Designation: ~~D70 – 18~~ D70 – 18a

Standard Test Method for Density of Semi-Solid Asphalt Binder (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 asphalt binder ~~and soft tar pitches~~ by use of a pycnometer.

NOTE 1—An alternate method for determining the density of asphalt binder is Test Method D3289. For materials which are too fluid for use of this test method, use Test Method D3142/D3142M.

NOTE 2—This test method may also be used for the determination of the relative density and density of soft tar pitches.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the 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) or Safety Data Sheet (SDS) 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 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.5 *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.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the 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)
D3666 Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
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

[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.

Current edition approved ~~April 1, 2018~~Dec. 1, 2018. Published ~~April 2018~~December 2018. Originally approved in 1920. Last previous edition approved in ~~2017~~2018 as ~~D70 – 17.~~D70 – 18. DOI: ~~10.1520/D0070-18.~~10.1520/D0070-18A.

[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**

E879 Specification for Thermistor Sensors for General Purpose and Laboratory Temperature Measurements
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~~3).

NOTE 3—Relative density is also described as specific gravity.

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.

5.2 The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of Specification D3666 are generally considered capable of competent and objective testing, sampling, inspection, etc. Users of this standard are cautioned that compliance with Specification D3666 alone does not completely ensure reliable results. Reliable results depend on many factors; following the suggestions of Specification D3666 or some similar acceptable guideline provides a means of evaluation and controlling some of these factors.

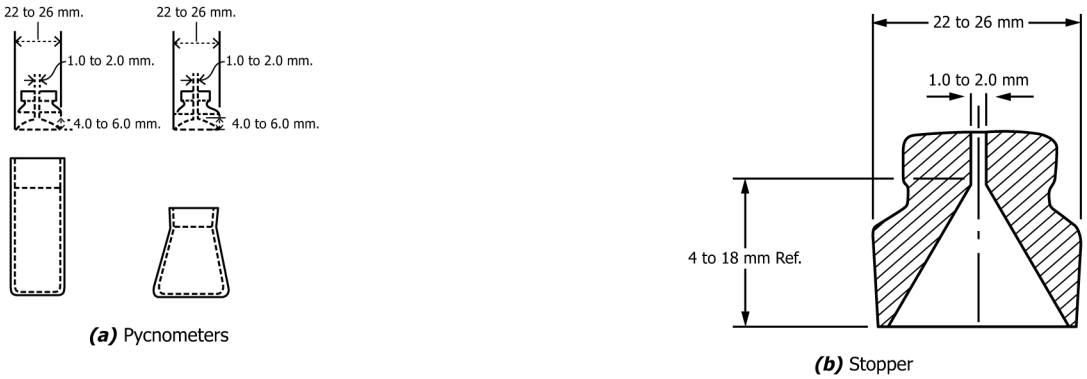
6. Apparatus

6.1 *Pycnometer,* glass, consisting of a cylindrical or conical vessel carefully ground to receive an accurately fitting glass stopper 22 to 26 mm [0.9 to 1.0 in.] in diameter. The stopper shall be provided with a hole 1.0 to 2.0 mm [0.04 to 0.08 in.] 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 [0.16 to 0.71 in.] at the center. The stoppered pycnometer shall have a capacity of 24 to 30 mL [0.95 to 1.18 in.] and shall weigh not more than 40 g [1.4 oz]. 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~~4 and ~~4~~5). A thermometer commonly used is an ASTM 63C.



(a) Pycnometers

(b) Stopper

FIG. 1 Suitable Pycnometers and Stopper

NOTE 4—Practice E563 provides instructions on the preparation and use of an ice-point bath as a reference temperature.
NOTE 5—If the thermometer does not read 0.0 ± 0.1 °C [32.0 ± 0.2 °F] at the ice point, then the thermometer should be recalibrated.

6.3.2 A platinum resistance thermometer (PRT) with sensor which conforms to the requirements of Specification E1137/E1137M. The thermometer shall be calibrated annually as a single unit and have a 3- or 4-wire connection configuration. The sensing element shall be immersed to the depth specified by the manufacturer. Calibrate the PRT system (sensor and readout) in accordance with Test Methods E644 or verify its original calibration at the ice point (Notes ~~3~~4 and ~~4~~5). Corrections shall be applied to ensure accurate measurements within 0.1 °C [0.2 °F].

6.3.3 A thermistor thermometer with sensor which conforms to the requirements of Specification E879, calibrated annually as a single unit. The sensing element of the thermistor shall be completely immersed. Calibrate the thermistor thermometer system (sensor and readout) in accordance with Test Methods E644 or verify its original calibration at the ice point (Notes ~~3~~4 and ~~4~~5). Corrections shall be applied to ensure accurate measurements within 0.1 °C [0.2 °F].

6.4 *Balance,* capable of making the required measurements to an accuracy of at least 0.001 g [0.00001 oz].

6.5 *Beaker,* 600-mL [20-fluid oz] or larger Griffin low-form beaker.

6.6 *Tongs or Clean Nitrile (or Similar) Gloves,* 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~~7).

NOTE 6—Water should be discarded or re-boiled if bubbles are seen in the pycnometer during testing.
NOTE 7—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 [20-fluid oz] 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 [1.6 in.].

9.2 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 [3.9 in.], 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.

9.3 Maintain the temperature of the water bath within 0.1 °C [0.2 °F] of the test temperature as determined by the thermometer described in 6.3.

10. Standardization of Pycnometer

10.1 Perform each of the following ~~steps,~~ steps for each test temperature at which the pycnometer will be used, handling the pycnometer only with tongs or gloves as described in 6.6:

10.1.1 Thoroughly clean, dry, and weigh the pycnometer to the nearest 0.001 g [0.00001 oz]. Designate this mass as *A*.

10.1.2 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 7—Standardization must be done at the test temperature. A pycnometer standardized at one temperature cannot be used at a different temperature without restandardization at that temperature.~~

10.1.3 Allow the pycnometer to remain in the water for a period of not less than 30 min. The water bath must be maintained within 0.1 °C [0.2 °F] of the test temperature as determined by the thermometer described in 6.3 during this time period. Remove the pycnometer and immediately dry the top of the stopper with one stroke of a dry towel (Note 8), then quickly dry the remaining outside area of the pycnometer and weigh to the nearest 0.001 g [0.00001 oz]. Designate the mass of the pycnometer plus water as *B*.

NOTE 8—Do not re-dry 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 re-dry the outside of the pycnometer (excluding the top) before recording the mass.

11. Procedure

11.1 Perform each of the following steps, handling the pycnometer only with tongs or gloves as described in 6.6: