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Canadian General Standards Board
Office des normes générales du Canada

CAN/CGSB-3.14-2013

Supersedes CAN/CGSB-3.14-2006

Propane for Fuel Purposes

ICS 75.160.20

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NATIONAL STANDARD OF CANADA **CAN/CGSB-3.14-2013**

Supersedes CAN/CGSB-3.14-2006

PROPANE FOR FUEL PURPOSES

CETTE NORME NATIONALE DU CANADA EST DISPONIBLE EN VERSIONS FRANÇAISE ET ANGLAISE.

Prepared by the
Canadian General Standards Board CGSB

Approved by the
Standards Council of Canada

Published May 2013 by the
Canadian General Standards Board
Gatineau, Canada K1A 1G6

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Acknowledgment is made for the translation of this National Standard of Canada by the Translation Bureau of Public Works and Government Services Canada.

Supersedes CAN/CGSB-3.14-2006

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PROPANE FOR FUEL PURPOSES

1. SCOPE

1.1 This standard describes two grades of propane used only for fuel purposes. These grades consist mainly of C_3 compounds.

1.1.1 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 footnote 6).

Note: *The requirements for Grade 1 are derived from the GPA 2140 HD-5 specification.*

1.1.2 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 quality fuel is not required.

Note*: Propane was referred to as 'liquefied petroleum gas' or 'LPG' in prior editions of this standard. The terms 'LPG', 'LP Gas' and 'Liquefied Petroleum Gas' are used in North America to refer to various mixtures of C_3 and C_4 hydrocarbon compounds.*

1.2 Users of this standard are advised to take appropriate measures to address health and safety concerns related to the use and handling of propane (par. 8.2).

1.3 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. CGSB neither assumes nor accepts any responsibility for any injury or damage that may occur during or as the result of tests, wherever performed.

2. REFERENCED PUBLICATIONS

2.1 The following publications are referenced in this standard:

2.1.1 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 Hydrocarbon Components in Automotive Gasoline using Gas Chromatography

No. 18.5 — Test for Ethyl Mercaptan Odorant in Propane, Field Method.

2.1.2 Canadian Standards Association (CSA)

CAN/CSA-B149.2 — Propane Storage and Handling Code.

2.1.3 ASTM International

Annual Book of ASTM Standards (See Appendix A).

2.1.4 Gas Processors Association (GPA)

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

GPA 2140 — Liquefied Petroleum Gas Specifications and Test Methods.

2.1.5 U.S. Department of Commerce

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

2.2 A dated reference in this standard is to the issue specified. An undated reference in this standard is to the latest issue unless otherwise specified by the authority applying this standard. The sources are given in the Notes section.

3. TERMINOLOGY

The following definitions apply in this standard:

3.1 **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.

3.2 **Propane** — In this standard, propane refers to a blend of the chemical propane, C_3H_8, plus other hydrocarbons and naturally occurring non-hydrocarbons as allowed by the specified limiting values.

3.3 **Proportional Sample** — A sample made by combining samples in volumetric proportion.

3.4 **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.

3.5 **Volume Weighted Average** — The 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 (par. 8.1.1):

4.1.1 ***Grades***

Grade 1
Grade 2.

5. GENERAL REQUIREMENTS

5.1 Grade 1 consists essentially of the chemical propane (C_3H_8), and Grade 2 consists predominantly of a mixture of the chemicals propane and propene (C_3H_6). Grades 1 and 2 shall meet the compositional requirements specified in par. 6.3 to 6.11.

5.2 Non-volatile additives shall not be used in propane. However, volatile additives[1] may be specified (par. 8.1.2 a).

5.3 **Odorization** — Propane distributed for fuel purposes shall be odorized[2], [3], [4] (par. 6.10, Appendix E, section E2, and Appendix F, section F1) to allow detection in the atmosphere at concentrations above one fifth of the lower explosive limit of propane in air. In commercial situations, propane that will be used for chemical purposes and propane that is being moved to intermediate storage shall be odorized later if it is withdrawn for sale as a fuel.

