



Designation: D2158 – 21

## Standard Test Method for Residues in Liquefied Petroleum (LP) Gases<sup>1</sup>

This standard is issued under the fixed designation D2158; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

### 1. Scope\*

1.1 This test method covers the determination of extraneous materials weathering above 38 °C that are present in liquefied petroleum gases. The extraneous materials will generally be dissolved in the LPG, but may have phase-separated in some instances.

1.2 Liquefied petroleum gases that contain certain anti-icing additives can give erroneous results by this test method.

1.3 Although this test method has been used to verify cleanliness and lack of heavy contaminants in propane for many years, it might not be sensitive enough to protect some equipment from operational problems or increased maintenance. A more sensitive test, able to detect lower levels of dissolved contaminants, could be required for some applications.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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:<sup>2</sup>

<sup>1</sup> 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.H0 on Liquefied Petroleum Gas.

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

- D96 Test Method for Water and Sediment in Crude Oil by Centrifuge Method (Field Procedure) (Withdrawn 2000)<sup>3</sup>
- D1796 Test Method for Water and Sediment in Fuel Oils by the Centrifuge Method (Laboratory Procedure)
- D1835 Specification for Liquefied Petroleum (LP) Gases
- D7756 Test Method for Residues in Liquefied Petroleum (LP) Gases by Gas Chromatography with Liquid, On-Column Injection
- E1137 Specification for Industrial Platinum Resistance Thermometers
- E2251 Specification for Liquid-in-Glass ASTM Thermometers with Low-Hazard Precision Liquids
- E2877 Guide for Digital Contact Thermometers

#### 2.2 Other Standards:

- EN 15470 Liquefied petroleum gases – Determination of dissolved residues – High temperature gas chromatographic method<sup>4</sup>
- EN 15471 Liquefied petroleum gases – Determination of dissolved residues – High temperature gravimetric method<sup>4</sup>
- EN 16423 Liquefied petroleum gases – Determination of dissolved residue – Gas chromatographic method using liquid, on-column injection<sup>4</sup>
- EN ISO 6246 Petroleum products – Gum content of fuels – Jet evaporation method<sup>5</sup>
- ISO 13757 Liquefied petroleum gases – Determination of oily residues – High-temperature method<sup>5</sup>

### 3. Terminology

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

3.1.1 *oil stain observation, n*—the volume of solvent-residue mixture required to yield an oil stain or ring that persists for 2 min under specified conditions on absorbent paper.

3.1.2 *residue, n*—the volume, measured to the nearest 0.05 mL, of the residual material boiling above 38 °C resulting

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

<sup>4</sup> Available from European Committee for Standardization (CEN), Avenue Marnix 17, B-1000, Brussels, Belgium, <http://www.cen.eu>.

<sup>5</sup> Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <https://www.iso.org>.

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

from the evaporation of 100 mL of sample under the specified conditions of this test method.

3.1.3 *solvent-residue mixture, n*—a mixture (solution) of 10 mL of solvent with any residue remaining in the centrifuge tube at the conclusion of the first step in this test method.

#### 4. Summary of Test Method

4.1 A 100 mL sample of liquefied petroleum gas is weathered in a 100 mL centrifuge tube. The volume of residue remaining after heating the tube to 38 °C is measured and recorded.

4.2 To dissolve any residue, 10 mL of solvent is added to the centrifuge tube. Small, measured volumes of solvent-residue mixture are deposited on an absorbent paper in a specified manner. The appearance of the absorbent paper to which the residue solution has been added in measured increments is observed and recorded.

#### 5. Significance and Use

5.1 Control over the residue content (required by Specification **D1835**) is of considerable importance in end-use applications of LPG. In liquid feed systems, residues can lead to troublesome deposits and, in vapor withdrawal systems, residues that are carried over can foul regulating equipment. Residues that remain in vapor-withdrawal systems will accumulate, can be corrosive, and will contaminate subsequent product. Water, particularly if alkaline, can cause failure of regulating equipment and corrosion of metals.

