



Government
of Canada

Gouvernement
du Canada

Canadian General
Standards Board

Office des normes
générales du Canada

CAN/CGSB-3.516-2017

Amendment No. 1, July 2020



Denatured fuel ethanol for use in automotive spark-ignition fuels

Canadian General Standards Board **CGSB**



Standards Council of Canada
Conseil canadien des normes

Canada

Experience and excellence

Expérience et excellence



ONGC

Canadian General Standards Board statement

The CANADIAN GENERAL STANDARDS BOARD (CGSB), under whose auspices this standard has been developed, is a government directorate within Public Services and Procurement Canada. CGSB is engaged in the production of voluntary standards in a wide range of subject areas through the media of standards committees and the consensus process. The standards committees are composed of representatives of relevant interests including producers, consumers and other users, retailers, governments, educational institutions, technical, professional and trade societies, and research and testing organizations. Any given standard is developed on the consensus of views expressed by such representatives.

CGSB has been accredited by the Standards Council of Canada as a national Standards Development Organization. The standards that CGSB develops and offers as National Standards of Canada conform to the requirements and guidance established for this purpose by the Standards Council of Canada. In addition to standards it publishes as National Standards of Canada, CGSB produces standards to meet particular needs, in response to requests from a variety of sources in both the public and private sectors. Both CGSB standards and CGSB national standards are developed in conformance with the policies described in the CGSB Policy and Procedures Manual for the Development and Maintenance of Standards.

CGSB standards are subject to review and revision to ensure that they keep abreast of technological progress. CGSB will review and publish this standard on a schedule not to exceed five years from the date of publication. Suggestions for their improvement, which are always welcome, should be brought to the notice of the standards committees concerned. Changes to standards are issued either as separate amendment sheets, amended standards or in new editions of standards.

An up-to-date listing of CGSB standards, including details on latest issues and amendments, is found in the CGSB Catalogue at our Web site — <http://www.tpsgc-pwgsc.gc.ca/ongc-cgsb/index-eng.html> along with more information about CGSB products and services.

Although the intended primary application of this standard is stated in its scope, it is important to note that it remains the responsibility of the users of the standard to judge its suitability for their particular purpose.

The testing and evaluation of a product or service 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.

Attention is drawn to the possibility that some of the elements of this standard may be the subject of patent rights. CGSB shall not be held responsible for identifying any or all such patent rights. Users of this standard are expressly advised that determination of the validity of any such patent rights is entirely their own responsibility.

In this standard, “shall” states a mandatory requirement, “should” expresses a recommendation and “may” is used to express an option or that which is permissible within the limits of this standard. Notes accompanying clauses do not include requirements or alternative requirements; the purpose of a note accompanying a clause is to separate from the text explanatory or informative material. Annexes are designated normative (mandatory) or informative (non-mandatory) to define their application.

For enforcement purposes, standards shall be considered published the final day of the month of their publication date.

Contact the Canadian General Standards Board

To obtain information on CGSB, its services and standards or to obtain CGSB publications, please contact:

- web — <http://www.tpsgc-pwgsc.gc.ca/ongc-cgsb/index-eng.html>
- e-mail — ncr.cgsb-ongc@tpsgc-pwgsc.gc.ca
- telephone — 1-800-665-2472
- mail — Canadian General Standards Board
Gatineau, Canada
K1A 1G6

Standards Council of Canada statement

A National Standard of Canada is a standard developed by a Standards Council of Canada (SCC) accredited Standards Development Organization, in compliance with requirements and guidance set out by SCC. More information on National Standards of Canada can be found at www.scc.ca.

SCC is a Crown corporation within the portfolio of Innovation, Science and Economic Development (ISED) Canada. With the goal of enhancing Canada’s economic competitiveness and social well-being, SCC leads and facilitates the development and use of national and international standards. SCC also coordinates Canadian participation in standards development, and identifies strategies to advance Canadian standardization efforts.

