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An American National Standard

Standard Test Method for Density or Relative Density of Light Hydrocarbons by Pressure Thermohydrometer[1]

This standard is issued under the fixed designation D 1657; 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 the determination of the relative density or density of light hydrocarbons including liquefied petroleum gases (LPG).

1.2 The prescribed apparatus should not be used for materials having vapor pressures higher than 1.4 MPa (14 bar) at the test temperature. (The SI unit of pressure is the pascal: 1 Pa = 1 N/m^2; 10^5 Pa = 1 bar = 1.01972 kgf/cm^2.)

NOTE 1—Attention is drawn to the hazards encountered when working with liquefied petroleum gas or light hydrocarbons. The requirements of any national, local, or domestic safety code should always be strictly observed.

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

1.4 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems 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:*

D 1250 Petroleum Measurement Tables (ASTM 1250/API 2540/IP 200)[2]

E 100 Specification for ASTM Hydrometers[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *density*—the mass of the liquid per unit volume at a temperature t.

3.1.2 *relative density* (this term now replaces the former term "specific gravity")—the ratio of the mass of a given volume of the liquid at a temperature t_1 to the mass of an equal volume of pure water at a temperature t_2.

NOTE 2—When reporting the density, the units of mass and volume used, together with the temperature, should be explicitly stated; for example, kg/m^3 at t°C. The standard reference temperatures are 15°C and 60°F.

When reporting the relative density, the temperatures t_1 and t_2 should be explicitly stated; for example, relative density 60/60°F. The standard reference temperatures in general use are 15°C and 60°F for both t_1 and t_2, but other temperatures may be employed for t_1.

4. Summary of Test Method

4.1 The apparatus is purged with a portion of the sample before filling with the portion to be used for testing. The pressure cylinder is filled to a level at which the enclosed hydrometer floats freely. The hydrometer reading and the temperature of the sample are noted.

5. Significance and Use

5.1 The density or relative density of light hydrocarbons and liquefied petroleum gases is determined to satisfy transportation, storage, and regulatory requirements. Although this determination does not describe any particular performance characteristic, density or relative density can be used to indicate approximate component concentrations in liquefied petroleum mixtures.

6. Apparatus[4]

6.1 *Thermohydrometers*, made of glass, graduated in density with a range from 500 to 650 kg/m^3, or in relative density with a wide range from 0.500 to 0.650, and conforming to the dimensions given in Table 1.

6.2 *Hydrometer Cylinder*, constructed of glass or transparent plastic; for example, poly(methyl methacrylate) or equivalent material, conforming to the design and dimensions given in Fig. 1. The ends shall be tightly sealed with neoprene gaskets and metal end plates as shown in Fig. 1.

6.2.1 **Caution**—A protective shield shall be placed around the plastic or glass cylinder. Replace any cylinders that show signs of fogging, crazing, cracking, or etching.

NOTE 3—Certain compounds attack plastics and cloud the inner surface of the cylinder, making it difficult or impossible to read the hydrometer. Tests showed no attack by ethane, ethylene, propane, propylene, butane, isobutane, normal butylenes, isobutylene, pentane, and isopentane, and no attack is expected from butadiene and acetaldehyde. Users are cautioned, however, to clean the cylinder thoroughly after each determination.

Ketones and alcohols should not be used for cleaning as they attack and weaken plastics while aromatics also tend to attack the surface of plastics and should similarly not be used.

6.2.2 The liquid inlet valve and the liquid outlet valve shall be tightly connected to a base plate that shall be bored to give both valves a common inlet to the cylinder. The

[1] This test method is under the jurisdiction of ASTM Committee D-2 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.H on Liquefied Petroleum Gas.

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[2] *Annual Book of ASTM Standards*, Vol. 05.01.

[3] *Annual Book of ASTM Standards*, Vols 05.03 and 14.03.

[4] Apparatus suitable for this test may be obtained from: EG&G Chandler Engineering, 7707 E. 38th St., Tulsa, OK 74145; Peter Peterson Scientific Glassblowing, Inc., 473 Elmira Rd., Guelph, Ontario N1K 1C2; and Refinery Supply Co., Inc., 6901 E. 12th St., Tulsa, OK 74112.

TABLE 1

	Thermohydrometer	
	For Petroleum Products and Other Liquids of Similar Surface Tensions (33 dynes/cm or less)	
	Thermometer Scale in Body	
	ASTM Hydrometer No.	Nominal Relative Density Range
	101H-62	0.500 to 0.650
Hydrometer		
Total length, mm	354 to 366	
Body diameter, mm	19 to 22	
Stem diameter min, mm	10.5	
Working pressure min, psi	200	
Hydrometer Scale		
Standard temperature, °F	60/60	
Subdivisions	0.001	
Intermediate lines at	0.005	
Main (numbered) lines at	0.010	
Scale error at any point not to exceed	0.001	
Length of nominal scale, mm	125 to 145	
Thermometer Scale		
Range, °F	30 to 90	
Immersion	total	
Subdivisions, °F	1	
Intermediate lines at, °F	5	
Main (numbered) lines at, °F	10	
Scale error at any point not to exceed, °F	0.5	
Scale length, mm	50 to 70	