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[1] *Corrosion inhibitors can be detrimental to some end uses of propane.*

[2] *The odorization requirement of propane used for **fuel purposes** is a legal requirement in all Canadian jurisdictions, with each province and territory in Canada referencing CAN/CSA-B149.1 or CAN/CSA-B149.2 in gas safety, building code or related regulations.*

[3] *In commerce, two situations commonly call for unodorized propane: propane that will be used for chemical purposes (usually within a refinery, as a feedstock) and propane that is being moved to intermediate storage (often in a cavern).*

[4] *The appropriate provincial or territorial regulator should be consulted.*

6. DETAILED REQUIREMENTS

6.1 The propane shall comply with the specified limiting values (par. 6.3 to 6.11). The specified limiting values shall not be changed. This precludes any allowances for the test method precision and adding or subtracting digits.

6.1.1 For the purpose of determining conformance with the specified limiting value, 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 $P = 0.5$.

6.2 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. Specific exemptions are provided for hydrocarbon composition, sulphur and dryness.

6.2.1 Differences in precision, sensitivity and bias between test methods referenced in the standard and the validated test methods shall be noted. See Appendices B to D.

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

6.2.3 In the event of a dispute, the procedures given in par. 6.1.1 and 6.1.2 shall be used. 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.

6.2.4 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.

		Specified Limiting Values				
	Property	**Grade 1**		**Grade 2**		**Test Method**
		Min.	**Max.**	**Min.**	**Max.**	
6.3	Composition,[5] liquid by volume, %					ASTM D2163 or CAN/CGSB 3.0 No. 14.3[8] (Appendix B)
	Propane	90	—	—	—	
	Propene (propylene)	—	5.0	(par. 8.1.2 b)		
	Butane and heavier hydrocarbons	—	2.5	—	2.5	
6.4	Copper strip corrosion,[6] 1 h at 37.8°C	No. 1		No. 1		ASTM D1838
6.5	Sulphur,[7] mg/kg (par. 6.11)	—	123	—	185	ASTM D2784[8] ASTM D4468 ASTM D5453 ASTM D5504 ASTM D6667[9] (Appendix C)
6.6	Vapour pressure at 37.8°C, kPa	—	1435	—	1435	ASTM D1267[8] ASTM D2598 ASTM D6897
6.7	Residual matter					ASTM D2158
	Evaporation, mL/100 mL	—	0.05	—	0.05	
	Oil stain, mL	0.3	—	0.3	—	
6.8	Hydrogen sulphide	Negative		Negative		ASTM D2420

	Property	Specified Limiting Values				Test Method
		Grade 1		Grade 2		
		Min.	Max.	Min.	Max.	
6.9	Dryness, [10] one of the following:					ASTM D1142 ASTM D2713[8] ASTM D5454 (Appendix D)
	Dew point, °C	—	-25	—	-25	
	Valve freeze, 60 s	Pass		Pass		
6.10	Odorant, one of the following (par. 5.3, Appendix E, section E2, and Appendix F, section F1)[11, 12]:					
	Ethyl mercaptan,[13] mg/L	14	30	14	30	
	Tetrahydrothiophene (thiophane), mg/L	75	—[7]	75	—[7]	

6.11 **Sulphur** — 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, the result of odorant addition at the minimum specified levels, is 14.4 mg/kg for ethyl mercaptan and 54.6 mg/kg for tetrahydrothiophene (thiophane).

7. INSPECTION

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 (par. 8.1.2 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). See the Appendix in ASTM D3700 for guidance on use of floating pistons or 20% ullage cylinders.

Note: *ASTM D3700 is particularly appropriate for specialized analysis of propane for trace and highly volatile components or dissolved gases.*

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[5] *The Grade 1 propene, butane and heavier hydrocarbons maximum limits cited equate to a minimum motor octane number of approximately 95 by the LPG motor method ASTM D2623-86. This ASTM standard was withdrawn in 1989.*

[6] *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 that diminish the reaction with the copper strip.*

[7] *The sulphur content shall include the contribution from the odorants.*

[8] *Referee method to be used in the event of dispute.*

[9] *ASTM D6667 may only be used to determine sulphur content in propane samples within the range defined in its scope.*

[10] *See par. 8.2.8,* The Use of Methyl Alcohol (Methanol) to Prevent Freezing.

