



Designation: D1835 – 22

Standard Specification for Liquefied Petroleum (LP) Gases¹

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1. Scope*

1.1 This specification covers those products commonly referred to as liquefied petroleum gases, consisting of propane, propene (propylene), butane, and mixtures of these materials. Four basic types of liquefied petroleum gases are provided to cover the common use applications.

1.2 This specification is applicable to products intended for use as domestic, commercial and industrial heating, and engine fuels.

1.3 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.3.1 The non-SI unit ‘psig’ is the standard unit for footnote C of **Table 1** because that unit of measurement is widely used in North American industry.

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 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

D1265 Practice for Sampling Liquefied Petroleum (LP) Gases, Manual Method

D1267 Test Method for Gauge Vapor Pressure of Liquefied Petroleum (LP) Gases (LP-Gas Method)

¹ This specification 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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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.

- D1657 Test Method for Density or Relative Density of Light Hydrocarbons by Pressure Hydrometer**
- D1837 Test Method for Volatility of Liquefied Petroleum (LP) Gases (Withdrawn 2017)³**
- D1838 Test Method for Copper Strip Corrosion by Liquefied Petroleum (LP) Gases**
- D2158 Test Method for Residues in Liquefied Petroleum (LP) Gases**
- D2163 Test Method for Determination of Hydrocarbons in Liquefied Petroleum (LP) Gases and Propane/Propene Mixtures by Gas Chromatography**
- D2420 Test Method for Hydrogen Sulfide in Liquefied Petroleum (LP) Gases (Lead Acetate Method)**
- D2598 Practice for Calculation of Certain Physical Properties of Liquefied Petroleum (LP) Gases from Compositional Analysis**
- D2713 Test Method for Dryness of Propane (Valve Freeze Method)**
- D3700 Practice for Obtaining LPG Samples Using a Floating Piston Cylinder**
- D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants**
- D5504 Test Method for Determination of Sulfur Compounds in Natural Gas and Gaseous Fuels by Gas Chromatography and Chemiluminescence**
- D5623 Test Method for Sulfur Compounds in Light Petroleum Liquids by Gas Chromatography and Sulfur Selective Detection**
- D6667 Test Method for Determination of Total Volatile Sulfur in Gaseous Hydrocarbons and Liquefied Petroleum Gases by Ultraviolet Fluorescence**
- D6897 Test Method for Vapor Pressure of Liquefied Petroleum Gases (LPG) (Expansion Method)**
- D7756 Test Method for Residues in Liquefied Petroleum (LP) Gases by Gas Chromatography with Liquid, On-Column Injection**
- D7828 Test Method for Determination of Residue Composition in Liquefied Petroleum Gas (LPG) Using Automated Thermal Desorption/Gas Chromatography (ATD/GC) (Withdrawn 2021)³**
- D7994 Test Method for Total Fluorine, Chlorine, and Sulfur**

³ The last approved version of this historical standard is referenced on www.astm.org.

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

in Liquid Petroleum Gas (LPG) by Oxidative Pyrohydrolytic Combustion Followed by Ion Chromatography Detection (Combustion Ion Chromatography-CIC)

2.2 GPA Midstream Association Standard.⁴

GPA Standard 2140 Liquefied Petroleum Gas Specifications and Test Methods

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this specification, refer to Terminology **D4175**.

3.1.2 *commercial butane, n*—a hydrocarbon product for use where low volatility is required.

3.1.3 *commercial PB mixtures, n*—mixtures of propane and butane for use where intermediate volatility is required.

3.1.4 *commercial propane, n*—a hydrocarbon product for use where high volatility is required. Commercial propane is suitable for certain low severity internal combustion engine applications.

3.1.5 *liquefied petroleum gas (LP Gas, LPG), n*—a narrow boiling range mixture of hydrocarbons consisting of propane, propylene, butanes and butylenes, individually or in specified combinations, with limited amounts of other hydrocarbons (such as ethane) and may contain naturally occurring, petroleum-derived, non-hydrocarbons.

⁴ Available from GPA Midstream Association, 6060 American Plaza, Suite 700, Tulsa, OK 74135, <http://www.gpaglobal.org>.

3.1.5.1 *Discussion*—LPG is typically maintained in a liquid state by containing it within a closed container or storage tank that can withstand the vapor pressure of the LPG at ambient temperature, or at a low temperature in refrigerated storage.

3.1.5.2 *Discussion*—In many jurisdictions, LPG for fuel purposes is required to be odorized with a stenching agent such as ethyl mercaptan.

3.1.6 *special-duty propane, n*—a product composed chiefly of propane which exhibits superior antiknock characteristics and was specifically developed for use as fuel in spark-ignition internal combustion engines.

