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CAN/CGSB-3.14-2023

Supersedes CAN/CGSB-3.14-2018
Corrigendum No. 1, March 2024

Propane for fuel purposes

Canadian General Standards Board CGSB

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NATIONAL STANDARD OF CANADA **CAN/CGSB-3.14-2023**

Supersedes CAN/CGSB-3.14-2018
Corrigendum No. 1, March 2024

Propane for fuel purposes

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Preface

This National Standard of Canada CAN/CGSB-3.14-2023 supersedes the 2018 edition and Corrigendum No.1 (French edition only). This Corrigendum supersedes the 2023 edition published in August 2023.

Changes since the previous edition

- Revised the definitions of LPG and propane (section 3)
- Added an explanatory footnote for “butane and heavier hydrocarbons” (6.5)
- Removed ASTM D5453 for sulphur (6.8)
- Added an informative footnote on inert gases for ASTM D2598 (6.9)
- Renamed the property “dryness” as “moisture content” (6.11)
- Updated sampling recommendations for trace analysis (7.1.5)
- Added precautionary statement on excessive methanol use and elastomer degradation (9.9)
- Added new precautionary clause on halogen-containing compounds (9.10)
- Added new precautionary clause on ammonia contamination referencing F.6 (9.11)
- Noted limitations in precision data of ASTM D5623 for sulphur (C.1)
- Added “oily” and “greasy” descriptive terminology for residues (F.5.3).

Corrigendum

- Correction of the wording in footnote i of Table 1 - Specified limiting values to fix the substance name. This correction only applies to the French version.
- Correction of the ICS number.
- Minor editorial corrections in both the French and English versions.

The following definitions apply in understanding how to implement this National Standard of Canada:

- "shall" indicates a **requirement**;
- "should" indicates a **recommendation**;
- "may" is used to indicate that something is **permitted**;
- "can" is used to indicate that something is **possible**, for example, that an organization is able to do something.

Notes accompanying clauses do not include requirements or alternative requirements. The purpose of a note accompanying a clause is to separate explanatory or informative material from the text. Annexes are designated normative (mandatory) or informative (non-mandatory) to define their application.

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Propane for fuel purposes

1 Scope

This National Standard of Canada describes two grades of propane used for fuel purposes. These grades consist mainly of hydrocarbons containing three carbon atoms.

Grade 1 is intended for use in internal combustion engines and for general industrial and commercial fuel applications. Grade 1 maintains a minimum octane quality by limiting concentrations of low-octane components (see 6.5).

Grade 2 is adequate for most industrial and domestic uses and may also be suitable for low severity internal combustion engine applications where a high-octane fuel is not required.

Note: The requirements for Grade 1 and Grade 2 are derived from the GPA Midstream Association Standard 2140 specifications for HD-5 and commercial propane, respectively.

In view of the maximum sulphur level specified in this standard, fuel conforming to the standard may be unsuitable for spark-ignition motor vehicle engines with emission control technology that includes catalysts (see F.7).

Users of this standard are advised to take appropriate measures to address health and safety concerns related to the use and handling of propane (see 9).

The testing and evaluation of a product against this standard may require the use of materials and/or equipment that could be hazardous. This standard does not purport to address all the safety aspects associated with its use. Anyone using this standard has the responsibility to consult the appropriate authorities and to establish appropriate health and safety practices in conjunction with any applicable regulatory requirements prior to its use.

Units of measurement – Quantities and dimensions used in this standard are provided in units from the International System of Units (SI units). This standard expresses the industry standard nominal unit of measurement in North America of “% by volume”. The SI equivalent expression for this unit is % (V/V).

2 Normative references

The following normative documents contain provisions that, through references in this text, constitute provisions of this National Standard of Canada. The referenced documents may be obtained from the sources noted below.

Note: The contact information provided below was valid at the date of publication of this standard.

An undated reference is to the latest edition or revision of the reference or document in question, unless otherwise specified by the authority applying this standard. A dated reference is to the specified revision or edition of the reference or document in question.

