



Designation: D2163 – 23^{ε1}

Standard Test Method for Determination of Hydrocarbons in Liquefied Petroleum (LP) Gases and Propane/Propene Mixtures by Gas Chromatography¹

This standard is issued under the fixed designation D2163; 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.

^{ε1} NOTE—Editorially updated scope in April 2023.

1. Scope*

1.1 This test method covers the quantitative determination of individual hydrocarbons in liquefied petroleum (LP) gases and mixtures of propane and propene, excluding high-purity propene in the range of C₁ to C₅. Component concentrations are determined in the range of 0.01 % to 100 % by volume.

1.2 This test method does not fully determine hydrocarbons heavier than C₅ and non-hydrocarbon materials, and additional tests may be necessary to fully characterize an LPG sample.

1.3 The values stated in SI units are to be regarded as 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4.1 *The user is advised to obtain LPG safety training for the safe operation of this test method procedure and related activities.*

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

D1835 Specification for Liquefied Petroleum (LP) Gases

D2421 Practice for Interconversion of Analysis of C₅ and Lighter Hydrocarbons to Gas-Volume, Liquid-Volume, or Mass Basis

D2598 Practice for Calculation of Certain Physical Properties of Liquefied Petroleum (LP) Gases from Compositional Analysis

D3700 Practice for Obtaining LPG Samples Using a Floating Piston Cylinder

D6729 Test Method for Determination of Individual Components in Spark Ignition Engine Fuels by 100 Metre Capillary High Resolution Gas Chromatography

E355 Practice for Gas Chromatography Terms and Relationships

E594 Practice for Testing Flame Ionization Detectors Used in Gas or Supercritical Fluid Chromatography

E1510 Practice for Installing Fused Silica Open Tubular Capillary Columns in Gas Chromatographs

2.2 Canadian General Standards Board Publications:³

CAN/CGSB 3.0 No. 14.3 Standard Test Method for the Identification of Hydrocarbon Components in Automotive Gasoline Using Gas Chromatography

2.3 Gas Processors Association:⁴

GPA Std 2145-03 for Hexane

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.D0.03 on Propylene.

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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 Available from CGSB, Canadian General Standards Board, Gatineau, Canada K1A 1G6. Visit the CGSB website, www.pwgsc.gc.ca/cgsb/

⁴ Available from Gas Processors Association (GPA), 6526 E. 60th St., Tulsa, OK 74145, <http://www.gasprocessors.com>.

3. Terminology

3.1 Definitions:

3.1.1 Additional terminology related to the practice of gas chromatography can be found in Practice E355.

3.1.2 *liquefied petroleum gas (LPG)*, *n*—hydrocarbon gases that can be stored or handled in the liquid phase through compression or refrigeration, or both.

3.1.2.1 *Discussion*—LPGs generally consist of C₃ and C₄ alkanes and alkenes or mixtures thereof and containing less than 10 % by volume of higher carbon number material. Vapor pressure does not normally exceed 2000 kPa at 40 °C.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *propane/propene mixtures*, *n*—mixtures primarily composed of propane and propene where one of these components is usually in the concentration range of 30 % to 85 % by mass with the other comprising the majority of the remainder. “Commercial Propane” in Specification D1835 is typically this sort of product mixture.

3.2.1.1 *Discussion*—Other components may be present, usually at less than 10 % by mass.

4. Summary of Test Method

4.1 An LPG sample is analyzed via either liquid or gas sampling valves by gas chromatography and compared to corresponding components separated under identical operating conditions from a reference standard mixture of known composition or from use of pure hydrocarbons. The chromatogram of the sample is interpreted by comparing peak retention times and areas with those obtained for the reference standard mixture or pure hydrocarbons.

5. Significance and Use

5.1 The hydrocarbon component distribution of liquefied petroleum gases and propene mixtures is often required for

end-use sale of this material. Applications such as chemical feed stocks or fuel require precise compositional data to ensure uniform quality. Trace amounts of some hydrocarbon impurities in these materials can have adverse effects on their use and processing.

5.2 The component distribution data of liquefied petroleum gases and propene mixtures can be used to calculate physical properties such as relative density, vapor pressure, and motor octane (see Practice D2598). Precision and accuracy of compositional data are extremely important when these data are used to calculate various properties of these petroleum products.

6. Apparatus

6.1 *Gas Chromatograph (GC)*—Any gas chromatographic instrument provided with a linear temperature programmable column oven. The temperature control must be capable of obtaining a retention time repeatability of 0.05 min (3 s) throughout the scope of this analysis.

6.2 *Detector*—A flame ionization detector (FID) having a sensitivity of 0.5 ppm (mole) or less for the compounds listed in Table 1 is strongly recommended (see Practice E594).

6.2.1 Other detectors may be used (alone or in series) provided that they have sufficient response, linearity, and sensitivity to measure the components of interest at the concentration levels required.

6.3 *Data Acquisition*—Any commercial integrator or computerized data acquisition system may be used for display of the chromatographic detector signal and peak area integration. The device should be capable of calibration and reporting of the final response corrected results.

6.4 *Sample Introduction*—Whether liquid or vapor sampling, the combination of valve injection size and split ratio

TABLE 1 Expected Retention Order and Times

Component	Estimated Retention Time (min) (using typical Al ₂ O ₃ PLOT operating conditions)	Estimated Retention Time (min) (using typical 100 m Dimethylpolysiloxane column operating conditions)	FID	TCD
C ₅ Olefin/C ₆ ⁺ Composite (back-flush)	NA ^A	...	x	x
Air Composite (O ₂ , Ar, N ₂ , Co)	NA ^A	...	...	x
Methane	1.9	6.5	x	x
Ethane	2.1	6.7	x	x
Propane	2.7	7.3	x	x
Cyclopropane	3.4	...	x	x
Propene	3.5	7.2	x	x
2-Methyl Propane (Isobutane)	4.0	8.4	x	x
Butane	4.2	9.5	x	x
Propadiene	4.7	...	x	x
Ethyne (Acetylene)	5.0	...	x	x
Trans-2-Butene	5.5	9.9	x	x
1-Butene	5.6	9.2	x	x
2-Methyl Propene (Isobutene)	5.7	9.1	x	x
2,2-Dimethylpropane (Neopentane)	5.9	10.1	x	x
Cis-2-Butene	6.2	10.6	x	x
Cyclopentane	6.7	25.8	x	x
2-Methyl Butane (Isopentane)	6.8	14.0	x	x
Pentane	7.2	16.9	x	x
1,3-Butadiene	7.5	9.3	x	x
Propyne (Methyl Acetylene)	7.9	...	x	x
>nC ₅ (Sum C ₅ Olefins and Heavier) ^B	8.1 until end of run	...	x	x

^A Not applicable.

^B >nC₅ components may be speciated and reported individually.