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Standard Specification for Liquefied Petroleum (LP) Gases[1]

This standard is issued under the fixed designation D1835; 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 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 the standard. The values given in parentheses are for information only.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

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

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

D1657 Test Method for Density or Relative Density of Light Hydrocarbons by Pressure Hydrometer

D1837 Test Method for Volatility of Liquefied Petroleum (LP) Gases

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 Analysis of Liquefied Petroleum (LP) Gases and Propene Concentrates by Gas Chromatography[3]

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)

D2784 Test Method for Sulfur in Liquefied Petroleum Gases (Oxy-Hydrogen Burner or Lamp)

D3700 Practice for Obtaining LPG Samples Using a Floating Piston Cylinder

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)

2.2 *Other Document:*[4]

GPA Standard 2140 [4]

3. Terminology

3.1 *Definitions:*

3.1.1 *commercial butane*—a hydrocarbon product for use where low volatility is required.

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

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

3.1.4 *special-duty propane*—a high-quality product composed chiefly of propane, which exhibits superior antiknock characteristics when used as an internal combustion engine fuel.

[1] This specification is under the jurisdiction of ASTM Committee D02 on Petroleum Products 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.

[3] Withdrawn.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

[4] Available from Gas Processors Assn., 6526 E. 60th St., Tulsa, OK 74145. www.gasprocessors.com

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

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; propane

TABLE 1 Detailed Requirements for Liquefied Petroleum Gases

	Product Type				
	Commercial Propane	Commercial Butane	Commercial PB Mixtures	Special-Duty Propane[A]	ASTM Test Methods (see Section 2)
Vapor pressure at 37.8°C (100°F), max, kPa	1434	483	[B]	1434	D1267 or D2598 or D6897[C]
psig	208	70	[B]	208	D1267 or D2598 or D6897[C]
Volatile residue:					
evaporated temperature, 95 %, max, °C	–38.3	2.2	2.2	–38.3	
°F	–37	36	36	–37	D1837
or					
butane and heavier, max, vol %	2.5	...	...	2.5	D2163
pentane and heavier, max, vol %	...	2.0	2.0	...	D2163
Propylene content, max, vol %	...	...	...	5.0	D2163
Residual matter:					
residue on evaporation 100 mL, max, mL	0.05	0.05	0.05	0.05	D2158
oil stain observation	pass[D]	pass[D]	pass[D]	pass[D]	D2158
Relative density at 15.6/15.6°C (60/60°F)	[E]	[E]	[E]	...	D1657 or D2598
Corrosion, copper, strip	No. 1	No. 1	No. 1	No. 1	D1838[F]
Sulfur, ppmw	185[G]	140[G]	140[G]	123[G]	D2784 or D6667[H]
Hydrogen sulfide	pass	pass	pass	pass	D2420
Moisture content	pass	...	...	pass	D2713
Free water content	...	none[I]	none[I]	...	...

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

[B] The permissible vapor pressures of products classified as PB mixtures shall not exceed 1430 kPa (208 psig) and additionally shall not exceed that calculated from the following relationship between the observed vapor pressure and the observed relative density:

Vapor pressure, max = 1167 − 1880 (relative density at 60/60°F) or 1167 − 1880 (relative density at 15.6/15.6°C)

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

[C] 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.

[D] 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.

[E] Although not a specific requirement, the relative density must be determined 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*).

[F] This method may not accurately determine the presence of reactive materials (for example, H_2S, S^o) in liquefied petroleum gas if the product contains corrosion inhibitors or other chemicals which diminish the reaction with the copper strip.

[G] The total sulfur limits in these specifications *do include* sulfur compounds used for stenching purposes.

[H] Test Method D6667 may be used as an alternative means of sulfur measurement for LPG samples within the range that has been validated in Test Method D6667.

[I] The presence or absence of water shall be determined by visual inspection of the samples on which the 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 is 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. Fuel products of this type will be less variable in composition and combustion characteristics than the other products covered by this specification.

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, Volatility, 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 may be experienced at fuel tank temperatures. Vapor pressure becomes more significant when it is related to volatility.