2.1 Canadian General Standards Board (CGSB)

CAN/CGSB-3.0 — *Methods of testing petroleum and associated products:*

No. 14.3 — *Standard test method for the identification of components in automotive gasoline using gas chromatography*

No. 18.5 — *Test for ethyl mercaptan odorant in propane, field method*

2.1.1 Contact information

The above may be obtained from the Canadian General Standards Board. Telephone: 1-800-665-2472. Email: ncr.cgsb-ongc@tpsgc-pwgsc.gc.ca. Web site: https://www.tpsgc-pwgsc.gc.ca/ongc-cgsb/index-eng.html.

It may also be obtained from the Government of Canada Publications, Publishing and Depository Services, Public Services and Procurement Canada. Telephone: 1-800-622-6232. Web site: https://publications.gc.ca/site/eng/home.html.

2.2 CSA Group

CSA B149.1 — *Natural gas and propane installation code*

CSA B149.2 — *Propane storage and handling code*

2.2.1 Contact information

The above may be obtained from CSA Group. Telephone: 416-747-2496. Web site: https://www.csagroup.org.

2.3 ASTM International

Annual Book of ASTM Standards (see Annex A)

2.3.1 Contact information

The above may be obtained from ASTM International. Telephone: 1-877-909-2786. Web site: https://www.astm.org. It can also be obtained from the Standards Store by Accuris. Telephone: 1-800-447-2273. Web site: https://www.global.ihs.com.

2.4 GPA Midstream Association

RR-129 — *Human Response Research Evaluation of Alternate Odorants for LP-Gas*

GPA 2140 — *Liquefied Petroleum Gas Specifications and Test Methods*

2.4.1 Contact information

The above may be obtained from GPA Midstream Association. Telephone: 918-493-3872. Email: news@gpamidstream.org. Web site: https://gpamidstream.org.

2.5 U.S. Department of Commerce

BERC/RI-77/1 — *A New Look at Odorization Levels for Propane Gas*

2.5.1 Contact information

The above may be obtained from U.S. Department of Commerce. Telephone: 202-482-2000. Email: webmaster@doc.gov. Web site: https://www.commerce.gov.

3 Terms and definitions

For the purposes of this National Standard of Canada, the following terms and definitions apply.

closed-loop side-stream sampler
a sample line connected to a storage tank or pipeline capable of extracting a sample and reinjecting any excess back into the product being sampled or elsewhere in the process.

LPG, LP gas or liquefied petroleum gas
mixtures consisting predominantly of hydrocarbons containing three or four carbon atoms, such as propane and butane.

propane
fuel conforming to the requirements of this standard or, when specifically indicated, the hydrocarbon C_3H_8.

proportional sample
a sample made by combining samples in volumetric proportion.

recirculation loop
piping and a transfer pump configured into a loop and used to mix the propane in a storage tank by recirculating it from one part of the tank to another.

volume weighted average
arithmetic average of results for samples taken from different batches or pipe flow for a specified time. The results are weighted to account for the volumes of the batches or total flow during the time period.

4 Classification

4.1 The propane shall be supplied in the following grades, as specified (see 8.1).

4.1.1 Grades

Grade 1;

Grade 2.

5 General requirements

5.1 The propane shall be predominantly the hydrocarbon propane (Grade 1) or shall be predominantly a mixture of the hydrocarbons propane and propene (Grade 2).

5.2 Additives may be utilized if usage of the desired dosage of the additive in propane does not increase the residual matter beyond the allowable limit (see 6.10, 8.2 a) and 9.6).

5.3 Odorization

Propane shall be odorized prior to its sale as a fuel to allow detection in the atmosphere at concentrations above one fifth of the lower explosive limit of propane in air (see 6.12, E.2, F.1 and F.2).

6 Detailed requirements

6.1 The propane shall comply with the specified limiting values (see 6.5 to 6.12). The specified limiting values shall not be changed. This precludes any allowances for the test method precision and for adding or subtracting digits.

6.1.1 To determine conformance with the specified limiting values, an observed value or a calculated value shall be rounded off "to the nearest unit" in the last right-hand digit used in expressing the specified limiting value, in accordance with the rounding-off method of ASTM E29.

6.1.2 Where test values differ between two parties, a resolution shall be in accordance with ASTM D3244 in order to determine conformance with the specified limiting values, with the criticality of the limits set at $P = 0.5$.