4. Sampling

4.1 Proper sampling of liquefied gases is extremely important if the test results are to be significant. Obtain representative samples in accordance with Practice **D1265** or Practice **D3700**. In the event of a dispute involving sample integrity when sampling for testing against D1835 requirements, Practice **D3700** shall be used as the referee sampling procedure.

5. Detailed Requirements

5.1 The four types of liquefied petroleum gases shall conform to the requirements prescribed in **Table 1**.

6. Keywords

6.1 butane; HD-5 propane; liquefied petroleum (LP) gases specifications; LPG; propane; special duty propane

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TABLE 1 Detailed Requirements for Liquefied Petroleum Gases

	Product Type				ASTM Test Methods (see Section 2)
	Commercial Propane	Commercial Butane	Commercial PB Mixtures	Special-Duty Propane ^A	
Vapor pressure at 37.8 °C (100 °F), kPa (psig) max ^B	1435 (208)	483 (70)	^C	1435 (208)	D1267 ^D or D2598 or D6897
Heavier hydrocarbon contaminants: ^E					
Butane and heavier, ^F % by volume, max	2.5	...	...	2.5	D2163
Pentane and heavier, ^G % by volume, max	...	2.0	2.0	...	D2163
Propylene content, % by volume, max	...	...	...	5.0	D2163
Residual matter: ^{H,I}					
One of the following requirements shall be met:					
(1) Residue on evaporation of 100 mL, mL, max, and Oil stain observation	0.05 pass ^J	0.05 pass ^J	0.05 pass ^J	0.05 pass ^J	D2158 ^K D2158 ^K
or					
(2) Residue by gas chromatography, mg/kg, max	350	350	350	350	D7756
Density at 15 °C or relative density at 15.6 °C/15.6 °C (60 °F/60 °F)	^L	^L	^L	...	D1657 or D2598
Corrosion, copper, strip, max	No. 1	No. 1	No. 1	No. 1	D1838 ^M
Sulfur, mg/kg (ppm by mass), max	185 ^N	140 ^N	140 ^N	123 ^N	D6667
Hydrogen sulfide	pass	pass	pass	pass	D2420
Moisture content	pass	...	...	pass	D2713
Free water content	...	none ^O	none ^O	...	...

^A Equivalent to Propane HD-5 of GPA Standard 2140.

^B Note that the total pressure of a batch of LPG can be higher than the vapor pressure determined by Practice D2598 if there are any inert gases (such as nitrogen or carbon dioxide) present in the LPG. Test Method D2598 is a calculation method of the vapor pressure of all hydrocarbons identified in a batch of LPG by Test Method D2163, but this gas chromatographic method does not detect the presence of inert gases, if present, in a batch of LPG.

^C The permissible vapor pressures of products classified as PB mixtures shall not exceed 208 psig (1435 kPa) and additionally shall not exceed the pressure calculated in psig from the following relationship between the observed vapor pressure at 100 °F (37.8 °C) and the observed relative density at either 60 °F or 15.6 °C:

$$\begin{aligned} & \text{Vapor pressure, psig, max} \\ & = 1167 - 1880 (\text{relative density at } 60 \text{ }^\circ\text{F}/60 \text{ }^\circ\text{C}) \quad (1) \\ & = 1167 - 1880 (\text{relative density at } 15.6 \text{ }^\circ\text{C}/15.6 \text{ }^\circ\text{C}) \quad (2) \end{aligned}$$

A specific mixture shall be designated by the vapor pressure at 100 °F in pounds per square inch gauge. To comply with the designation, the vapor pressure of the mixture shall be within +0 psi to -10 psi of the vapor pressure specified.

^D In case of dispute about the vapor pressure of a product, the value actually determined by Test Method D1267 shall prevail over the value calculated by Practice D2598 or measured by Test Method D6897.

^E See X1.2.2.3.

^F "Butane and heavier" includes all hydrocarbons (including olefins) with 4 or more carbon atoms.

^G "Pentane and heavier" includes all hydrocarbons (including olefins) with 5 or more carbon atoms.

^H See X1.2.4 for information about residues in LPG and for information about gas chromatographic tests for residues in LPG.

^I See X1.2.9 for information about determining halide contaminants in LPG.

^J An acceptable product shall not yield a persistent oil ring when 0.3 mL of solvent residue mixture is added to a filter paper, in 0.1 mL increments and examined in daylight after 2 min as described in Test Method D2158.

^K In case of dispute, Test Method D2158 shall be the referee test method.

^L Although not a specific requirement, the density or relative density can be needed for other purposes and should be reported. Additionally, the relative density of PB mixture is needed to establish the permissible maximum vapor pressure (see Footnote B).

^M This method may not accurately determine the presence of reactive materials (for example, H₂S, S^o) in liquefied petroleum gas if the product contains corrosion inhibitors or other chemicals which diminish the reaction with the copper strip.

^N The total sulfur limits in these specifications do include sulfur compounds used for stenching purposes.