5.2 See **Appendix X2** for information on the effect of temperature on the measurement of residue in LPG.

#### 6. Interferences

6.1 Solid contaminants such as rust, scale or dirt can interfere with this test method, which is not intended for representative measurement of solid, undissolved contaminants. However, the presence of solids in the centrifuge tube should be reported.

#### 7. Apparatus

7.1 *Centrifuge Tube*, 100 mL graduated, conforming to dimensions given in **Fig. 1**. The first 0.5 mL shall be graduated in 0.05 mL increments. The shape of the lower tip of the tube is especially important. The taper shall be uniform and the bottom shall be rounded as shown in **Fig. 1**. Tubes shall be made of thoroughly annealed heat-resistant glass. Volumetric graduation tolerances, based on air-free water at 20 °C, are given in **Table 1**. Detailed requirements for centrifuge tubes appear in Test Methods **D96** and **D1796**.

7.2 *Cooling Coil and Cooling Bath*, a minimum length of 6 m of 5 mm to 7 mm outside diameter copper tubing wound to a diameter of 63.5 mm  $\pm$  1.5 mm outside diameter, and assembled in a suitable cooling bath. (See **Fig. 2** as an example.)

7.2.1 Mechanical refrigeration is permitted provided that the coolant temperature is below  $-43$  °C. If dry ice is used, a non-glass dewar or vessel is recommended.

7.3 *Syringe*, 2 mL graduated in 0.1 mL and equipped with a needle 200 mm  $\pm$  5 mm long. The needle may be either a sharp needle (ordinary medical syringe needle) or a safe, non-sharp syringe needle to avoid a puncture hazard. Alternatively, an equivalent liquid dispensing device capable of delivering 0.1 mL increments may be used, such as a 0.1 mL pipet.

7.4 *Temperature Measuring Device*, that is intrinsically safe, with accuracy equal to or better than liquid-in-glass thermometer ASTM S5C described in Specification **E2251**. Guide **E2877** and Specification **E1137** may be useful for selecting a digital contact thermometer.

7.4.1 For routine testing, a general purpose thermometer or a digital contact thermometer with 0.5 °C subdivisions or display resolution and a maximum error of 0.5 °C may be used.

NOTE 1—When a thermometer or a water bath, or both, are not available, for example when conducting a field test, a satisfactory alternative for screening purposes is to warm the tip of the centrifuge tube with the hand.

7.5 *Absorbent Paper*, white, at least 100 mm diameter. Medium grade or rapid filter paper has been found to be satisfactory. In this test method, the paper will be referred to as “filter paper.”

7.6 *Solvent Wash Bottle*, typically polyethylene.

7.7 *Water Bath*, controlled at 38 °C  $\pm$  2 °C.

7.8 *Copper Wire*, 1 mm to 2 mm diameter, at least 10 mm longer than the centrifuge tube’s height.

7.9 *Clamp*, suitable for holding the centrifuge tube during weathering.

#### 8. Reagents and Materials

8.1 *Solvent*—HPLC-grade pentane or cyclopentane. Another grade of solvent may be used provided that it meets the requirements of **10.2**.

8.1.1 Although pentane is the preferred solvent for use in this test method, cyclopentane may be substituted for pentane whenever the ambient temperature or altitude is too high to enable the convenient handling of pentane.

