



# Standard Test Method for Density of Semi-Solid Bituminous Materials (Pycnometer Method)<sup>1</sup>

This standard is issued under the fixed designation D70; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

<sup>ε1</sup> NOTE—Values in Table 1 were editorially corrected in July 2009.

## 1. Scope\*

1.1 This test method covers the determination of the relative density and density of semi-solid bituminous materials, asphalt cements, and soft tar pitches by use of a pycnometer.

NOTE 1—An alternate method for determining the density of semi-solid and solid bituminous materials is Test Method D3289. For materials which are too fluid for use of this test method, use Test Method D3142.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 *This standard does not purport to address the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials

D140 Practice for Sampling Bituminous Materials

D3142 Test Method for Specific Gravity, API Gravity, or Density of Cutback Asphalts by Hydrometer Method

D3289 Test Method for Density of Semi-Solid and Solid Bituminous Materials (Nickel Crucible Method)

D4311 Practice for Determining Asphalt Volume Correction to a Base Temperature

E1 Specification for ASTM Liquid-in-Glass Thermometers

### 2.2 Other:

CRC Handbook of Chemistry and Physics

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.47 on Miscellaneous Asphalt Tests.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

## 3. Terminology

### 3.1 Definitions of Terms Specific to This Standard:

3.1.1 *density*—the mass per unit volume of a material.

3.1.2 *relative density*—the ratio of the mass of a given volume of a material to the mass of the same volume of water at the same temperature (see Note 2).

NOTE 2—Relative density is also described as specific gravity.

## 4. Summary of Test Method

4.1 The sample is placed in a calibrated pycnometer. The pycnometer and sample are weighed, then the remaining volume is filled with water. The filled pycnometer is brought to the test temperature, and weighed. The density of the sample is calculated from its mass and the mass of water displaced by the sample in the filled pycnometer.

## 5. Significance and Use

5.1 Values of density are used for converting volumes to units of mass, and for correcting measured volumes from the temperature of measurement to a standard temperature using Practice D4311.

## 6. Apparatus

6.1 *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 substantially plane and have no chips, and the lower surface shall be concave 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 center. The stoppered pycnometer shall have a capacity of 24 to 30 mL and shall weigh not more than 40 g. Suitable pycnometers are illustrated in Fig. 1.

6.2 *Water Bath*, constant-temperature, capable of maintaining the temperature within 0.1°C (0.2°F) of the test temperature.

\*A Summary of Changes section appears at the end of this standard



**FIG. 1 Suitable Pycnometers and Stopper**

6.3 *Thermometric device*, calibrated liquid in glass, total immersion type, of suitable range with graduations at least every 0.1°C (0.2°F) and a maximum scale error of 0.1°C (0.2°F) as prescribed in Specification E1. Thermometer commonly used is ASTM 63°C (63°F). Any other thermometric device of equal accuracy may be used.

6.4 *Balance*, capable of making the required measurements to an accuracy of at least 0.001g.

6.5 *Beaker*, 600 mL or larger Griffin low-form beaker.

## 7. Materials

7.1 *Water*—Freshly boiled and cooled distilled or deionized water.

## 8. Hazards

8.1 **Warning:** Mercury has been designated by the United States Environmental Protection Agency (EPA) and many state agencies as a hazardous material that can cause central nervous system, kidney and liver damage. Mercury, or its vapor, may be hazardous to health and corrosive to materials. Caution should be taken when handling mercury and mercury containing products. See the applicable product Material Safety Data Sheet (MSDS) for details and EPA’s website—[www.epa.gov/mercury/faq.htm](http://www.epa.gov/mercury/faq.htm)—for additional information. Users should be aware that selling mercury, mercury containing products, or both, into your state may be prohibited by state law.

## 9. Sampling

9.1 Take samples in accordance with Practice D140. The sample shall be free of foreign substances.

9.2 Thoroughly mix the sample before removing a representative portion for testing.

## 10. Preparation of Apparatus

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

10.2 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. Utilize some

method to ensure that the beaker does not tip over, while making sure that circulation of the water in the conditioning bath around the beaker is not restricted.

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

## 11. Calibration of Pycnometer

11.1 Thoroughly clean, dry, and weigh the pycnometer to the nearest 0.001 g. Designate this mass as *A*.

11.2 Remove the beaker from the water bath if necessary. Fill the pycnometer with freshly boiled distilled or deionized water, placing the stopper loosely in the pycnometer. Place the pycnometer in the beaker and press the stopper firmly in place. Return the beaker to the water bath if previously removed.

NOTE 3—Calibration must be done at the test temperature. A pycnometer calibrated at one temperature cannot be used at a different temperature without recalibration at that temperature.

11.3 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 4), then quickly dry the remaining outside area of the pycnometer and weigh to the nearest 0.001 g. Designate the mass of the pycnometer plus water as *B*.

NOTE 4—Do not redry the top of the stopper even if a small droplet of water forms as a result of 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 redry the outside of the pycnometer (excluding the top) before recording the mass.

## 12. Procedure

12.1 *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 55°C (131°F) above the expected softening point for tar, or to more than 110°C (230°F) above the expected softening point for asphalt. Do not heat for more than 60 min, and avoid incorporating air bubbles into the sample.

12.2 Pour enough sample into the clean, dry, warmed pycnometer to fill it about three fourths of its capacity. Take precautions to keep the material from touching the sides of the pycnometer above the final level and prevent the inclusion of