6.1.3 Zeroes trailing the last nonzero digit for numbers represented with a decimal point are significant digits, in accordance with ASTM E29.

6.2 Test methods other than those referenced in this standard may be used only if they have been validated in accordance with ASTM D3764 or D6708. These are referred to as validated test methods.

6.2.1 Differences in precision, sensitivity and bias between test methods referenced in the standard and the validated test methods shall be noted.

6.2.2 Validated test methods shall be used only within the bounds of the data covered in their validation.

6.3 In the event of a dispute, the procedures given in 6.1.1 to 6.1.3 shall be used.

6.3.1 If parties in a dispute cannot agree on an analytical method to resolve the dispute, the method listed in the standard shall be used. Where more than one method is listed for a given detailed requirement, the referee method shall be used.

6.4 Differences in precision, sensitivity and bias between the referee test methods and others referenced in the standard shall be considered.

6.4.1 Specific requirements are provided for hydrocarbon composition, sulphur and moisture content test methods (see Annexes B, C and D).

Table 1 – Specified limiting values

	Property	Specified limiting values				Test method
		Grade 1		Grade 2		
		Min.	Max.	Min.	Max.	
6.5	Composition[a], liquid, % by volume	—	—	—	—	ASTM D2163 CAN/CGSB-3.0 No. 14.3[b] (See Annex B)
	Propane (C_3H_8)	90.	—	—	—	—
	Propene (propylene)	—	5.0	see 8.2 b)		—

	Property	Specified limiting values				Test method
		Grade 1		Grade 2		
		Min.	Max.	Min.	Max.	
	Butane and heavier hydrocarbons[c]	—	2.5	—	2.5	—
6.6	Copper strip corrosion[d], 1 h at 37.8 °C	—	No. 1	—	No. 1	ASTM D1838
6.7	Hydrogen sulphide, one of the following:	—				
6.7.1	Lead acetate	Negative		Negative		ASTM D2420[b]
6.7.2	Gas chromatography / chemiluminescence, mg/kg	—	1.5	—	1.5	ASTM D5504 ASTM D5623 (See Annex C)
6.8	Sulphur[e], mg/kg (see F.7)	—	123	—	185	ASTM D4468 ASTM D5623 ASTM D5504 ASTM D6667[b] (See Annex C)
6.9	Vapour pressure at 37.8 °C, kPa	—	1435	—	1435	ASTM D1267[b] ASTM D2598[f] ASTM D6897
6.10	Residual matter, one of the following shall be met:	—				
6.10.1	Evaporation, mL/100 mL and	—	0.05	—	0.05	ASTM D2158[b]
	Oil stain, using 0.3 mL of solvent-residue mixture	Pass		Pass		
6.10.2	Residue by gas chromatography, mg/kg	—	350	—	350	ASTM D7756
6.11	Moisture content (see 9.9), one of the following:	—				
6.11.1	Dew point, °C	—	-25	—	-25	ASTM D1142 ASTM D5454 (See Annex D)
6.11.2	Valve freeze, 60 s	Pass		Pass		ASTM D2713[b]

	Property	Specified limiting values				Test method
		Grade 1		Grade 2		
		Min.	Max.	Min.	Max.	
6.12	Odorant (see 5.3)[g, h]:					—
	Ethyl mercaptan[i], mg/L	14	30	14	30	

[a] The Grade 1 composition limits equate to a minimum motor octane number of approximately 95 by the LPG motor method ASTM D2623-86, which was withdrawn in 1989.

[b] Referee method to be used in the event of a dispute.

[c] "Butane and heavier hydrocarbons" refers to all hydrocarbons with four or more carbon atoms.

[d] This method may not accurately determine the presence of reactive materials (e.g., H_2S or elemental sulphur) in propane if the product contains corrosion inhibitors or other components that diminish the reaction with the copper strip.

[e] The sulphur content shall include the contribution from the odorant. The total sulphur for a batch of odorized propane may be determined by adding the calculated sulphur contribution from odorant, based on the odorant addition rate, to the sulphur measured on the batch of propane at point of manufacture, prior to odorization. The increase in sulphur associated with ethyl mercaptan addition at the minimum specified level is 14.4 mg/kg.