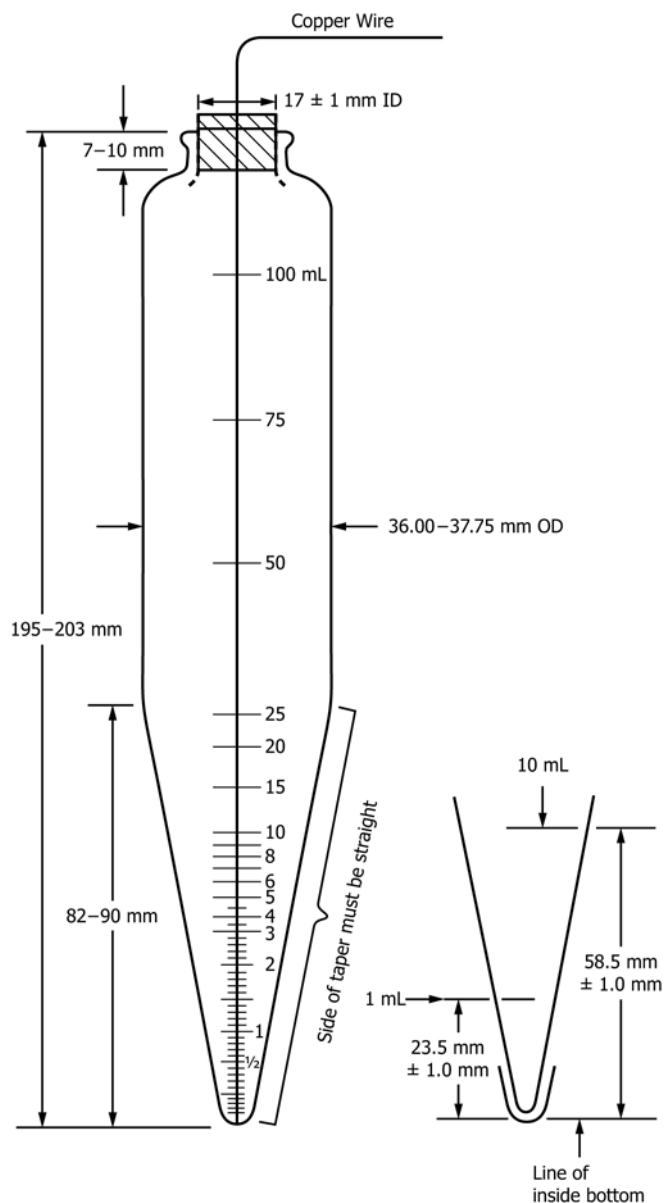
8.1.2 Storage of solvent in a polyethylene wash bottle for several days contaminates the solvent. Therefore, do not use any solvent that has remained in a polyethylene wash bottle for more than one day.

#### 9. Hazards

9.1 Note that there is a significant fire hazard from LPG vapors, and since the boiling point of LPG can be as low as  $-41$  °C, there is a risk of freezing “burns.” Take appropriate safety precautions to prevent ignition or fire, and wear suitable protective equipment to protect against skin contact with liquid or vaporizing LPG.

9.2 Operators should wear a grounded antistatic wrist strap. The use of an antistatic floor mat and grounding the sample cylinder are also advised.

9.3 When using a cooling bath of dry ice and hydrocarbon solvent, be aware that the bath can ‘bump’ or splatter cold liquid when LPG is passed through the tubing.



**FIG. 1 Cone-Shaped Centrifuge Tube, 203 mm**

**TABLE 1 Centrifuge Tube Graduation Tolerances**

Range, mL	Scale, Division, mL	Limit of Error, mL
0.0 to 0.1	0.05	0.02
0.1 to 0.3	0.05	0.03
0.3 to 0.5	0.05	0.05
0.5 to 1.0	0.1	0.05
1.0 to 3.0	0.1	0.1
3.0 to 5.0	0.5	0.2
5.0 to 25.0	1.0	0.5
25.0 to 100.0	1.0	1.0

**10. Preparation of Apparatus**

10.1 Wash all glassware that is to be used in the test in the selected solvent.

10.2 Verification of cleanliness of glassware and solvent.

10.2.1 Add 10 mL of a new sample of solvent to the centrifuge tube.

10.2.2 Mark the center of the filter paper with a pencil or other non-pentane-soluble writing tool.

10.2.3 Fill the syringe or equivalent liquid dispensing device (see 7.3) with a portion of the solvent drawn from the centrifuge tube and direct 0.1 mL portions of the solvent to the mark on the paper.

10.2.3.1 The solvent is added in 0.1 mL increments to confine the solvent ring to a circle about 30 mm to 35 mm in diameter. The filter paper should be held level during the solvent addition. One method is to place it on a 250 mL beaker.