depending on the size of the test sample.

10.10.1.3 Preparation of specimens

a) Clean the specimen well to remove any dust particles adhering to it, remove any grease, oil and other matter from it.

b) Using a wire brush, scub the surface of the specimen to remove any particles that may come loose during the immersion of the specimen in water.

c) The temperature of the specimen should be in close proximity to room temperature.

d) Dry the specimen to a constant mass.

e) If the specimen is a core consisting of more than one layer of the same material the core may be split into its different layers tested separately and averaging the result.

f) If the specimen is a core consisting of more than one layer of different materials the core must be split into its different layers and each layer must be tested separately.

10.10.2 Bulk specific gravity of compacted bituminous mixtures test

10.10.2.1 Methods

a) Method A

Dry the specimen to constant mass and record its dry mass A. Immerse the specimen in water at 25° C for 4 min plus or minus 1 min and record the mass, C of the specimen in water. Remove the specimen from the water, quickly damp dry the specimen by blotting with a damp cloth and determine the surface - dry mass, B of the specimen.

Note. Constant mass shall be defined as the mass at which further drying at 52°C plus or minus 3° C does not alter the mass by more than 0.05%.
Recently moulded laboratory specimens which have not been exposed to moisture do not require drying. Samples saturated with water should be dried overnight at the specified temperature and then weighed at 2 hourly drying intervals.

Note. The sequence of the testing operations may be changed to expedite the test result. For example, first the immersed mass, C can be taken, then the surface-dry mass, B and finally the dry mass, A.

a.1) Calculations: Calculate the bulk specific gravity of the specimen as follows, round and report the value to the nearest 0.001 kg:

\[
\text{Bulk Sp. Gr.} = \frac{A}{B - C}
\]

Where

- \(A\) = dry mass of specimen in kg. in air.
- \(B\) = mass of surface-dry specimen in kg. in air
- \(C\) = Mass of specimen in water in kg.

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

\[
\text{Percent water absorbed} = \frac{B - A}{B - C}
\]

b) Method B

Dry the specimen to constant mass and record the dry mass. Immerse in water bath and let saturate for at least 10 min. At the end of the 10 Minute period fill a calibrated volumeter with distilled water at 25° C plus or minus 1° C. Remove the immersed and saturated specimen from the water bath, quickly damp dry the specimen surface by blotting with a damp cloth and quickly as possible weigh the specimen.

Place the weighed saturated specimen into volumeter and let stand for at least 60 seconds. Bring the temperature of the water in the volumeter to 25° C plus or minus 1° C, and cover the volumeter ensuring that water escapes through the overflow. Wipe the volumeter dry and weigh the volumeter and contents.

b.1) Calculations

Calculate the bulk specific gravity of the specimen as follows, round and report the value to the nearest 0.001 kg.

\[
\text{Bulk Sp. Gr.} = \frac{A}{B + D - E}
\]

Where

- \(A\) = dry mass of specimen in kg. in air.
- \(B\) = mass of surface-dry specimen in kg. in air
- \(D\) = mass of volumeter filled with at 25° C plus or minus 1° C water in kg.
- \(E\) = mass of volumeter filled with the specimen and water at 25° C plus or minus 1° C, in kg.
Calculate the percent water absorbed by the specimen (on volume basis) as follows:

\[
\text{Percent water absorbed} = \frac{B - A}{B + D - E}
\]

c) **Method C (Rapid test)**

This method can be used for specimens which are not required to be saved or which may contain large amounts of water. Specimens obtained from coring or sawing do contain water and should be tested using this method.

The testing procedure shall be as given in method A or method B except the sequence of operations. The dry mass of the specimen is determined last, as follows:

After the original mass in air, mass in water, and surface-dry mass have been determined, place the sample in a large flat tray and place the tray in an oven at 110° C plus minus 5° C for only long enough, for the asphalt aggregate portion of the sample to be able to be separated into fractions not greater than about 6.4 mm. Place the separated specimen into the oven again and dry to constant mass. Cool the specimen to room temperature and weight the mass \( A \).

c.1) **Calculations**

The calculations of method A or method B are valid for this method, Forms 10.10.1 and 10.10.2.