[11] *See Appendix F for more information on odorant addition. Odorant types and quantities specified in par. 6.10 meet the requirement of par. 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 RR-129. The U.S. Department of Energy research report may be obtained from the U.S. Department of Commerce(par. 8.3.5) and the GPA RR-129 may be obtained from the Gas Processors Association (par. 8.3.4).*

[12] *Only the concentrations of the listed odorants, ethyl mercaptan and thiophane, shall be counted when calculating the amount of odorant required to meet the standard.*

[13] *Ethyl mercaptan odorant concentration can be verified during storage and distribution with stain tube field tests that are described in CAN/CGSB-3.0 No. 18.5.*

7.1.4 Liquid-filled pressure-vented cylinders may also be acceptable for use (see Appendix E). 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 may be used for trace analysis of reactive sulphur components (e.g. H_2S) that may undergo reaction with steel containers with prolonged storage prior to analysis. Polymer-coated (fluorocarbon, epoxy, etc.) or silica-coated steel cylinders have been successfully used for this purpose. Cylinders should be cleaned after each use.[14]

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. NOTES

8.1 Options

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

a. Grade (par. 4.1).

8.1.2 The following options may be specified if the buyer's requirements are more stringent than those stipulated in this standard:

a. Corrosion inhibitor or other volatile additives (par. 5.2)

b. Propene content for Grade 2 (par. 6.3)

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

8.2 Precautionary Notes

8.2.1 See Appendix F for additional precautions and warning statements on propane.

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

8.2.3 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.

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

8.2.5 Propane is stored under pressure as a liquid. Storage and handling requirements are detailed in CAN/CSA-B149.2.

8.2.6 Contact with liquid propane can cause freezing "burns" or frostbite to skin and eyes.

8.2.7 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 otherwise good quality propane because the rate of conversion to H_2S is normally low.

[14] *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 air or nitrogen.*

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 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.

8.2.8 ***The Use of Methyl Alcohol (Methanol) to Prevent Freezing —*** Grade 1 and Grade 2 propane should be produced to comply with the moisture content requirement in par. 6.9. An anti-freeze additive such as methyl alcohol (methanol) should not routinely be used to pass the dryness test requirement. Grades 1 and 2 propane should be so dry that they are sub-saturated with water at most ambient temperatures. They should be maintained dry during storage and distribution.

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.

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

8.3 **Sources of Referenced Publications**

The following addresses were valid at the date of publication.

8.3.1 The publications referred to in par. 2.1.1 may be obtained from the Canadian General Standards Board, Sales Centre, Gatineau, Canada K1A 1G6, telephone 819-956-0425 or 1-800-665-2472. Fax 819-956-5644. E-mail ncr.cgsb-ongc@pwgsc.gc.ca, Web site www.ongc-cgsb.gc.ca.

8.3.2 The publication referred to in par. 2.1.2 may be obtained from the Canadian Standards Association, Sales, 5060 Spectrum Way, Suite 100, Mississauga, Ontario L4W 5N6, telephone 416-747-4044 or 1-800-463-6727. Fax 416-747-2510, e-mail sales@csa.ca, Web site www.csa.ca.

8.3.3 The publications referred to in par. 2.1.3 may be obtained from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, U.S.A., telephone 610-832-9585, fax 610-832-9555, Web site www.astm.org, or from IHS Global Canada Ltd., 200-1331 MacLeod Trail SE, Calgary T2G 0K3, telephone 613-237-4250 or 1-800-267-8220, fax 613-237-4251, Web site www.global.ihs.com.

8.3.4 The publications referred to in par. 2.1.4 may be obtained from the Gas Processors Association, 6526 E. 60th Street, Tulsa, OK 74145, U.S.A., telephone 918-493-3872, Web site www.gpaglobal.org

8.3.5 The publication referred to in par. 2.1.5 may be obtained from the U.S. Department of Commerce, National Technology Information Service, 5285 Port Royal Road, Springfield, Virginia 22161, U.S.A., telephone 703-605-6000, Web site www.ntis.gov.

(This appendix forms a mandatory part of the standard.)