^O The presence or absence of water may be determined by visual inspection of the samples on which the density or relative density is determined.

APPENDIX
(Nonmandatory Information)
X1. SIGNIFICANCE OF ASTM SPECIFICATIONS FOR LIQUEFIED PETROLEUM (LP) GASES
X1.1 General

X1.1.1 Liquefied petroleum gas products are composed of those readily liquefiable hydrocarbon compounds that are produced in the course of processing natural gas and also in the course of the conventional refining of crude oil. The composition of liquefied gases can vary widely depending upon the source and the nature of the treatment to which the products have been subjected.

X1.1.2 There are many uses for liquefied petroleum gases. Important uses include, (1) as domestic, commercial, and industrial fuels, (2) as a carbon source material in metal treating operations, (3) as refinery raw materials for synthesis of gasoline components, and (4) as petrochemical raw materials. The nature of the needs dictates the required composition characteristics in these various applications. Since the last three uses of those listed are in the category of specialty applications, which involve special requirements, they are excluded from consideration in the specifications.

X1.1.3 In substance, this specification is designed to properly define acceptable products for domestic, commercial, and industrial uses. In many cases it will be found that products meeting the specifications will also be usable in applications other than the ones for which they were designed. The following can be accepted as a general guide in the more common use applications of the four types of fuels:

X1.1.3.1 *Commercial Propane*—This fuel type is adequate for domestic, commercial, and industrial use, particularly in geographical areas and in seasons where low ambient temperatures are common, and where uniformity of fuel is an important consideration. Commercial propane can be suitable for certain low severity internal combustion engine applications.

X1.1.3.2 *Commercial PB Mixtures*—This fuel type, since it covers a broad range of mixtures, permits the tailoring of fuels to specific needs. The various mixtures find application as domestic, commercial, and industrial fuel in areas and at times when low ambient temperature conditions are not encountered. This fuel type is not suitable for vapor withdrawal applications in cool or cold climates.

X1.1.3.3 *Commercial Butane*—This fuel type finds limited application as a domestic fuel in areas of warmer climates. It is similarly used in industrial applications where problems of fuel vaporization are not present, such as direct liquid injection.

X1.1.3.4 *Special-Duty Propane*—This fuel type, equivalent to HD-5 propane, is a product tailored to meet the restrictive needs of internal combustion engines operating under moderate to high engine severity (that is, normal automotive applications). Fuel products of this type will be less variable in composition and combustion characteristics than the other products covered by this specification. Special-Duty Propane can be used as a substitute for Commercial Propane.

X1.2 Significance and Use

X1.2.1 This specification addresses commercial liquefied petroleum gases consisting of either propane or butane or mixtures thereof. Consequently, the important characteristics of these products can be defined and controlled by a relatively few simple measurements. The specification test methods provided achieve the desired results. The significance of the various tests as they can apply to consumer problems is summarized here.

X1.2.2 *Vapor Pressure, Heavier Hydrocarbon Contaminants, and [Relative] Density:*

X1.2.2.1 *Vapor Pressure*—Indirect measure of the most extreme low-temperature conditions under which initial vaporization can be expected to take place. It can be considered as a semiquantitative measure of the amount of the most volatile material present in the product. It can also be used as a means for predicting the maximum pressures which can be experienced at fuel tank temperatures. Vapor pressure becomes more significant when it is related to volatility.

X1.2.2.2 *Heavier Hydrocarbon Contaminants*—Expressed as limits on ‘butane and heavier hydrocarbons’ and ‘pentane and heavier hydrocarbons’ are a measure of less volatile components present in the product. Coupled with a vapor pressure limit, they serve to assure essentially single-component products in the cases of commercial propane and commercial butane fuel types. When heavier hydrocarbon contaminants are coupled with a vapor pressure limit which has been related to density or gravity, as in the case of the commercial PB-mixture type of fuels, the combination serves to assure essentially two component mixtures for such fuels. When coupled with a proper vapor pressure limit, this measurement serves to assure that special-duty propane products will be composed chiefly of propane and propylene and that propane will be the major constituent.

X1.2.2.3 The withdrawn Test Method **D1837** – 17 (Withdrawn 2017), which uses a mercury thermometer, has been useful in investigating suspected LPG contamination incidents in the field when gas chromatographic testing is not readily available. Users can consider using Test Method **D1837** in jurisdictions that still allow use of mercury thermometers.

X1.2.2.4 *Density or Relative Density*—by itself, has little significance. It becomes of value when related to vapor pressure and volatility. Since density or relative density is of importance in meeting transportation and storage requirements it is always determined for all liquefied petroleum gas products.

Other Product Characteristics

X1.2.3 While the vaporization and combustion characteristics of commercial liquefied gas products are completely defined for the normal use applications by vapor pressure, heavier hydrocarbon contaminants, and relative density, as