10.10.2.2 **Expression of result**

Duplicate results from the same operator should be accepted if the two results do not differ by more than 0.02.

10.10.2.3 **Report**

The test report should include at least the following information:

- Name of testing agency
- Client name
- Contractor name
- Contract name
- Location sample was taken
- Type of sample
- Number of layers in sample
- Sample identification number
- Method of testing used
- Date sample taken
- Date sample tested
- Date sample reported
- Name of tester
- Signature of tester
# Core Density on SSD Basis

<table>
<thead>
<tr>
<th>Sample no</th>
<th>Location</th>
<th>Layer no</th>
<th>Dry weight of core in air</th>
<th>Oven-dry weight of core in air</th>
<th>Saturated surface-dry weight in air</th>
<th>Weight of core in water</th>
<th>Density A / (B-C)</th>
<th>Relative density 100 X (D / M) E</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRRL-DHF</td>
<td>chainage</td>
<td>2 layers</td>
<td>80 mm</td>
<td>525.8</td>
<td>523.6</td>
<td>526.1</td>
<td>304.3</td>
<td>2.361</td>
</tr>
<tr>
<td>0064C - 1</td>
<td>0+010</td>
<td>Top layer tested</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>BRRL-DHF</td>
<td>chainage</td>
<td>2 layers</td>
<td>85 mm</td>
<td>541.2</td>
<td>539.1</td>
<td>543.0</td>
<td>315.1</td>
<td>2.366</td>
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<tr>
<td>0064C - 2</td>
<td>0+022</td>
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<td></td>
</tr>
<tr>
<td>BRRL-DHF</td>
<td>chainage</td>
<td>2 layers</td>
<td>78 mm</td>
<td>538.1</td>
<td>528.2</td>
<td>532.1</td>
<td>309.8</td>
<td>2.376</td>
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<td>0064C - 3</td>
<td>0+031</td>
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</tbody>
</table>

Pertent water absorbed $100 \times \frac{(B - A)}{(B - C)} = 1 = 1.1\%, 2 = 1.7\%, 3 = 1.9\%$

Method on SSD basis OK.

Marshall density = $2.405 \text{g/cm}^3 - 2.405 \text{kg/m}^3$

Compaction required > 95%. Sample BRRL-DHF-0094C (1-3) comply.
### Core Density Using Paraffin Wax

<table>
<thead>
<tr>
<th>Sample no</th>
<th>Location</th>
<th>Layer no</th>
<th>Dry weight of core in air (A)</th>
<th>Dry weight of core plus paraffin in air (D)</th>
<th>Dry weight of core plus paraffin in water (E)</th>
<th>Specific gravity of paraffin (F)</th>
<th>Density A / (D-E) / (D-A) / F</th>
<th>Relative density 100 X (C / M)</th>
<th>Pertinent water absorbed</th>
<th>M. Marshall density</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRRL-DHF-0091C-1 tested on SSD basis for water absorbed</td>
<td>ch. 15+020</td>
<td>1 layer 85 mm</td>
<td>543.2 g</td>
<td>568.2 g</td>
<td>310.3 g</td>
<td>0.8981 g/cm³</td>
<td>2.361</td>
<td>98.2 %</td>
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<td>0091C-2</td>
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<tr>
<td>0091C-3</td>
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<tr>
<td>0091C-4</td>
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</tbody>
</table>

*Pertinent water absorbed = BRRL-DHF-0091C-1 = 4.2%*

*Use paraffin wax method.*

**Compaction required > 95% BRRL DHF-0091C (2-4) OK.**

**Maximum Theoretical Specific Gravity of Paving**

**M. Marshall density = 2.405 g/cm³, 2405 kg/m³**