REFERENCED ASTM PUBLICATIONS (par. 2.1.3)

Annual Book of ASTM Standards

D1142	Standard Test Method for Water Vapor Content of Gaseous Fuels by Measurement of Dew-Point Temperature
D1265	Standard Practice for Sampling Liquefied Petroleum (LP) Gases (Manual Method)
D1267	Standard Test Method for Gage Vapor Pressure of Liquefied Petroleum (LP) Gases (LP-Gas Method)
D1838	Standard Test Method for Copper Strip Corrosion by Liquefied Petroleum (LP) Gases
D2158	Standard Test Method for Residues in Liquefied Petroleum (LP) Gases
D2163	Standard Test Method for Determination of Hydrocarbons in Liquefied Petroleum (LP) Gases and Propane/ Propene Mixtures by Gas Chromatography
D2420	Standard Test Method for Hydrogen Sulfide in Liquefied Petroleum (LP) Gases (Lead Acetate Method)
D2598	Standard Practice for Calculation of Certain Physical Properties of Liquefied Petroleum (LP) Gases from Compositional Analysis
D2623-86	Method for Knock Characteristics of Liquefied Petroleum (LP) Gases by the Motor (LP) Method (Withdrawn 1989)[A1]
D2713	Standard Test Method for Dryness of Propane (Valve Freeze Method)
D2784	Standard Test Method for Sulfur in Liquefied Petroleum Gases (Oxy-Hydrogen Burner or Lamp)
D3244	Standard Practice for Utilization of Test Data to Determine Conformance with Specifications
D3700	Standard Practice for Obtaining LPG Samples Using a Floating Piston Cylinder
D3764	Standard Practice for Validation of Process Stream Analyzer Systems
D4468	Standard Test Method for Total Sulfur in Gaseous Fuels by Hydrogenolysis and Rateometric Colorimetry
D5453	Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Motor Fuels and Oils by Ultraviolet Fluorescence
D5454	Standard Test Method for Water Vapor Content of Gaseous Fuels Using Electronic Moisture Analyzers
D5504	Standard Test Method for Determination of Sulfur Compounds in Natural Gas and Gaseous Fuels by Gas Chromatography and Chemiluminescence
D5623	Standard Test Method for Sulfur Compounds in Light Petroleum Liquids by Gas Chromatography and Sulfur Selective Detection
D6667	Standard Test Method for Determination of Total Volatile Sulfur in Gaseous Hydrocarbons and Liquefied Petroleum Gases by Ultraviolet Fluorescence
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

[A1] *This ASTM method is referenced in footnote 6 of par. 6.3.*

D6849	Standard Practice for Storage and Use of Liquefied Petroleum Gases (LPG) in Sample Cylinders for LPG Test Methods
D6897	Standard Test Method for Vapor Pressure of Liquefied Petroleum Gases (LPG) (Expansion Method)
E29	Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications.

(This appendix forms a mandatory part of the standard.)

APPLICATION OF GAS CHROMATOGRAPHY TEST METHODS IN THE STANDARD (ASTM D2163 AND CAN/CGSB-3.0 No. 14.3)

B1. ASTM D2163 was originally written as a packed column, thermal conductivity Gas Chromatography (GC) method and was updated by ASTM International in 2007 to incorporate modern GC instrumentation and calibration procedures.

B2. Few laboratories currently use packed GC columns or the sampling method (ASTM D3700) that was referenced in ASTM D2163 prior to the 2007 revision. This standard and ASTM D2163 allow the use of ASTM D1265 for sampling.

B3. ASTM D2163 allows the use of "equivalent" columns and detectors. An interlaboratory study was initiated in 2010 under the auspices of ASTM International to develop precision data using updated GC instruments and capillary columns. This interlaboratory study is still underway as of April 2012.

B4. GC methods for testing against the standard should baseline-resolve[B1] 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 discriminate higher molecular weight (non-volatile) components. 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 using mass selective detectors provided that the responses are equivalent to those obtained with the above GC- FID methods. On-line versions of these methods are acceptable provided that the requirements of par. 6.2 and 7.1 are met.

[B1] *See ASTM D2163.*

(This appendix forms a mandatory part of the standard.)

APPLICATION OF SULPHUR TEST METHODS IN THE STANDARD (ASTM D2784, D4468, D5453, D5504 AND D6667)

C1. No precision data are available for ASTM D2784 (Oxy-Hydrogen Burner or Lamp Method). Few laboratories are equipped to determine sulphur content by the ASTM D2784 lamp method.

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 sulphur content of propane. Direct liquid injection is preferred over gas injection to avoid discrimination of higher molecular weight (less volatile) components if present. No precision data concerning sulphur detection in propane currently exists for any of these methods.

ASTM D6667 may only be used to determine sulphur content in propane samples within the range defined in its scope.

(This appendix forms a mandatory part of the standard.)