[f] This method calculates vapour pressure from hydrocarbon composition and can underestimate the total pressure if inert gases (e.g., nitrogen, carbon dioxide) are present.

[g] See Annex F for more information on odorant addition. Odorant type and concentration specified in 6.12 meet the requirement of 5.3, based on the U.S. Department of Energy research report BERC/RI-77/1 and confirmed in subsequent studies, as reported in GPA Midstream Association RR-129.

[h] Only the concentration of the listed odorant (i.e., ethyl mercaptan) shall be counted when calculating the amount of odorant required to meet the standard.

[i] When reporting this parameter, metered (measured) volumes may be used in place of analytical tests when the component is added. Ethyl mercaptan odorant concentration may be verified during storage and distribution with stain tube field tests that are described in CAN/CGSB-3.0 No. 18.5. Analytical methods (see Annex C) may also be used.

7 Inspection[1]

7.1 Sampling

7.1.1 Sampling equipment and procedures shall be designed and used to obtain representative samples of the product and for preserving the integrity of the sample for the test being performed. Sampling equipment, lines, hoses, etc. should be adequately flushed prior to taking a sample.

7.1.2 A minimum sample size of 300 mL shall be taken for testing purposes by the testing laboratory, unless otherwise specified [see 8.2 c)].

7.1.3 Samples for laboratory testing shall be obtained in accordance with ASTM D1265 (common 20% ullage, high-pressure sampling cylinders) or ASTM D3700 (floating piston, constant pressure cylinders).

[1] See ASTM D6849 to obtain guidance on procedures for the storage and use of propane in 18 L (20 lb) cylinders for quality control testing of propane.

7.1.4 Liquid-filled pressure-vented cylinders may also be acceptable for use (see Annex F, F.3). Suitable safety precautions shall be taken to protect against any sample temperature increase (which could result in thermal expansion leading to liquid hydraulic "lock" and explosion) and uncontrolled venting. This provision is intended for sampling in hazardous locations or where sample toxicity precludes venting and when the analysis will be performed immediately after sampling. Liquid-filled pressure vessels shall not be used for sample storage or transport.

7.1.5 Inert sample containers should be used for trace analysis of reactive sulphur components (e.g., H_2S) and water that can undergo reaction or adsorption with steel containers prior to analysis. Polymer-coated (e.g., fluorocarbon or epoxy-based coatings) or silica-coated steel cylinders and uncoated aluminum cylinders have been successfully used for this purpose. Cylinders should be cleaned after each use.[2]

Note: Water-washing or steam-cleaning steel cylinders prior to sample collection can result in significant levels of adsorbed water contaminating the sample.

7.1.6 Closed-loop side-stream samplers designed to minimize volatile light-end losses during sampling may be used. The sample system shall be connected to on-line analyzers or sample collection systems in a manner that ensures sample integrity is maintained for the test(s) being performed.

7.1.7 Samples may be taken from tank recirculation loops provided that the recirculation time and flow rate were sufficient to effect complete mixing of the product in the tank.

7.1.8 Results from on-line sampling may be obtained either as volumetric weighted averages of multiple determinations or as single determinations on volumetric proportional samples.

8 Options

8.1 The following option shall be specified in the application of this standard:

a) Grade (see 4.1).

8.2 The following options may be specified:

a) Addition and concentration of additives (see 5.2 and 9.6);

b) Propene content for Grade 2 (see 6.5);

c) Sample volume, if different than 300 mL (see 7.1.2).

9 Precautionary notes

9.1 See Annex F for additional precautions and warning statements on propane.

9.2 Propane is colourless and without odorant can have low odour, making a leak hard to detect.

9.3 Propane vapour is heavier than air and initially tends to settle and accumulate in low points and cavities. Subsequent diffusion or convection can distribute propane vapour throughout an area.

9.4 A propane spill can create localized gas pockets that increase the risk of an ensuing fire or explosion.

9.5 Propane is stored under pressure as a liquid. Storage and handling requirements are detailed in CSA B149.2. Installation requirements are detailed in CSA B149.1.