Accreditation services are provided by SCC to various customers, including product certifiers, testing laboratories, and standards development organizations. A list of SCC programs and accredited bodies is publicly available at www.scc.ca.

NATIONAL STANDARD OF CANADA

CAN/CGSB-3.516-2017

Amendment No. 1, July 2020

Denatured fuel ethanol for use in automotive spark-ignition fuels

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

ICS 75.160.20

Published March 2017 by the
Canadian General Standards Board
Gatineau (Quebec) Canada K1A 1G6

© HER MAJESTY THE QUEEN IN RIGHT OF CANADA,
as represented by the Minister of Public Services and Procurement,
the Minister responsible for the Canadian General Standards Board (2020).

No part of this publication may be reproduced in any form without the prior permission of the publisher.

CANADIAN GENERAL STANDARDS BOARD

Committee on Gasoline and Alternative Automotive Fuels

(Voting membership at date of approval)

Chair (Voting, General interest)

Andrew Pickard Consultant (Independent)

General interest category

Aurelian Hanganu	Bureau Veritas
Bradley Saville	Savant Technical Consulting
Dan Wispinski	VUV Analytics
Devin O'Grady	Natural Resources Canada
Glen Maclean	Intertek Caleb Brett
Hannu Jääskeläinen	Consultant (Independent)
Jelena Whittington	Anton Paar
Jodi Johnston	InnoTech Alberta
Michael Bailey	Amspec Services Llc
Michael Chae	Consultant
Mike Pama	Certispec Services Inc.
Pierre Poitras	Fuel+Consulting
Tim Galvan	Compass Instruments

Producer category

Allison Hillmer	Co-op Refinery Complex
David Coelho	Afton Chemical Corporation
Denis Tétreault	Baker Hughes
Gandalf O'Breham	Shell Canada Limited
Greg Rockwell	Imperial Oil
Guy Chandler	Husky Energy
Herdis Adams	Archer Daniels Midland Company
Jean-François Samray	Quebec Association for the Production of Renewable Energy (AQPER)
Jody Kocsis	Lubrizol Canada Limited
Joe Stark	Innospec Inc.
Ken Mitchell	Consultant for Canadian Fuels Association
Kristin Moore	Advanced Biofuels Canada Association
Marie Pelletier	Valero Energy Inc.
Marie-Claude Raymond	Suncor Energy Products Partnership
Marissa Macagnone	BASF Corporation
Matt Levis	Irving Oil Limited
Ronald Gropp	Suez
Stu Porter	Renewable Industries Canada

Regulator category

Caroline De Foy	Gouvernement du Québec, Ministère de l'Énergie et des Ressources naturelles
Michael Rensing	Government of British Columbia, Ministry of Energy, Mines and Petroleum Resources
Prashant Reddy	Government of Alberta, Climate Change Office
Roop Dhaliwal	Transport Canada (Ottawa)

User category

Bobbi Macleod	Public Services and Procurement Canada
Claudio Ardiles	Government of Northwest Territories
Nathalie Gaudet	National Defence
Nathaniel Hutchinson	Government of Nunavut

Committee Manager (Non-voting)

Astrid Lozano	Canadian General Standards Board
---------------	----------------------------------

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

Preface

This National Standard of Canada CAN/CGSB-3.516-2017, *Denatured fuel ethanol for use in automotive spark-ignition fuels*, was published in April 2017. Amendment No. 1 includes all previous changes to the standard as well as the following changes made to the original document.

Changes since the previous edition

Amendment

- Addition of (E11-E15) and (E20-E25) to reflect updates to CAN/CGSB-3.511 (Amended 2018) and CAN/CGSB-3.512-2018
- Removal of ASTM D1613 from Section 6.7 and Annex A
- Removal of footnote denoting referee for ASTM D7795 as it is no longer required

Contents		Page
1	Scope	1
2	Normative references	1
3	Terms and definitions	2
4	Classification.....	2
5	General requirements	3
6	Detailed requirements	3
7	Inspection	5
8	Options.....	6
9	Precautions.....	6
Annex A	(normative) Referenced ASTM International publications	7
Annex B	(informative) Transportation, storage, handling and additional information or precautions for denatured fuel ethanol	9
Annex C	(informative) Federal, provincial and territorial acts and regulations applicable to denatured fuel ethanol.....	10

Denatured fuel ethanol for use in automotive spark-ignition fuels

1 Scope

This standard applies to denatured fuel ethanol, a blendstock that is used solely as a component of automotive spark-ignition fuels.

