DENSITY OF BITUMINOUS MATERIALS AND OILS

1 SCOPE

This method describes the procedure for determining the density of paraffin wax, bituminous materials and oils using a density bottle.

2 SAFETY

This method does not attempt to address all the safety concerns, if any, associated with its use. It is the responsibility of the user of the method to establish appropriate occupational health and safety practices that meet statutory regulations.

3 APPARATUS

(a) **Density bottle** approximately 25 mL capacity. Suitable designs are shown in Figure 1.

(b) **Water bath** thermostatically controlled to maintain a temperature of 25°C±0.1°C.

(c) **Thermometer** readable to 0.1ºC.

(d) **Balance** of at least 200 g capacity readable to at least 0.0001 g with a Limit of Performance (F) of not more than 0.0005 g.

(e) **Distilled or Deionized water** that has been freshly boiled and cooled.

(f) **Timing device** capable of measuring at least 30 minutes ± 0.5 minutes.

4 VOLUME OF DENSITY BOTTLE

(a) Determine the mass of the clean dry density bottle (m_1) to the nearest 0.0001 g.

(b) Fill the density bottle to the lower part of the ground glass neck with Distilled or Deionized water that is at a temperature slightly below 25°C.

(c) Insert the stopper in the density bottle taking care to avoid trapping air bubbles in the neck of the bottle and so that the excess water is expelled through the stopper's capillary.

(d) Totally immerse the density bottle in the water bath for at least 30 minutes.

(e) Raise the density bottle carefully from the water bath so that the stopper protrudes from the water and wipe the top of the stopper with one stroke of an absorbent cloth or a tissue.

(f) Remove the density bottle from the water bath ensuring that the temperature to which the density bottle is exposed is below 25°C and dry with the minimum of handling.

NOTE: The top of the stopper shall not be re-dried even if a water forms due to expansion.

(g) Determine the mass of the density bottle plus water (m_2) to the nearest 0.0001 g.

(h) Repeat section 4(a) to 4(g) of this procedure.

(i) Calculate the volume of the density bottle determinations. Where the range of the two values is greater than 0.005 mL the procedure shall be repeated.

(j) Calculate the average volume of the density bottle.

5 PROCEDURE

5.1 Total Filling Method

This method is only applicable to materials which are sufficiently fluid at 25°C to press the bottle stopper into position when the bottle is filled.

(a) Determine the mass of the clean dry density bottle (m_1) to the nearest 0.0001 g.

(b) Fill the density bottle to the lower part of the ground glass neck with a test increment, taken from the test sample, that is at a temperature slightly below 25°C.

(c) Insert the stopper in the density bottle taking care to avoid trapping air bubbles in the neck of the bottle and so that excess material is expelled through the stopper's capillary.

(d) Immerse the density bottle in the water bath. The depth of immersion should be such that the level of the water in the bath is approximately 5 mm below the top of the density bottle.

(e) Allow the density bottle to remain in the water bath for at least 30 minutes.

(f) Wipe the top of the stopper with one stroke of an absorbent cloth or a tissue.

(g) Remove the density bottle from the water bath ensuring the temperature to which the bottle is exposed is below 25°C and dry with the minimum of handling.

(h) Determine the mass of the density bottle plus test increment (m_3) to the nearest 0.0001 g.

Repeat Procedure 5.1(a) to 5.1(h) on at least one further test increment obtained from the same test sample.

(i) Calculate the density of the test increments. Where the range of the two values is greater than 0.005 kg/L discard the results and repeat the test.

(j) Calculate the average density from the acceptable results.

5.2 Partial Filling Method

This method is only applicable to materials which are too viscous for the total filling method.

(a) Determine the mass of the clean dry density bottle (m_1) to the nearest 0.0001 g.

(b) Part fill the density bottle with a test increment and replace the stopper.

NOTE: The test sample may be warmed sufficiently for it to be poured or, for solid material, break the test sample into pieces small enough to be inserted easily into the density bottle, ensuring that no air bubbles are present in the solid material.

(c) If the test sample has been warmed, maintain the density bottle and test increment at the pouring temperature for at least 30 minutes to permit air bubbles to escape and then allow it to cool to below 25°C.

(d) Determine the mass of the density bottle plus test increment (m_4) to the nearest 0.0001 g.

(e) Fill the density bottle to the lower part of the ground glass neck with Distilled or Deionized water that is at a temperature slightly below 25°C.

(f) Insert the stopper in the density bottle taking care to avoid trapping air bubbles in the neck of the density bottle and so that the excess water is expelled through the stopper's capillary.

