EXPERIMENT NO: 09

SPECIFIC GRAVITY OF SEMI-SOLID BITUMINOUS MATERIAL

AASHTO DESIGNATION: T 228-93
(ASTM DESIGNATION: D 70-76)



1. SCOPE

1.1 This method covers the determination of the specific gravity of semi-solid bituminous materials, asphalt cements, and soil tar pitches by use of a pycnometer.

2. SPECIFIC GRAVITY

2.1 The specific gravity of semi-solid bituminous materials, asphalt cements, and soft tar pitches shall be expressed as the ratio of the mass of a given volume of the material at 25^0C(77^0F) or at 15.6°C (60°F) to that of an equal volume of water at the same temperature, and shall be expressed thus:

Specific gravity, 25/25°C (77/77^0F) or 15.6/15.6°C (60/60°F)

3. APPARATUS

3.1 Pycnometer, glass, consisting of a cylindrical or conical vessel carefully ground to receive an accurately fitting glass stopper 22 to 26 mm in diameter. The stopper shall be provided with a hole 1.0 to 2.0 mm in diameter, centrally located in reference to the vertical axis. The top surface of the stopper shall be smooth and substantially plane and the lower surface shall be concave in order to allow all air to escape through the bore. The height of the concave section shall be 4.0 to 18.0 mm at the centre. The stoppered pycnometer shall have a capacity of 24 to 30 ml, and shall weigh not more than 40 g.

3.2 Water Bath- Constant temperature, capable of maintaining the temperature within 0.1^0C (0.2^0F) of the test temperature.

3.3 Thermometers- Calibrated liquid-in-glass of suitable range with graduations at least every 0.2°F (0.1°C) and a maximum scale error of 0.2°F (0.1°C) as prescribed in ASTM specification on El. Thermometers commonly used are 63°F or 63°C. Any other thermometer of equal accuracy may be used.

NOTE-1: Other ASTM thermometers (such as the ASTM 17°C) which have sub-divisions and scale errors equal to or smaller than those specified for the ASTM 63^0C and 63^0F may also be used.

3.4 Balance - a balance conforming to the requirements of M 231, Class B.

4. MATERIALS

4.1 Distilled Water - Freshly boiled and cooled distilled water shall be used to fill the pycnometer and the beaker.
NOTE-2: For the purpose of this lest, freshly boiled and cooled distilled, a mineralized or deionized water may be used.

5. PREPARATION OF EQUIPMENT

5.1 Partially fill a 600 ml or larger Griffin low-form beaker with freshly boiled and cooled distilled water to a level that will allow the top of the pycnometer to be immersed to a depth of not less than 40 mm.

5.2 Partially immerse the beaker in the water bath to a depth sufficient to allow the bottom of the beaker to be immersed to a depth of not less than 100 mm, while the top of the beaker is above the water level of the bath. Clamp the beaker in place.

5.3 Maintain the temperature of the water bath within 0.1°C(0.2°F) of the test temperature.

6. CALIBRATION OF PYCNOMETER

6.1 Thoroughly clean, dry, and weigh the pycnometer to the nearest 1 mg. Designate this mass as "A".

6.2 Fill the pycnometer with freshly boiled distilled water at test temperature and place the stopper in the pycnometer. Do not allow any air bubbles to remain in the pycnometer.

6.3 Allow the pycnometer to remain in the water for a period of not less than 30 min. Remove the pycnometer, immediately dry the top of the stopper with one stroke of a dry towel (Note 3), then quickly dry the remaining outside area of the pycnometer and weigh to the nearest 1 mg. Designate the mass of the pycnometer plus water as "B".

Note-3: Do not re-dry the top of the stopper even if a small droplet of water forms due to expansion. If the top is dried at the instant of removing the pycnometer from the water, the proper mass of the contents at the test temperature will be recorded. If moisture condenses on the pycnometer during weighing, quickly re-dry the outside of the pycnometer (excluding the top) before recording the mass.
Note-4: Calibration should be done at the specific temperature. A pycnometer calibrated at one temperature cannot be used at a different temperature without recalibration, at that temperature.