These automotive spark ignition fuels include:

CAN/CGSB-3.511 — *Oxygenated automotive gasoline containing ethanol (E1-E10 and E11-E15), and*

CAN/CGSB-3.512 — *Automotive ethanol fuel (E50-E85 and E20-E25).*

The testing and evaluation of a product against this standard may require the use of materials and/or equipment that could be hazardous. This document 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 given in metric units, mainly SI units.

2 Normative references

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

NOTE The addresses provided below were 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*

CAN/CGSB-3.511 — *Oxygenated automotive gasoline containing ethanol (E1-E10 and E11-E15)*

CAN/CGSB-3.512 — *Automotive ethanol fuel (E50-E85 and E20-E25).*

2.1.1 Source

The above may be obtained from the Canadian General Standards Board, Sales Centre, Gatineau, QC, Canada K1A 1G6. Telephone: 819-956-0425 or 1-800-665-2472. Fax: 819-956-5740. E-mail: ncr.cgsb-ongc@tpsgc-pwgsc.gc.ca. Web site: www.tpsgc-pwgsc.gc.ca/ongc-cgsb/index-eng.html.

2.2 ASTM International

Annual Book of ASTM Standards (see Annex A).

2.2.1 Source

The above 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 Markit, 200-1331 MacLeod Trail SE, Calgary, Alberta T2G 0K3, telephone: 613-237-4250 or 1800-267-8220, fax: 613-237-4251, Web site: www.global.ihs.com.

2.3 NACE International

TM-0172 — *Determining Corrosive Properties of Cargoes in Petroleum Product Pipelines*.

2.3.1 Source

The above may be obtained from NACE International, 1440 South Creek Drive, Houston, TX 77084-4906, U.S.A. Telephone: 281-228-6200. E-mail: firstservice@nace.org. Web site: www.nace.org.

2.4 See Annex C for federal, provincial and territorial acts and regulations that apply to denatured fuel ethanol.

3 Terms and definitions

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

3.1

denaturant

material added to fuel ethanol to make it unsuitable for beverage or medicinal use but suitable for use in automotive engines. The only denaturant allowed shall be as required for grade DA-2C or DA-2F (see Annex C, C1.5.). The denaturant used in grade DA-2C is commonly referred to as natural gasoline, and the denaturant used in grade DA-2F is commonly referred to as gasoline or as a gasoline component.

3.2

denatured fuel ethanol

commercially manufactured ethanol containing denaturant as required by the *Denatured and Specially Denatured Alcohol Regulations* — SOR/2005-22, which makes the ethanol unsuitable for beverage or medicinal use. (See Annex C, C1.5.)

3.3

ethanol

ethyl alcohol, the chemical compound $\text{CH}_3\text{CH}_2\text{OH}$.

3.4

impurities

in commercially produced ethanol, compounds other than ethanol or denaturants present, such as water, methanol and fusel oils (for example, amyl and isoamyl alcohols).

4 Classification

4.1 The denatured fuel ethanol shall be supplied in the following types, as specified (see 8.1):

4.1.1 Types

Type 1 — Intended for use in oxygenated automotive gasoline containing ethanol (E1-E10 and E11-E15) as defined in CAN/CGSB-3.511.

Type 2 — Intended for use in automotive ethanol fuel (E50-E85 and E20-E25) as defined in CAN/CGSB-3.512 and may also be used in oxygenated automotive gasoline containing ethanol (E1-E10 and E11-E15) as defined in CAN/CGSB-3.511.