(g) Totally immerse the density bottle in the water bath for at least 30 minutes.

(h) Raise the density bottle carefully from the water bath so that the stopper protrudes from the water and wipe the top of the stopper with one stroke of an absorbent cloth or a tissue.

(i) Remove the density bottle from the water bath ensuring that the temperature to which the density bottle is exposed is below 25°C and dry it with the minimum of handling.

(j) Determine the mass of the density bottle plus test increment plus water (m_5) to the nearest 0.0001g.

(k) Repeat Procedure 5.2(a) to 5.2(j) on at least one further test increment obtained from the same test sample.

(l) Calculate the density of the test increments. Where the range of the two values is greater than 0.005 kg/L discard the results and repeat the test.

(m) Calculate the average density from the acceptable results.

6 CALCULATONS

6.1 Volume of Density Bottle

(k) Calculate the volume of the density bottle using the formula:

$$V_b = \frac{m_2 - m_1}{\rho_w}$$

Where:

V_b = volume of density bottle at 25°C in mL

m_1 = mass of density bottle in grams

m_2 = mass of density bottle plus water in grams

ρ_w = density of water at 25°C in kg/L (sufficiently correct to use 0.997 kg/L)

6.2 Total Filling Method

(a) Calculate the mass of the test increment using the formula:

$$m_{TP} = m_3 - m_1$$

Where:

m_{TP}= mass of test increment in grams

m_1 = mass of density bottle in grams

m_3 = mass of density bottle plus test increment in grams

(b) Calculate the density of the test increment using the formula:

$$\rho = \frac{m_{TP}}{V_b}$$

Where:

ρ = density of test increment of 25°C in kg/L

m_{TP}= mass of test increment in grams

V_b = volume of density bottle at 25°C in mL

6.3 Partial Filling Method

(a) Calculate the mass of the test increment using the formula:

$m_{TP} = m_4 - m_1$

Where:

m_{TP}= mass of test increment in grams

m_1 = mass of density bottle in grams

m_4 = mass of density bottle plus test increment in grams

(b) Calculate the volume of the test increment using the formula:

$$V_{TP} = V_b - \frac{m_5 - m_4}{\rho_w}$$

Where:

V_{TP}= volume of test increment at 25°C in mL

V_b = volume of density bottle at 25°C in mL

m_4 = mass of density bottle plus test increment in grams

m_5 = mass of density bottle plus test increment plus water in grams

ρ_w = density of water 25°C in kg/L (sufficiently correct to use 0.997 kg/L)

(c) Calculate the density of the test increment using the formula:

$$\rho = \frac{m_{TP}}{V_{TP}}$$

Where:

ρ = density of test increment of 25°C in kg/L

m_{TP}= mass of test increment in grams

V_{TP} = volume of test increment at 25°C in mL

7 REPORTING

Report the following:

(a) Average density to the nearest 0.001 kg/L.

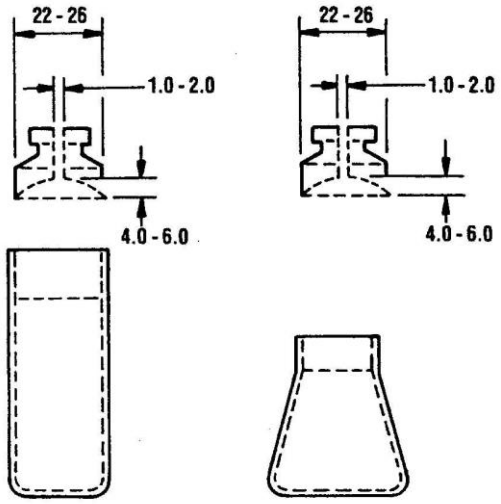
(b) Sample Description

(c) Batch / Lot Number

(d) Sampling Method

(e) Supplier

(f) FIGURES



Density Bottle — cylindrical or conical with ground glass neck to receive a glass stopper. The stopper and density bottle shall have an approximate capacity of 25 ml and a mass of not more than 40 g.

Figure 1
(Measurements in mm)

9 ISSUING AUTHORITY

Document Owner
Bituminous Product Consultant

10 REVISION STATUS RECORD

Page No.	Section	Revision Description / Reference
1	3 Apparatus	Thermometer – remove uncertainty. Add option to use distilled water
1	4	Change heading from Calibration to Volume of Density Bottle. Remove note after (d). Moved calculation to clause 6.
All	All	Change portion to increment
3	7	Add Sample Description, Batch / Lot Number, Sampling Method and Supplier to reporting requirement.