



Designation: D70 – 17

Standard Test Method for Density of Semi-Solid Bituminous Materials (Pycnometer Method)¹

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 (ϵ) 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.

1. Scope*

1.1 This test method covers the determination of the relative density and density of semi-solid bituminous materials, asphalt, 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/D3142M.

1.2 The values stated in SI units are to be regarded as the standard. No other units of measurement are included in this standard, with the exception of temperature measurements, which are stated in degrees Celsius with temperature. Units provided in Fahrenheit are for reference purposes only. Temperatures given in degrees Celsius are to be considered standard.

1.3 **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 the EPA's website (www.epa.gov/mercury/faq.htm) for additional information. Users should be aware that selling mercury, mercury-containing products, or both, in your state may be prohibited by state law.

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

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the*

¹ 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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Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 ASTM Standards:²

- C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
- D140/D140M Practice for Sampling Asphalt Materials
- D3142/D3142M 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 Asphalt Materials (Nickel Crucible Method)
- D4311/D4311M Practice for Determining Asphalt Volume Correction to a Base Temperature
- E1 Specification for ASTM Liquid-in-Glass Thermometers
- E77 Test Method for Inspection and Verification of Thermometers
- E563 Practice for Preparation and Use of an Ice-Point Bath as a Reference Temperature
- E644 Test Methods for Testing Industrial Resistance Thermometers
- E1137/E1137M Specification for Industrial Platinum Resistance Thermometers

2.2 Other:

- CRC Handbook of Chemistry and Physics

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.

² 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.

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

4. Summary of Test Method

4.1 The sample is placed in a standardized 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/D4311M.

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. The water bath shall be equipped with a thermometer as described in 6.3.

6.3 *Thermometer*—The thermometer shall be one of the following:

6.3.1 A liquid-in-glass partial immersion thermometer of suitable range with subdivisions and maximum scale error of 0.1 °C (0.2 °F) which conforms to the requirements of Specification E1. Calibrate the thermometer in accordance with one of the methods in Test Method E77 or verify its original calibration at the ice point (Notes 3 and 4). Thermometer commonly used is ASTM 63C.

NOTE 3—Practice E563 provides instructions on the preparation and use of an ice-point bath as a reference temperature.

NOTE 4—If the thermometer does not read 0.0 ± 0.1 °C (32.0 ± 0.1 °F) at the ice point then the thermometer should be recalibrated.

6.3.2 A platinum resistance thermometer (PRT) with a probe which conforms to the requirements of Specification E1137/E1137M. The PRT shall have a 3- or 4-wire connection configuration and the overall sheath length shall be at least 50 mm greater than the immersion depth. Calibrate the PRT system (probe and readout) in accordance with Test Methods E644 or verify its original calibration at the ice point (Notes 3 and 4). Corrections shall be applied to ensure accurate measurements within 0.1 °C.

6.3.3 A metal-sheathed thermistor with a sensor substantially similar in construction to the PRT probe described in 6.3.2. Calibrate the thermistor system (sensor and readout) in accordance with Test Methods E644 or verify its original calibration at the ice point (Notes 3 and 4). Corrections shall be applied to ensure accurate measurements within 0.1 °C.

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

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

6.6 *Tongs*, rubber covered, for placing and removing the pycnometer from the beaker.

7. Materials

7.1 *Water*—Boiled and cooled distilled or deionized water free of visual contaminants. Water greater than three days post boiling and cooling shall not be used (Note 6).

NOTE 5—Water should be discarded or re-boiled if bubbles are seen in the pycnometer during testing.

NOTE 6—As an alternative to using heat, a vacuum source to pull a negative pressure until the water boils without heat may be used. In this case, the water does not have to be cooled before use.

8. Sampling

8.1 Take samples in accordance with Practice D140/D140M. The sample shall be free of foreign substances.

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

9. Preparation of Apparatus

9.1 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.

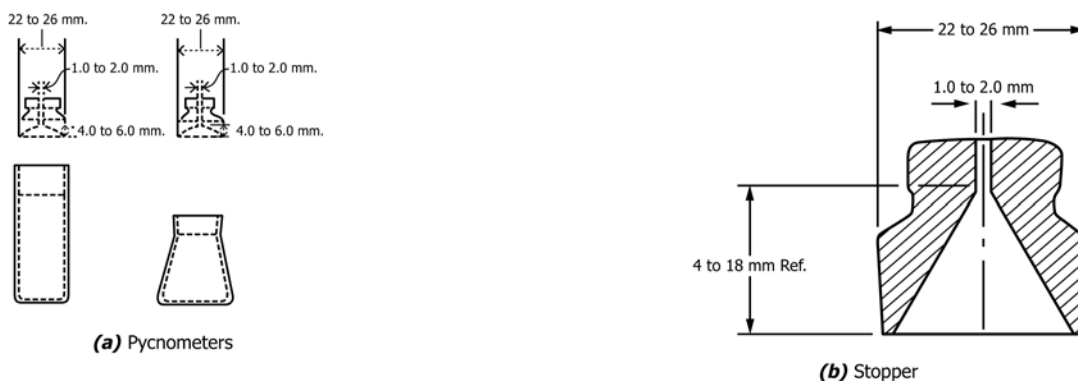


FIG. 1 Suitable Pycnometers and Stopper