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[2] The following cylinder cleaning method has been successfully used: An equal mixture of acetone and toluene is poured into the cylinder, the valves closed and the cylinder shaken for approximately 30 s and then emptied. This is followed by an identical procedure using acetone. The cylinder is then dried by purging with clean, dry air or nitrogen.

9.6 Additives and other compounds boiling above about 200 °C can accumulate in vaporizing systems and interfere with proper equipment operation. In vaporizing systems operating at elevated temperatures, additives and compounds boiling above 350 °C have been shown to lead to deposit formation[3]. See Annex F, F.5.3 for additional information.

9.7 Contact with liquid propane can cause freezing “burns” or frostbite to skin and eyes. Use appropriate personal protective equipment (PPE).

9.8 Trace levels of carbonyl sulphide (COS) can be present in propane. While COS in propane is not itself corrosive towards copper, it can hydrolyze and react to produce H_2S, which is corrosive. Higher concentrations of COS can be tolerated in propane because the rate of conversion to H_2S is normally low. However, traces of free water, methanol, caustic, other sulphur species often found in commercial propane, and catalytically active surfaces can, under some conditions, increase the rate of conversion considerably. There have been reports from industry that propane has become corrosive towards copper during storage, distribution or use, especially after different batches of propane containing different reactive sulphur species were mixed. Propane containing less than 50 parts per million (ppm) COS is believed to present a very low risk of developing corrosivity towards copper. Propane containing greater than 100 ppm COS presents a greater risk under typical commercial circumstances. COS can be determined in propane by various gas chromatographic analytical test methods such as ASTM D5504 and D5623.

9.9 Use of methyl alcohol (methanol) to prevent freezing

Propane that meets the moisture content requirement in 6.11 should be sub-saturated with water at most ambient temperatures. This level of moisture content control should be maintained during storage and distribution. An anti-freeze additive such as methyl alcohol (methanol) should not routinely be used to pass the moisture content requirement.

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 an effective solution. The presence of methyl alcohol can prevent separated water from freezing and can allow use of propane containing excessive dissolved water in many 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. Excessive methanol addition has been suspected of causing elastomer degradation, leading to increased residues and operating issues.

An anti-freeze additive such as methyl alcohol should not be added to propane without specific agreement and approval of the purchaser.

9.10 Contamination of propane with halogen-containing compounds (e.g., refrigerants, contaminants from hydrofluoric acid (HF) alkylation or salt dryers) can yield noxious, corrosive combustion products. If suspected, ASTM D7994 can be used to test for their presence.

9.11 Ammonia contamination in propane, which can occur during distribution, is a serious safety risk. See Annex F, F.6 for additional information.

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[3] Southwest Research Institute Final Report to the Propane Education & Research Council (PERC), *Investigation of Fuel System Technologies and Fuel Composition Effects on the Ability of Propane Forklifts to Meet 2007 EPA Emission Standards*, July 2006.

Annex A
(normative)

Referenced ASTM International publications (see 2.3)

Annual Book of ASTM Standards

ASTM D1142 Standard Test Method for Water Vapor Content of Gaseous Fuels by Measurement of Dew-Point Temperature

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

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

ASTM D1838 Standard Test Method for Copper Strip Corrosion by Liquefied Petroleum (LP) Gases

ASTM D2158 Standard Test Method for Residues in Liquefied Petroleum (LP) Gases

ASTM D2163 Standard Test Method for Determination of Hydrocarbons in Liquefied Petroleum (LP) Gases and Propane/Propene Mixtures by Gas Chromatography

ASTM D2420 Standard Test Method for Hydrogen Sulfide in Liquefied Petroleum (LP) Gases (Lead Acetate Method)

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

ASTM D2623-86 Method for Knock Characteristics of Liquefied Petroleum (LP) Gases by the Motor (LP) Method (Withdrawn 1989)

ASTM D2713 Standard Test Method for Dryness of Propane (Valve Freeze Method)

ASTM D3244 Standard Practice for Utilization of Test Data to Determine Conformance with Specifications

ASTM D3700 Standard Practice for Obtaining LPG Samples Using a Floating Piston Cylinder

