



Designation: D1480 – 21

Standard Test Method for Density and Relative Density (Specific Gravity) of Viscous Materials by Bingham Pycnometer¹

This standard is issued under the fixed designation D1480; 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.

1. Scope*

1.1 This test method covers two procedures for the measurement of the density of materials which are fluid at the desired test temperature. Its application is restricted to liquids of vapor pressures below 80 kPa (600 mm Hg) and viscosities below 40 000 mm²/s (cSt) at the test temperature. The method is designed for use at any temperature between 20 °C and 100 °C. It can be used at higher temperatures; however, in this case the precision section does not apply.

NOTE 1—For the determination of density of materials which are fluid at normal temperatures, see Test Method [D1217](#).

1.2 This test method provides a calculation procedure for converting density to specific gravity.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 **WARNING**—Mercury has been designated by many regulatory agencies as a hazardous substance that can cause serious medical issues. Mercury, or its vapor, has been demonstrated to be hazardous to health and corrosive to materials. Use Caution when handling mercury and mercury-containing products. See the applicable product Safety Data Sheet (SDS) for additional information. The potential exists that selling mercury or mercury-containing products, or both, is prohibited by local or national law. Users must determine legality of sales in their location.

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

[D1217](#) Test Method for Density and Relative Density (Specific Gravity) of Liquids by Bingham Pycnometer

[D4052](#) Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter

[D8278](#) Specification for Digital Contact Thermometers for Test Methods Measuring Flow Properties of Fuels and Lubricants

[E1](#) Specification for ASTM Liquid-in-Glass Thermometers

[E2251](#) Specification for Liquid-in-Glass ASTM Thermometers with Low-Hazard Precision Liquids

3. Terminology

3.1 Definitions:

3.1.1 *density, n* —mass per unit volume at a specified temperature. **D4052**

3.1.2 *relative density, n* —the ratio of the density of a material at a stated temperature to the density of water at a stated temperature. **D4052**

4. Summary of Test Method

4.1 The liquid sample is introduced into the pycnometer, equilibrated to the desired temperature, and weighed. The density or specific gravity is then calculated from this weight and the previously determined calibration factor, and a correction is applied for the buoyancy of air.

5. Significance and Use

5.1 Density is a fundamental physical property that can be used in conjunction with other properties to characterize both the light and heavy fractions of petroleum and to assess the quality of crude oils.

¹ This test method is under the jurisdiction of ASTM Committee [D02](#) on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee [D02.04.0D](#) on Physical and Chemical Methods.

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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

5.2 Determination of the density or relative density of petroleum and its products is necessary for the conversion of measured volumes to volumes at the standard temperatures of 15 °C.

5.3 The determination of densities at the elevated temperatures of 40 °C and 100 °C is particularly useful in providing the data needed for the conversion of kinematic viscosities in mm²/s (centistokes) to the corresponding dynamic viscosities in mPa·s (centipoises).

6. Apparatus

6.1 *Pycnometer*,³ Bingham-type of 10 mL capacity (as shown in Fig. 1), constructed of heat-resistant⁴ glass.

NOTE 2—Pycnometers having capacities of 2 mL to 25 mL are available but have not been cooperatively evaluated.

6.2 *Constant-Temperature Bath*, provided with suitable pycnometer holders and means for maintaining temperatures constant to ± 0.01 °C in the desired range. Water-glycerin mixtures can be used for temperatures up to 100 °C.

6.3 *Bath Thermometer*, graduated in 0.1 °C subdivisions and standardized for the range of use to the nearest 0.01 °C (for example ASTM Saybolt Viscosity Thermometers 17C to 22C, conforming to the requirements in Specification E1). Alternative non-mercury-containing liquid-in-glass thermometers such as thermometer S18C and S22C in Specification E2251 conforming to the temperature range with equal or better accuracy may be used. A digital contact thermometer meeting

³ There is more than one supplier. If you cannot find a supplier, then contact Subcommittee D02.04.0D on Physical and Chemical Methods for possible suppliers.

⁴ Borosilicate glass has been found satisfactory for this purpose.