5 General requirements

5.1 The denatured fuel ethanol shall be a stable homogeneous liquid free from foreign matter and dissolved material that can clog filters or screens (see Annex B).

5.2 The denatured fuel ethanol may contain additives designed to improve its characteristics. Additives include, but are not limited to, corrosion inhibitors, buffers, dispersants and detergents. Additives designed and tested to enhance performance may be added in amounts less than 1.0 % by volume, unless otherwise specified in this standard (see 9.4).

5.3 Impurities such as aldehydes, ketones, amines, acid esters and soluble polymers shall not be added to either the ethanol or the denaturant, except as functional components of additives (see 5.2). Halogenated compounds, silicon compounds, fusel oils, used lubricating oils and used solvents (including ethanol) or other such materials shall not be added to either the ethanol or the denaturant, except as normally occurring trace constituents.

5.3.1 The denaturant used in denatured fuel ethanol shall not contain materials, such as drag reducing additive or its degradation products, which can separate from solution at the expected temperatures of blending, storage and use.

5.3.2 Ethanol-blended gasoline contaminated with silicon has caused fouling of spark plugs, exhaust gas oxygen sensors and exhaust catalysts. ASTM D7757 is a standard test method for determining silicon content.

6 Detailed requirements

6.1 The denatured fuel ethanol shall comply with the specified limiting values. 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 For purposes of determining 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 Those validated test methods shall correlate with methods referenced in the standard. Differences in precision, sensitivity and bias between test methods referenced in the standard and the validated test methods shall be noted when using results from validated methods.

6.2.2 Validated test methods shall only be used 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 and 6.1.2 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.

Specified limiting values						
Property	Both types		Test methods			
	Min.	Max.	ASTM	CGSB/Others		
6.4	Ethanol, % by volume		92.0	D5501	CAN/CGSB-3.0 No. 14.3 ^c	
6.5	Methanol content, % by volume			0.5	D5501	CAN/CGSB-3.0 No. 14.3 ^c
6.6	Copper, mg/L			0.1 0.05	D1688 Method A, modified ^a	
6.7	Total acidity, as acetic acid			56 0.0070 70.	D7795	
6.8	Ethanol denaturant, % by volume ^b only		0.99 1.96	4.76 4.76		
6.9	Water, % by volume			0.8	E203 E1064 D6304 D7923 ^c	
6.10	Chloride, inorganic, mg/kg			10. 1	D7319 ^c D7328	
6.11	Sulphur content, mg/kg ^d			14 12	D5453 ^c D7039	
6.12	Sulphate, mg/kg			4 1	D7318 D7319 ^c D7328	
6.13	Solvent washed gum content, mg/100 mL			5	D381 ^e	
6.14	pHe		6.5	9.0	D6423	
6.15	Benzene, % by volume ^d			0.25		CAN/CGSB-3.0 No. 14.3

Specified limiting values				
Property	Both types		Test methods	
	Min.	Max.	ASTM	CGSB/Others
6.16	Aromatics, % by volume ^d		2.5	CAN/CGSB-3.0 No. 14.3
6.17	Steel corrosion, tested after blending with 90% by volume reagent grade iso-octane		B+	D7548
6.18	Phosphorus, mg/L		1.3	D3231
6.19	Conductivity, $\mu\text{S/m}$		500.	D1125

^a The modifications of ASTM D1688, Test Method A (atomic absorption, direct), consist of mixing reagent grade ethanol, which may be denatured according to formula for specially denatured alcohol grade SDAG-1 or SDAG-2, in place of water as the solvent or diluent for the preparation of reagents and standard solutions. However, this shall not be done to prepare the stock copper solution described in ASTM D1688, because a violent reaction can occur between the acid and the ethanol. Use water, as specified, in the acid solution part of the procedure to prepare the stock copper solution. Use ethanol for the rinse and final dilution only. The precision of this modified method has not been determined, but it is expected to be similar to the precision of ASTM D1688, Test Method A.

