1. **SCOPE**

1.1. **Description**

This method covers the determination of bulk and apparent specific gravity, 23/23°C and absorption of fine aggregate. Bulk specific gravity is the characteristic generally used for calculations of the volume occupied by the aggregate in asphalt mixes.

1.2. **Application**

This method determines (after 24 hours in water) the bulk specific gravity and the apparent specific gravity as defined in ASTM definitions E12, Terms Relating to Density and Specific Gravity of Solids, Liquids and Gases, the bulk specific gravity on the basis of weight of saturated surface-dry aggregate, and the absorption as defined in ASTM Definitions C-125, for Terms Relating to Concrete and Concrete Aggregates.

2. **APPARATUS AND MATERIALS**

2.1. **Equipment Required**

2.1.1. **Balance**

A balance or scale having a capacity of 1 kg or more, sensitive to 0.1 g or less and accurate within 0.1 percent of the test load at any point within the range of use for this test. Within any 100 g range of test load, a difference between readings shall be accurate within 0.1 g.

2.1.2. **Pycnometer**

A flask or other suitable container into which the fine aggregate test sample can be readily introduced and in which the volume content can be reproduced within ± 0.1 cm$^3$. The volume of the container filled to mark shall be at least 50 percent greater than the space required to accommodate the test sample. A volumetric flask of 500 cm$^3$ capacity or a jar fitted with a pycnometer top is satisfactory for a 500 g test samples of most fine aggregates.
2.1.3. Mold

A metal mold in the form of a frustum of a cone with dimensions as follows: 40 ± 3 mm inside diameter at the top, 90 ± 3 mm inside diameter at the bottom, and 75 ± 3 mm in height, with the metal having a minimum thickness of 0.8 mm.

2.1.4. Tamper

A metal tamper weighing 340 ± 15 g and having a flat circular tamping face 25 ± 3 mm in diameter.

2.1.5. Smooth Non-Absorbent Surface

To place sample in after water is removed, and to begin drying process.

2.1.6. A means such as a fan or hair dryer, to supply a gentle current of warm air.

2.1.7. Suitable pan or vessel to dry specimen in.

3. PROCEDURE

3.1. Sample Preparation

Obtain approximately 1000 g of the fine aggregate from the sample by use of sample splitter or by quartering. Dry it in a suitable pan or vessel to constant weight at a temperature of 100 to 110°C.

Wash the sample thoroughly on a 71 mm sieve.

NOTE: The process of quartering and the correct use of a sample splitter are discussed in the Manual of Concrete Testing (Annual Book of ASTM Standards, Part 14).

Allow the sample to cool to a comfortable handling temperature, cover with water and permit to stand for 24 ± 4 hours.

NOTE: Where the absorption and specific gravity values are to be used in proportioning concrete mixtures with aggregates used in their naturally moist condition, the requirement for initial drying to constant weight may be eliminated.
3.2. **Test Procedure**

Decant excess water with care to avoid loss of fines, spread the sample on a flat surface exposed to a gently moving current of warm air, and stir frequently to secure uniform drying. Continue this operation until the test specimen approaches a free-flowing condition.

Then, place a portion of the partially dried fine aggregate loosely into the mold, held firmly on a smooth non-absorbent surface with the large diameter down, lightly tamp the surface 25 times with the tamper and lift the mold vertically. If surface moisture is still present, the fine aggregate will retain the mold shape. Continue drying with constant stirring and test at frequent intervals until the tamped fine aggregate slumps slightly upon removal of the mold. This indicates that it has reached a surface-dry condition.

**NOTE:** The procedure described above is intended to ensure that the first cone test trial will be made with some surface water in the specimen. If the fine aggregate slumps on the first trial, it has been dried past the saturated and surface-dry condition. In this case thoroughly mix a few cubic centimetres of water with the fine aggregate and permit the specimen to stand in a covered container for 30 minutes. The process of drying and testing for free-flowing condition shall then be resumed.

Immediately introduce into the pycnometer 500 g of the fine aggregate and fill with water to approximately 90 percent of capacity.

**NOTE:** An amount other than 500 g, but not less than 50 g may be used provided that the actual weight is inserted in place of the figure "500" wherever it appears in the formulas. If the weight used is less than 500 g, limits on accuracy of weighing and measuring must be scaled down in proportion.

Roll, invert and agitate the pycnometer to eliminate all air bubbles. Adjust its temperature to 23 ± 1.7°C, if necessary by immersion in circulating water and bring the water level in the pycnometer to its calibrated capacity. Leave pycnometer in circulating water or water bath for 30 ± 5 minutes to ensure constant temperature. Continue to agitate every 10 minutes to ensure all air bubbles are eliminated. Dry off pycnometer and weigh.

Record this and all other weights to the nearest 0.1 g.