ASTM D3764 Standard Practice for Validation of the Performance of Process Stream Analyzer Systems

ASTM D4468 Standard Test Method for Total Sulfur in Gaseous Fuels by Hydrogenolysis and Rateometric Colorimetry

ASTM D5454 Standard Test Method for Water Vapor Content of Gaseous Fuels Using Electronic Moisture Analyzers

ASTM D5504 Standard Test Method for Determination of Sulfur Compounds in Natural Gas and Gaseous Fuels by Gas Chromatography and Chemiluminescence

ASTM D5623 Standard Test Method for Sulfur Compounds in Light Petroleum Liquids by Gas Chromatography and Sulfur Selective Detection

ASTM D6667 Standard Test Method for Determination of Total Volatile Sulfur in Gaseous Hydrocarbons and Liquefied Petroleum Gases by Ultraviolet Fluorescence

ASTM D6708 Standard Practice for Statistical Assessment and Improvement of Expected Agreement Between Two Test Methods that Purport to Measure the Same Property of a Material

ASTM D6849 Standard Practice for Storage and Use of Liquefied Petroleum Gases (LPG) in Sample Cylinders for LPG Test Methods

ASTM D6897 Standard Test Method for Vapor Pressure of Liquefied Petroleum Gases (LPG) (Expansion Method)

ASTM D7756 Standard Test Method for Residues in Liquefied Petroleum (LP) Gases by Gas Chromatography with Liquid, On-Column Injection

ASTM D7994 Standard Test Method for Total Fluorine, Chlorine, and Sulfur in Liquid Petroleum Gas (LPG) by Oxidative Pyrohydrolytic Combustion Followed by Ion Chromatography Detection (Combustion Ion Chromatography- CIC)

ASTM E29 Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

Annex B
(normative)

Application of gas chromatography test methods in the standard (ASTM D2163 and CAN/CGSB-3.0 No. 14.3)

B.1 Gas Chromatography (GC) methods for testing against the standard should baseline-resolve[4] C_3 and C_4 saturates and mono-olefin components, and detect components up to C_7 to the nearest 0.1% by volume. Direct liquid injection is preferred over gas injection to enable measurement of higher molecular weight (non-volatile) components if present. Methods using Flame Ionization Detectors (FID) may use theoretical Relative Response Factors (RRF) based on the methane standard, and calculation methods according to CAN/CGSB-3.0 No. 14.3. Methods using other detectors may be cross validated with a GC-FID method using the methane standard RRFs or a calibrant mixture according to the procedures outlined in ASTM D2163. Molecular separation or GC baseline resolution is not required for methods with deconvolution capabilities provided that the responses are proportional to those obtained with the above GC-FID methods. On-line versions of these methods are acceptable provided that the requirements of 6.2 and 7.1 are met.

[4] See ASTM D2163.

Annex C
(normative)

Application of sulphur test methods in the standard (ASTM D4468, D5504, D5623 and D6667)

C.1 Commercially available equipment used for determining sulphur in natural gas, such as ASTM D4468 (rateometric) and D5504 (GC/chemiluminescence), may be used with calibration against reference materials to determine the total sulphur, hydrogen sulphide, carbonyl sulphide and/or the ethyl mercaptan content of propane. Direct liquid injection is preferred over gas injection to enable measurement of higher molecular weight (less volatile) components if present. ASTM D5623 does not have applicable precision data for propane. Users are cautioned to develop their own supporting data for correlation with the referee test method, ASTM D6667.

Annex D
(normative)

Application of moisture content test methods in the standard (ASTM D1142, D2713 and D5454)

D.1 No precision data are available for ASTM D2713 (valve freeze) because it is a pass/fail test. Therefore, 6.2 cannot be invoked to allow the validation of other methods.

D.2 No precision data are available for ASTM D1142 (chilled-mirror dew point) or for ASTM D5454 (electronic moisture analyzers). Electronic hygrometers (moisture analyzers, dew-point meters, etc.) are acceptable alternative test methods provided that validation is demonstrated using a reference material, or by performing a two-point calibration using “zero” and the concentration of water at saturation in propane. The intent is to enable operators to verify proper instrument operation during normal application.