^b When reporting this parameter, metered (measured) volumes may be used in place of analytical tests when the component is added. Note that the denaturant limits are absolute (see 3.2 and Annex C, C1.5). Ethanol denaturants shall consist of a hydrocarbon mixture with a final boiling point less than 225°C (as determined by ASTM D86). Only Grades No. DA-2F or No. DA-2C as defined in *Denatured and Specially Denatured Alcohol Regulations* (see Annex C, C1.5) meet these requirements.

^c Referee method to be used in the event of a dispute.

^d Compliance with the sulphur, benzene and aromatics requirements ensures that the denatured fuel ethanol is a “commercially pure oxygenate” under the *Benzene in Gasoline Regulations* and a “sulphur-limited oxygenate” under the *Sulphur in Gasoline Regulations*. If levels are greater than the limits of this table, the finished fuel blend shall be tested to ensure compliance with both the *Benzene in Gasoline Regulations* and *Sulphur in Gasoline Regulations*.

^e Solvent-washed gum content shall be determined using the “air jet apparatus” specified in ASTM D381.

7 Inspection

7.1 Sampling

7.1.1 Sampling equipment and procedures shall be designed and used to obtain representative samples of a product. Sample lines, hoses, etc. should be adequately flushed prior to taking a sample. Samples should be stored in a cool, dark place. Procedures shall be in accordance with ASTM D4057, D4177 or D5854.

7.1.2 Sample volume shall be consistent with the requirements of the testing laboratory, or the authority having jurisdiction, or both. Unless otherwise specified (see 8.1 b)) a sample of at least 1 L shall be taken (see 9.3).

8 Options

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

- a) Type (see 4.1)
- b) Sample size, if other than as specified (see 7.1.2).

9 Precautions

9.1 Health and safety

Users should refer to their supplier's Safety Data Sheet (SDS) for guidance on the safe handling of denatured fuel ethanol.

9.2 Equipment

The equipment in contact with denatured fuel ethanol shall be specifically designed and approved by the appropriate authority having jurisdiction for use with this fuel. Otherwise, component degradation, fuel contamination and component failure can result.

9.3 Sampling containers

The sample shall be collected in containers that are compatible with denatured fuel ethanol. Where practical, denatured fuel ethanol should be sampled in glass containers. Plastic containers should be avoided. If the sample has to be collected in a metal container, do not use a soldered metal container, as the solder can contaminate the sample. ASTM D4306 provides general guidance on the selection of sampling containers for trace contamination analysis.

9.4 Incorporating additives

Users are cautioned against incorporating other additives in the denatured fuel ethanol unless detailed test data are first obtained, to confirm that performance is improved without harmful side effects.

9.5 See Annex B for transportation, storage, handling and additional information.

Annex A (normative)

Referenced ASTM International publications (see 2.4)

Annual Book of ASTM Standards

- D86 Standard Test Method for Distillation of Petroleum Products and Liquid Fuels at Atmospheric Pressure
- D381 Standard Test Method for Gum Content in Fuels by Jet Evaporation
- D1125 Standard Test Methods for Electrical Conductivity and Resistivity of Water
- D1688 Standard Test Methods for Copper in Water
- D3231 Standard Test Method for Phosphorus in Gasoline
- D3244 Standard Practice for Utilization of Test Data to Determine Conformance with Specifications
- D3764 Standard Practice for Validation of the Performance of Process Stream Analyzer Systems
- D4057 Standard Practice for Manual Sampling of Petroleum and Petroleum Products
- D4177 Standard Practice for Automatic Sampling of Petroleum and Petroleum Products
- D4306 Standard Practice for Aviation Fuel Sample Containers for Tests Affected by Trace Contamination
- D5453 Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence
- D5501 Standard Test Method for Determination of Ethanol and Methanol Content in Fuels Containing Greater than 20% Ethanol by Gas Chromatography
- D5854 Standard Practice for Mixing and Handling of Liquid Samples of Petroleum and Petroleum Products
- D6304 Standard Test Method for Determination of Water in Petroleum Products, Lubricating Oils, and Additives by Coulometric Karl Fischer Titration
- D6423 Standard Test Method for Determination of pH of Denatured Fuel Ethanol and Ethanol Fuel Blends
- 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
- D7039 Standard Test Method for Sulfur in Gasoline, Diesel Fuel, Jet Fuel, Kerosine, Biodiesel, Biodiesel Blends, and Gasoline-Ethanol Blends by Monochromatic Wavelength Dispersive X-ray Fluorescence Spectrometry
- D7318 Standard Test Method for Existent Inorganic Sulfate in Ethanol by Potentiometric Titration
- D7319 Standard Test Method for Determination of Existent and Potential Sulfate and Inorganic Chloride in Fuel Ethanol and Butanol by Direct Injection Suppressed Ion Chromatography
- D7328 Standard Test Method for Determination of Existent and Potential Inorganic Sulfate and Total Inorganic Chloride in Fuel Ethanol by Ion Chromatography Using Aqueous Sample Injection