Table 9.1: Precision of specific Gravity Data for Semi-Solid Bituminous Materials

	deg C (deg F)	Single-Operator			Multilaboratory		
		Degrees of Freedom	(IS)	(D2S)	Degrees of Freedom	(LS)	(D2S)
Asphalt	15.6(60)	54	0.0011	0.0032	24	0.0018	0.0051
	25.0(77)	54	0.00080	0.0023	24	0.0024	0.0068
Soft tar pitch	15.6(60)	72	0.0013	0.0038	27	0.0029	0.0083
	25.0(77)	72	0.00083	0.0023	27	0.0017	0.0048
Pooled	15.6(60)	114	0.0013	0.0035	51	0.0024	0.0067
	25.0(77)	114	0.00082	0.0023	51	0.0019	0.0053

7. PROCEDURE

7.1 Preparation of Sample - Heat the sample with care, stirring to prevent local overheating, until the sample has become sufficiently fluid to pour. In no case should the temperature be raised to more than 56^0C (100°F) above the expected softening point for tar, or to more than 111°C (200°F) above the expected softening point for asphalt. Do not heat for more than 30 minutes over a flame or hot plate or for more than 2 hours in an oven, and avoid incorporating air bubbles in the sample.

7.2Pour enough sample into the clean, dry, warmed pycnometer to fill it about three-fourth to its capacity. Take precautions to keep the material from touching the sides of the pycnometer above the final level, and to prevent the inclusion of air bubbles (Note 5). Allow the pycnometer and its contents to cool to ambient temperature for a period of not less than 40 minutes, and weigh with the stopper to the nearest 1 mg. Designate the mass of the pycnometer plus sample as “C”.

NOTE-5: If any air bubbles are inadvertently included, remove by brushing the surface of the asphalt in the pycnometer with a high "soft" flame of a Bunsen burner. In order to avoid overheating, do not allow the flame to remain in contact with the asphalt more than a few seconds at any one time.

7.3 Fill the pycnometer with freshly boiled distilled water at test temperature and place the stopper in the pycnometer. Do not allow any air bubbles to remain in the pycnometer.

7.4 Allow the pycnometer to remain in the water bath for a period of not less than 30 minutes. Remove the pycnometer from the bath. Dry and weigh using the same technique as that employed in Section 6.3. Designate this mass of pycnometer plus sample plus water as “D”.

8. CALCULATIONS

8.1 Calculate the specific gravity to the nearest third decimal as follows:

$$\text{Specific gravity} = \frac{(\mathrm{C}-\mathrm{A})}{[(B-A)-(D-C)]}$$

Where :

A = mass of pycnometer (plus stopper)
B = mass of pycnometer filled with water
C = mass of pycnometer partially filled with asphalt, and
D = mass of pycnometer plus asphalt plus water

9. REPORT

9.1 Report the specific gravity to the nearest third decimal at 25/25°C (77°F) or 15.6/15.6^{0}C (60/60°F).

10. PRECISION

1.1 Single-Operator Precision:

1.1.1 The single-operator standard deviation for semi-solid bituminous materials tested at 15.6^0 C (60^{0}F) has been found to be 0.0013 (Note 6). Therefore, results of two properly conducted tests by the same operator should not differ by more than 0.002 (Note 6).

1.2 Multi-laboratory Precision:

1.2.1 The multi-laboratory standard deviation for semi-solid bituminous materials tested at 15.6^{0}C (60^{0}F) has been found to be 0.0024 (Note 6). Therefore, results of two properly conducted tests from two different laboratories on samples of the same material should not differ by more than 0.007 (Note 6).

1.2.2 For materials tested at 25^{0}C (77^{0}F) the standard deviation has been found to be 0.0019 (Note 6). Therefore, results of two properly conducted tests from two different laboratories on samples of the same material should not differ by more than 0.005 (Note 6).

NOTE-6: These numbers represent, respectively, the (IS) and (D2S) limits as describe in AASHTO Recommended Practice R2, for Preparing Precision Statements for Test Methods for Construction Materials.