Annex E
(informative)

Federal and provincial regulations applicable to propane[5, 6, 7]

E.1 Federal regulations

E.1.1 *Transportation of Dangerous Goods Regulations*

These regulations give detailed packaging, labelling and documentation requirements for transporting dangerous goods, including propane samples, within Canada.

E.2 Provincial regulations

E.2.1 CSA B149.1 — *Natural Gas and Propane Installation Code*[8]

CSA B149.2 — *Propane Storage and Handling Code*[8]

E.2.1.1 The odorization of propane for fuel purposes is a legal requirement in all Canadian jurisdictions, with each province and territory in Canada referencing a version of CSA B149.1 or CSA B149.2 in gas safety, building codes or related regulations. The appropriate provincial or territorial regulator should be consulted regarding current and relevant regulations to ensure compliance.

E.2.1.2 CSA B149.2 requires that propane distributed **for fuel purposes** be odorized in accordance with this standard.

E.2.1.3 CSA B149.2 exempts odorant in propane at petroleum refineries, pipelines, pipeline or marine terminals, refrigerated or underground storage facilities and propane when used as a feedstock in chemical plants.

E.2.1.4 CSA B149.2 requires that persons transferring propane from one container to another hold a pressure-vessel certificate recognized by a jurisdictional authority.

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[5] The regulations listed are subject to revision by the relevant authority. The user should consult the relevant authority to confirm the current regulations. The information provided about the regulations is for information only. In case of conflict, the text of the regulation takes precedence.

[6] The requirements in jurisdictions other than those listed above will be added as information becomes available in future revisions or amendments to this standard.

[7] Federal Acts and Regulations may be obtained from the Department of Justice Canada, Communications Branch. Web site: https://laws-lois.justice.gc.ca/eng/. If this Web site becomes inoperative, the Canadian Legal Information Institute Web site at https://www.canlii.org/en/ may also be useful.

[8] These publications may be obtained from CSA Group (see 2.2.1).

Annex F
(informative)

Additional precautions and warning statements

F.1 Odorants

F.1.1 Odorants are not always effective as warning agents. The odorants are polar or chemically reactive or both, and can be depleted by reaction or adsorption. People differ in their ability to smell, and the sensitivity to odours generally decreases with age or with impaired physical conditions, such as colds or respiratory allergies. Prolonged exposure to odorants can cause olfactory desensitization. Other odours or distractions can reduce the effectiveness of odorants as warning agents.

F.1.2 Technical grade odorants are typically 95% pure and can contain solvents, diluents and markers. Any components added to odorants should not be deleterious to either the end use of the propane or to the effectiveness of the odorant.

F.2 Metering odorants

F.2.1 Metered injection systems are recommended for the odorization of propane. Odorant may be added by mass or volume, and the metered amounts may be used for reporting the amount of odorant and sulphur added.

F.2.2 Note that the thermal expansion coefficient of propane is larger than that of the specified odorant. Injector systems that operate on volume-to-volume ratios calibrated at 15 °C will over-inject by about 7% at -40 °C and under-inject by about 2.5% at 30 °C. A suitable offset may be required to assure conformance with the standard if calibration is done at lower temperatures or if injection occurs at a temperature very different from the calibration temperature.

F.3 Transportation of dangerous goods (TDG)

F.3.1 For the transportation of propane samples between Canada and another country, both Canadian and international regulations can apply.

F.3.2 Liquid-filled pressure-vented cylinders (cylinders equipped with a pressure-relief valve, with or without a 20%-ullage tube, and filled to capacity with liquid propane) may only be used within production facilities and for local transport between production facilities as allowed by jurisdictional authorities. Liquid-filled pressure-vented cylinders are not acceptable for transportation by common carrier because of the possibility of venting from thermal expansion.

Fill densities should be established for road, marine or air transport using one of the following:

— a 20%-ullage tube, also called a “dip tube” (see ASTM D1265);

— a floating piston position (see ASTM D3700);

— a mass (weight) (see ASTM D3700);

— other means specified in TDG regulations or by other transport jurisdictional authorities.