APPLICATION OF DRYNESS TEST METHODS IN THE STANDARD (ASTM D1142, D2713 AND D5454)

D1. No precision data are available for ASTM D2713 (valve freeze) because it is a pass/fail test. Therefore, par. 6.2 cannot be invoked to allow the validation of other methods.

D2. 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.

(This appendix does not form a mandatory part of the standard.)

FEDERAL AND PROVINCIAL REGULATIONS APPLICABLE TO PROPANE [E1, E2, E3]

E1. FEDERAL REGULATIONS

E1.1 ***Transportation of Dangerous Goods Regulations*** [E4]— These regulations give detailed packaging, labelling and documentation requirements for transporting dangerous goods, including propane samples, within Canada.

E2. PROVINCIAL REGULATIONS

E2.1 **CAN/CSA-B149.1 — Natural Gas and Propane Installation Code** [E5]

CAN/CSA-B149.2 — Propane Storage and Handling Code [E5]

E2.1.1 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 CAN/CSA-B149.1 or CAN/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.

E2.1.2 CAN/CSA-B149.2 requires that propane distributed **for fuel purposes** shall be odorized in accordance with this standard.

E2.1.3 CAN/CSA-B149.2 exempts petroleum refineries, pipelines, pipeline or marine terminals, refrigerated or underground storage facilities and propane when used as a feedstock in chemical plants.

E2.1.4 CAN/CSA-B149.2 requires that persons transferring propane from one container to another hold a pressure-vessel certificate recognized by a jurisdictional authority.

[E1] *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.*

[E2] *The requirements in jurisdictions other than those listed above will be added as information becomes available in future revisions or amendments to this standard.*

[E3] *Federal Acts and Regulations may be obtained from the Department of Justice Canada, Communications Branch, Web site http://laws-lois.justice.gc.ca/eng/index.html. If this Web site becomes inoperative, the Canadian Legal Information Institute Web site at www.canlii.com may also be useful.*

[E4] *Available from Canadian Government Publishing, Public Works and Government Services Canada, Ottawa, Ontario K1A 0S5, Canada, telephone 1-800-635-7943 (North America only) or 613-941-5995, fax 1-800-565-7757 (Canada only) or 613-954-5779. The Regulations are also available on-line from Transport Canada's Web site at www.tc.gc.ca*

[E5] *This publication may be obtained from the Canadian Standards Association (par. 8.3.2).*

(This appendix does not form a mandatory part of the standard.)

ADDITIONAL PRECAUTIONS AND WARNING STATEMENTS

F1. ODORANTS

F1.1 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.

F1.2 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.

F2. TRANSPORTATION OF DANGEROUS GOODS

F2.1 For the transportation of propane samples between Canada and another country, both Canadian and international regulations can apply.

F2.2 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.

F2.3 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.

F2.4 Consult the jurisdictional authority for pressure vessel certification requirements for propane sample cylinders (Transport Canada within Canada). At present 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.

F3. METERING ODORANTS

F3.1 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.

F3.2 Note that the thermal expansion coefficient of propane is larger than that of the specified odorants. 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.

F4. ASPHYXIANT AND ANAESTHETIC PROPERTIES

F4.1 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.

F4.2 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.

F4.2.1 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 temporary and will rapidly disappear in fresh air.

F5. SOLID RESIDUES IN LPG SYSTEMS

F5.1 **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.

F5.1.1 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.

F5.2 **Solid Residues and Magnetic Residues ("Black Deposits")** — Solid residues can physically block the operation of components such as regulators, mixers and pressure release valves.

F5.2.1 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.

F5.3 **Organic Residues** — Non-volatile additives and soluble contaminants in propane used in vaporizing systems tend to accumulate at the point of vaporization as a residue or gum that can interfere with the proper and safe operation of some equipment. These contaminants, especially in association 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.

F6. AMMONIA CONTAMINATION

F6.1 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.

F6.2 When contamination by ammonia is suspected, GPA 2187[F1] or NPGA 151[F2] can be used to check the propane batch.

[F1] *GPA 2187* — Tentative Method for the Determination of Ammonia in Liquid Propane. *This publication may be obtained from the Gas Processors Association (par. 8.3.4).*

[F2] *NPGA 151*— Suggested Field Tests for Contamination of Propane. *This publication may be obtained from the National Propane Gas Association, 1150 17th Street N.W., Suite 310, Washington, D.C. 20036-4623, U.S.A., telephone (202) 466-7200, Web site www.npga.org.*