CAN/CGSB-3.516-2017
Amendment No. 1, July 2020

- D7548 Standard Test Method for Determination of Accelerated Iron Corrosion in Petroleum Products
- D7757 Standard Test Method for Silicon in Gasoline and Related Products by Monochromatic Wavelength Dispersive X-ray Fluorescence Spectrometry
- D7795 Standard Test Method for Acidity in Ethanol and Ethanol Blends by Titration
- D7923 Standard Test Method for Water in Ethanol and Hydrocarbon Blends by Karl Fischer Titration
- E29 Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- E203 Standard Test Method for Water Using Volumetric Karl Fischer Titration
- E1064 Standard Test Method for Water in Organic Liquids by Coulometric Karl Fischer Titration

Annex B (informative)

Transportation, storage, handling and additional information or precautions for denatured fuel ethanol

B.1 Storage and handling

Denatured fuel ethanol should be transported, stored and handled using equipment specifically designed for this purpose. Note that ethanol can corrode aluminum alloys. Since denatured fuel ethanol is an electrolyte (see B2.), it will promote the formation of galvanic corrosion cells when in contact with dissimilar metals. The galvanic reaction will introduce metallic compounds of the anodic metal into the fuel, which can result in plugged vehicle fuel filters. Brass in direct contact with aluminum in denatured fuel ethanol has resulted in galvanic corrosion, giving rise to fuel contamination.

B.2 Water

Denatured fuel ethanol is hygroscopic, and it can eventually absorb enough moisture from the ambient air to cause mixtures with gasoline to separate into two phases or layers. Separation can be avoided if care is taken during storage, distribution and use to prevent contact with water or humid air. Phase separation of gasoline-ethanol mixtures is a greater risk as ambient temperatures drop.

B.3 Denaturant

The choice of a suitable denaturant (see 5.3.1, 5.3.2 and 6.7) is impacted by the *Benzene in Gasoline Regulations* and *Sulphur in Gasoline Regulations* (see 6.10, 6.14 and 6.15). The only denaturants allowed are those used in grades DA-2C and DA-2F (see C1.5).

B.3.1 No industry standard method for quantification of denaturant content has been established. However, it is recognized that the purchaser of the product often requests quantification of denaturant. For this purpose denaturant content can be approximated by the following equation subject to the agreement of purchaser and seller:

$$D_n = 100 - (E + M + W + H)$$

Where,

D_n = Denaturant content volume %

E = Ethanol content volume % as measured by methods listed in 6.3

M = Methanol content volume % as measured by methods listed in 6.4

W = Water content volume % as measured by methods listed in 6.8

H = Higher alcohol (C3+) content as measured by CAN/CGSB-3.0 No. 14.3 (modified)¹ or other appropriate method.