X1.2.2.2 *Volatility*—Expressed in terms of the 95 % evaporated temperature of the product, is a measure of the amount of least volatile fuel component present in the product. Coupled with a vapor pressure limit, it serves to assure essentially single-component products in the cases of commercial propane and commercial butane fuel types. When volatility is coupled with a vapor pressure limit which has been related to 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 *Relative Density*—By itself, has little significance. It becomes of value only when related to vapor pressure and volatility. Since relative density is of importance in meeting transportation and storage requirements it is always determined for all liquefied petroleum gas products.

X1.2.3 *Other Product Characteristics*—While the vaporization and combustion characteristics of commercial liquefied gas products are completely defined for the normal use applications by vapor pressure, volatility, and relative density, as given in X1.2.2, there are other items which either affect or might affect the results obtained in some specific use applications. For that reason, limits are specified for residue content, copper corrosion, sulfur content, moisture content, and free water content to provide assurance of product dependability under the more extreme conditions of use.

X1.2.3.1 *Residue*—A measure of the concentration of soluble hydrocarbon materials present in the product which are substantially less volatile than the liquefied petroleum gas

product being sampled. Control of residue content is of importance in applications where the fuel is used in liquid or vapor feed systems (where fuel vapors are withdrawn from the top of the LPG storage container). In either case, failure to limit the permissible concentration of residue materials may result in troublesome deposits or regulating equipment may become fouled, or both.

X1.2.3.2 *Copper Corrosion*—Limits are for the purpose of providing assurance that difficulties will not be experienced in the deterioration of the copper and copper-alloy fittings and connections which are commonly used in many types of utilization, storage, and transportation equipment. The copper corrosion test will detect the presence of hydrogen sulfide, which is highly toxic. The copper corrosion limits also provide assurance that the LP-Gas will not contain H_2S in such quantities as to present a health and safety hazard if it is known that the product does not contain corrosion inhibitors or other chemicals which diminish the reaction with the copper strip. In addition, Test Method D2420 is recommended as a field test and added safeguard to ensure that LP-Gas does not contain detectable amounts of hydrogen sulfide.

X1.2.3.3 *Sulfur Content*—Limits are provided to more completely define liquefied petroleum gas products because these products are generally lower in sulfur content than most other petroleum-derived fuels. The limit on sulfur content minimizes sulfur oxide emissions and limits potential corrosion by exhaust gases from combustion of LPG.

X1.2.3.4 *Moisture Content*—Limits the percent saturation of the product with water. This measurement using Test Method D2713 is a requirement only on the commercial and special duty propane types of liquefied petroleum gas which must be sub-saturated with water at temperatures above about -26 °C. The purpose of moisture content control is to provide assurance that pressure reducing regulators and similar equipment will operate consistently without troublesome freeze-ups caused by the separation of dissolved water from the product. The presence of an antifreeze agent such as methyl alcohol which prevents separated water from freezing may allow use of propane containing excessive dissolved water in many applications.

NOTE X1.1—Commercial propane and special duty propane should be produced to comply with the moisture content requirement, and de-icer additives should not routinely be used to pass dryness test requirements. That is, these products must be so dry that they are sub-saturated with water at most ambient temperatures. They should be maintained dry during storage and distribution. A de-icer such as methyl alcohol (methanol) should not be added to these products without specific agreement and approval of the purchaser. During short-term upsets in production, or inadvertent contamination by trace water during storage or distribution, addition of 50 ppm methyl alcohol has proven to be acceptable to prevent valve freezing in normal applications. For guidance, based on historical experience and phase separation data, the maximum cumulative addition of methyl alcohol should not exceed 200 ppm by volume.

X1.2.3.5 *Free Water Content*—Of importance only on the commercial PB-mixtures and commercial butane type products. These two types of products are normally used under ambient conditions which are mild and, as a consequence, the only requirement is vigilance to ensure that no free water is present.

SUMMARY OF CHANGES

Subcommittee D02.H0 has identified the location of selected changes to this standard since the last issue (D1835 – 03a) that may impact the use of this standard.

(*1*) Added Test Method D6897 to Section 2.
(*2*) Added a statement to subsection 4.1.
(*3*) Added a footnote to Table 1.