Thermohydrometer (Pressure)		
	ASTM Hydrometer No.	Density Range, kg/m³
	310H	500–650
Hydrometer		
Nominal length, mm	387	
Body diameter, mm	16 to 22	
Nominal stem diameter, mm	10.5	
Working pressure, kPa	1400	
Hydrometer Scale		
Standard temperature, °C	15	
Subdivisions, kg/m³	1	
Intermediate lines at, kg/m³	5	
Main (numbered) lines at, kg/m³	10	
Scale error at any point not to exceed, kg/m³	1	
Length of nominal scale, mm	125 to 145	

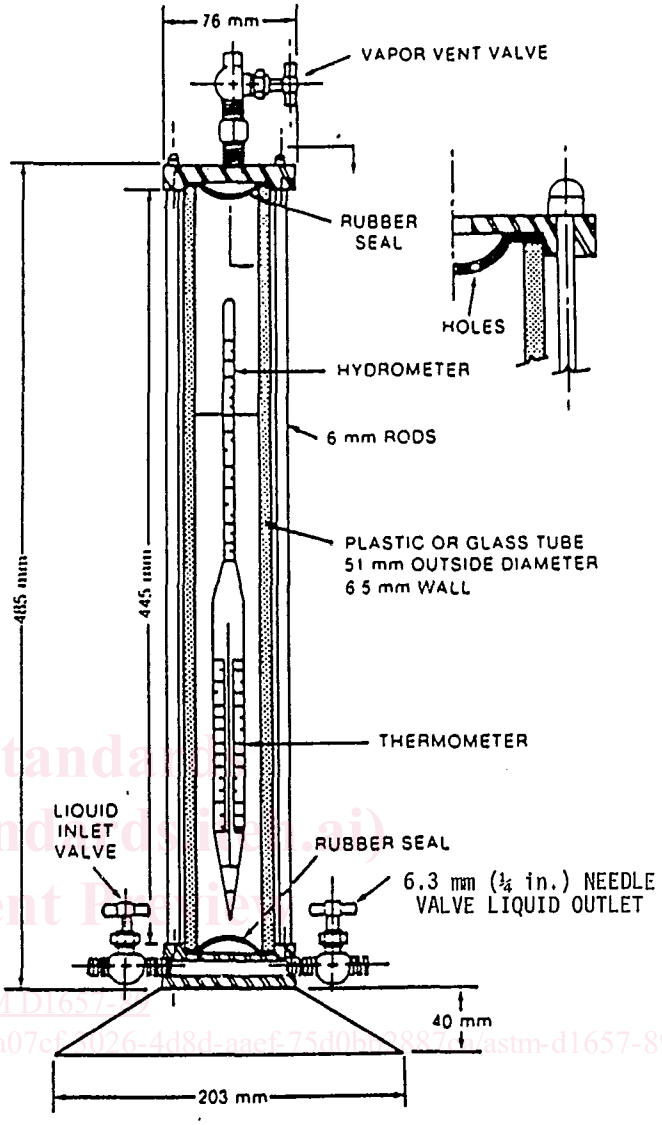

FIG. 1 Pressure Thermohydrometer Cylinder

vapor vent valve shall be similarly connected to the top plate, which shall be bored to provide a vapor outlet from the pressure cylinder. All valves shall be 6.3 mm (¼ in.) or equivalent needle valves.

6.2.3 The cylinder shall not be operated at a gage pressure greater than 1.4 MPa (14 bar).

6.3 *Water Bath*, fitted with a thermostat or other means of maintaining the bath at a constant temperature of 15 ± 0.2°C (60 ± 0.5°F), and of such dimensions that the cylinder can be completely immersed.

7. Reference Liquids

7.1 The following reference liquids are required for standardization of the hydrometer:

7.1.1 *Propane*, pure grade, having a nominal density of 507.6 kg/m³ at 15°C or a relative density 60/60°F of 0.50699.

7.1.2 *n-Butane*, pure grade, having a nominal density of 584.1 kg/m³ at 15°C or a relative density 60/60°F of 0.5840.

8. Sampling

8.1 The procedure for sampling for calibration of the apparatus and for subsequent testing is described as follows:

8.1.1 Connect the source of supply of the liquid to be tested to the inlet valve by suitable fittings so that a representative sample can be introduced into the cylinder. Ascertain that these connections are free of leaks. Open the outlet valve and purge the sampling connections by opening the inlet valve slightly, permitting the product to flow through the outlet valve at the bottom of the cylinder.

8.1.2 When the connections have been purged, close the outlet and vent valves and open the inlet valve, permitting the liquid to enter the cylinder until it is full. If necessary, the vent valve can be opened slightly to permit complete filling of the cylinder and then closed. At no time shall the pressure