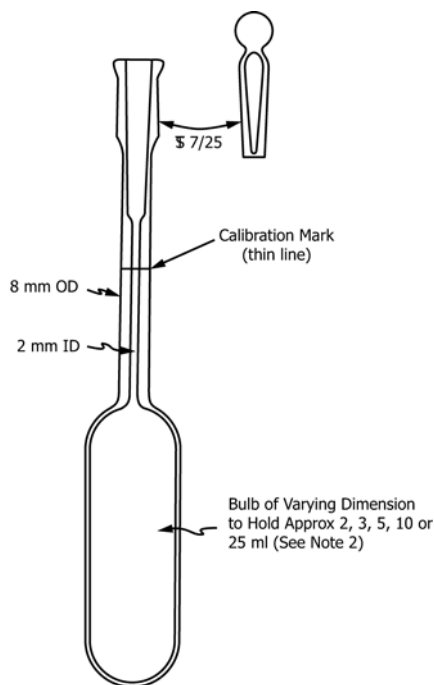
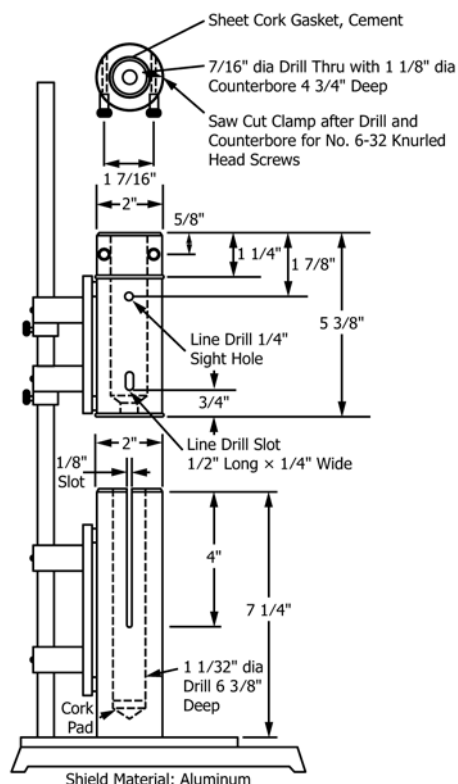


FIG. 1 Bingham-Type Pycnometer

the criteria for D02-DCT05 of Specification D8278 may also be used, and it offers the best means for observing temperature changes in the bath.

NOTE 3—For most hydrocarbons, the density coefficient is about 0.0008 units / °C, and therefore an error of ± 0.013 °C would cause an error of ± 0.00001 g/mL in density.

6.4 *Thermal Shields*, as shown in Fig. 2, to hold the pycnometer and syringe during the filling procedure, constructed of two aluminum shells with suitably spaced viewing ports, the upper bored to hold a 30 mL hypodermic syringe and the lower bored to hold a 25 mL Bingham pycnometer. A winding of No. 26 Chromel “A” wire, insulated from the shields with mica, covered with insulating tape, and having resistances connected in series of 25 Ω on the upper shield and 35 Ω on the lower produces controlled heat to the shields by means of a variable transformer. A stand is necessary to support



Metric Equivalents

in.	mm	in.	mm	in.	mm	in.	mm
1/8	3.2	5/8	15.9	1 1/4	31.8	4	102
1/4	6.4	3/4	19.1	1 7/16	36.5	4 3/4	121
7/16	11.1	1 1/32	26.2	1 7/8	47.6	5 3/8	136
1/2	12.7	1 1/8	28.6	2	50.8	6 3/8	162
						7 1/4	184

NOTE 1—Cover shields with mica or insulating cement. Wind with No. 26 gauge Chromel “A” wire: Upper block 1.52 m (60 in.) (25.4 Ω), lower block 2.16 m (85 in.) (35.0 Ω) wound vertically. Cover with insulating tape or insulating cement and connect heaters in series. Insulate shields from stand with 1/4 in. Transite.

FIG. 2 Details of Thermal Shields for 30 mL Syringe and 25 mL Pycnometer