Remove the fine aggregate from the pycnometer, dry to constant weight at a temperature of 100 to 110°C, cool in air at room temperature for 1/2 to 1 1/2 hours and weigh.
4. **RESULTS AND CALCULATIONS**

4.1. **Calculations**

4.1.1. **Bulk Specific Gravity**

Calculate the bulk specific gravity, 25/25°C, as defined in ASTM Definitions E121, as follows:

Bulk Specific Gravity = \( \frac{A}{B+500-C} \)

Where:  
- \( A \) = weight of oven-dry specimen in air, g  
- \( B \) = weight of pycnometer filled with water, g  
- \( C \) = weight of pycnometer with specimen and water to calibration mark, g

4.1.2. **Bulk Specific Gravity (Saturated Surface-Dry Basis)**

Calculate the bulk specific gravity, 25/25°C, on the basis of weight of saturated surface-dry aggregate as follows:

Bulk Specific Gravity (Saturated Surface-Dry Basis)  
= \( \frac{500}{B+500-C} \)

Where:  
- \( B \) = weight of pycnometer filled with water, g  
- \( C \) = weight of pycnometer with specimen and water to calibration mark, g

4.1.3. **Apparent Specific Gravity**

Calculate the apparent specific gravity, 23/23°C, as defined in Definitions E12 as follows:

Apparent Specific Gravity = \( \frac{A}{B+A-C} \)

Where:  
- \( A \) = weight of oven-dry specimen in air, g  
- \( B \) = weight of pycnometer filled with water, g  
- \( C \) = weight of pycnometer with specimen and water to calibration mark, g
4.1.4. Calculation for Absorption

Calculate the percentage of absorption, as defined in Definitions C125 as follows:

Absorption Percent = \[ \frac{(500 - A)}{A} \times 100 \]

Where: \( A \) = weight of oven dry specimen in air, g

4.1.5. Example of Recorded Data

<table>
<thead>
<tr>
<th></th>
<th>Pycnometer #1</th>
<th>Pycnometer #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wt. of Flask</td>
<td>173.36</td>
<td>185.85</td>
</tr>
<tr>
<td>Wt. of Specimen</td>
<td>500.00</td>
<td>500.00</td>
</tr>
<tr>
<td>Wt. of Flask &amp; Specimen</td>
<td>673.36</td>
<td>685.85</td>
</tr>
<tr>
<td>Wt. of Flask, Specimen &amp; H₂O</td>
<td>983.64</td>
<td>995.30</td>
</tr>
<tr>
<td>Wt. of H₂O</td>
<td>310.28</td>
<td>309.45</td>
</tr>
<tr>
<td>Wt. of Pan</td>
<td>205.38</td>
<td>207.53</td>
</tr>
<tr>
<td>Wt. of Oven-Dry &amp; Pan</td>
<td>700.04</td>
<td>702.24</td>
</tr>
<tr>
<td>Wt. of Oven-Dry</td>
<td>494.66</td>
<td>494.71</td>
</tr>
<tr>
<td>Volume</td>
<td>189.72</td>
<td>190.55</td>
</tr>
<tr>
<td>BSG</td>
<td>2.6073</td>
<td>2.5962</td>
</tr>
</tbody>
</table>

Average BSG: 2.602

5. REPEATABILITY

For specific gravity, single operator and multi-operator precision shall be within ± 0.03.

6. ADDED INFORMATION

6.1. General

To calculate overall Bulk Specific Gravity for virgin gradation use the following formula:

\[ \text{BSG(virgin gradation)} = \text{BSG(Coarse)} \times (\% \text{retained on 5.0 mm sieve}) + \text{BSG (fine)} \times (\% \text{passing 5.0 mm sieve} - \% \text{passing 71 mm sieve}) + \text{BSG (71 mm material)} \times (\% \text{passing 71 mm material}) \]

Normally the BSG (71 mm material) will be 2.7.
Section: AGGREGATES
Subject: SPECIFIC GRAVITY - BULK, APPARENT FINE AGGREGATES

APPROVAL SHEET
New ___ Revision ___ Date of Previous Document 93-05-07

Effective Date: 94-03-18

Description of Revision (Reason for Revision):

Section 3.1, Sample Preparation, the following was added "Wash the sample thoroughly on a 71mm sieve" to represent what SHT actually does.

Information on calculating the BSG was added in at new Section 6 ADDED INFORMATION.

Review/Implementation Process:

Reviewed by the Lab Supervisors' Committee.

Other Manuals/Policies Affected:

Nil

Follow Up/Training Required:

Nil

Comments/Concerns/Implications (Budget/Environment/Stakeholders):

Prepared and Recommended by D. MacLeod Quality Control Engineer Date 94-03-08

Approval Recommended by R.A. Widger Senior Materials Engineer Date 94-03-15

Approval Recommended by A.R. Gerbrandt Dir., Technical Standards & Policies Br. Date - -

Approved by D.G. Metz Assistant Deputy Minister, Infrastructure Date 94-03-18

Electronic File Updated Date 94-03-30

Update Mailed Date - -