F.3.3 Consult the jurisdictional authority for pressure vessel certification requirements for propane sample cylinders (Transport Canada within Canada). There is no international approval process for pressure cylinders. Authorities in one jurisdiction may not approve cylinders approved by another jurisdiction. Cylinders require approval by all the jurisdictions in which they are used for transporting samples.

Cylinders approved by a jurisdictional authority under “equivalent safety” criteria are acceptable provided that they are used in accordance with the applicable permits or exemptions. For example, users may not subsequently alter valves or pressure-venting devices that are part of a permit or exemption. Periodic cylinder inspections may be required.

F.4 Asphyxiant and anaesthetic properties

F.4.1 Propane will displace air and can act as an asphyxiant. Lack of oxygen (hypoxia) can cause dizziness, headaches, diminished awareness, faulty judgment, increased fatigue, impaired muscular co-ordination progressing to convulsion, coma and death.

F.4.2 Propane is believed to be a central nervous system depressant (“anaesthetic gas”) at high (explosive) concentrations, and can cause such symptoms as light-headedness, dizziness, drunkenness, sleepiness or intoxication, which can impair a person’s judgment.

F.4.2.1 Any person working with propane or in close proximity to a propane source (filling cylinders, purging lines, lighting or adjusting pilot lights, investigating leaks, etc.) who feels these symptoms should go immediately to a safe location with fresh air. This “narcotic” or “intoxicating” effect is expected to be temporary and rapidly disappear in fresh air.

F.5 Residues in LPG systems

F.5.1 Naturally occurring radioactive materials (NORM)

Sludges and tank scale from propane storage tanks, trucks and rail cars, and filters and screens can contain NORM in the form of lead 210 (^{210}Pb). Equipment used for transferring propane, such as product pipelines, pumps and compressors, can also have detectable levels of radioactive ^{210}Pb on inner surfaces.

F.5.1.1 Workers involved in cleaning, repairing or other maintenance on inner surfaces of such equipment should avoid breathing dust generated from such activities. For example, protection can take the form of wearing a suitable mask or wetting work surfaces to eliminate dust.

F.5.2 Solid residues and magnetic residues (“Black deposits”)

F.5.2.1 Solid residues can physically block the operation of components such as regulators, mixers and pressure release valves.

F.5.2.2 Magnetic iron oxide and sulphide residues can occur from heat treating during tank manufacture (“mill scale”) or from corrosion. These residues can adversely impact the operation of magnetically operated components such as level gauges and electronic solenoid valves.

F.5.3 Oily and greasy residues

Non-volatile additives and soluble contaminants in propane used in vaporizing systems tend to accumulate at the point of vaporization as an oily residue or gum that can interfere with the proper and safe operation of some equipment. These contaminants, especially in greasy agglomerates with fine particulates, can interfere with the proper operation of safety lock-offs, overpressure vents and regulators. This usually occurs at the point in the system where chilling occurs because of the auto-refrigeration of vaporizing propane.

Certain higher boiling or polymeric materials can interfere with the catalytic elements of some heating equipment.

F.6 Ammonia contamination

F.6.1 Ammonia (NH_3) can cause stress corrosion cracking of brass valves and fittings when present at approximately 5 ppm or higher by volume in propane. Ammonia should not be present in propane, and therefore, it should not be necessary to test for its presence in production of propane batches. However, rail or truck tanks previously used to transport anhydrous ammonia can contaminate propane if they are not properly cleaned prior to being put into propane service.

F.6.2 When contamination by ammonia is suspected, the following test can be performed:

a) Arrange a stream of propane vapour in a safe location.

b) Holding a piece of red litmus paper with clean tweezers, wet it with distilled water.

c) With the tweezers, hold the wet litmus paper in the stream of propane vapour for 30 seconds.

d) The appearance of any blue colour on the litmus paper indicates that ammonia is present at a minimum concentration of 1 ppm to 2 ppm, and the propane is not recommended for use in normal propane fuel systems.

F.7 Use of propane in engines with emission control technology

The sulphur level of fuel conforming to this standard (see 6.8) may or may not be suitable for spark-ignition engines with emission control technology that includes catalysts.

Excessive sulphur levels will cause poisoning of the catalysts used in after-treatment systems and result in reduced conversion efficiency, which will increase exhaust emissions.