B.4 Steel corrosion protection

For further information, refer to the document *Evaluation Protocol for Corrosion Inhibitors for Fuel Ethanol* available from the Renewable Fuels Association (http://www.ethanolrfa.org/wp-content/uploads/2015/11/RFA-Evaluation-Protocol-for-Corrosion-Inhibitors-for-Fuel-Ethanol_V073010a.pdf).

¹ CAN/CGSB-3.0 No. 14.3 is the referee method.

Annex C (informative)

Federal, provincial and territorial acts and regulations applicable to denatured fuel ethanol²

C.1 Federal acts and regulations³

C.1.1 *Fuels Information Regulations, No. 1* (C.R.C., c. 407 as amended by SOR/79-280, 80-138, 2000-105)

These regulations require producers and importers to submit information on sulphur and additive contents (other than lead).

C.1.2 *Transportation of Dangerous Goods Regulations* (SOR/2001-286)

These regulations give detailed requirements for transporting fuels within Canada.

C.1.3 *Benzene in Gasoline Regulations* (SOR/97-493)

These regulations establish the limits for benzene and BEN in *complying gasoline*. In addition, these regulations define *commercially pure oxygenates*, the addition of which to complying gasoline is not deemed to be *blending* (i.e. re-testing of batches for *model parameters* is not required). The requirements for *Commercially Pure Oxygenates* are as follows:

- Sulphur (mg/kg) = 40 maximum
- Benzene (volume %) = 0.25 maximum
- Aromatics (volume %) = 2.5 maximum

C.1.4 *Sulphur in Gasoline Regulations* (SOR/ 99-236)

These regulations establish the limits for sulphur in low sulphur gasoline. In addition, these regulations define *sulphur limited oxygenates*, the addition of which to *complying gasoline* is not deemed to be *blending* (i.e. re-testing of batches for sulphur concentration is not required). The requirement for *Sulphur Limited Oxygenates* is as follows:

- Sulphur (mg/kg) = 14 maximum from January 1, 2017 until December 31, 2019
- Sulphur (mg/kg) = 12 maximum on or after January 1, 2020.

C.1.5 *Denatured and Specially Denatured Alcohol Regulations* (SOR/2005-22)

The denaturants used in grades DA-2C and DA-2F are defined in these Regulations as:

DA-2C, "Petroleum Derivative: A volatile, highly flammable liquid that has the characteristic odour of light petroleum distillate. Upon distillation, a maximum of 10% by volume of the liquid shall pass over at or below 35°C, or the liquid shall have a vapour pressure at 37.8°C (at a vapour-to-liquid ratio of 4:1) that is less than or equal to 105 kPa, and

² The regulations listed in Annex C 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. If any of the websites referenced becomes inoperative, Regulations may also be found at www.canlii.org.

³ Federal acts and regulations are obtainable from the Department of Justice Canada, Communications Branch, 284 Wellington Street, Ottawa, Canada K1A 0H8. Web site: <http://laws-lois.justice.gc.ca/eng/index.html>. If this Web site becomes inoperative, regulations may also be found at www.canlii.org.

a minimum of 95% by volume of the liquid shall pass over at or below 225°C. Petroleum derivative does not include gasoline, petroleum naphtha or solvent naphtha.”

DA-2F, “Gasoline: A petroleum distillate — or a mixture of petroleum distillates, oxygenates or additives — that is suitable for use in a spark ignition engine and that has the following characteristics, as determined by the applicable test method listed in the Canadian General Standards Board Standard CAN/CGSB-3.5-2004, entitled *Unleaded Automotive Gasoline*, published November 2004, as amended from time to time;

- a) a vapour pressure of at least 38 kPa;
- b) an antiknock index of at least 80;
- c) a distillation temperature, at which 10% of the fuel has evaporated, of not less than 35°C and not greater than 70°C; and
- d) a distillation temperature, at which 50% of the fuel has evaporated, of not less than 65°C and not greater than 120°C.”

These regulations govern the composition and concentration of materials used to denature ethanol.

SOR/2005-22, February 1, 2005, made under the *Excise Act, 2001*, *Denatured and Specially Denatured Alcohol Regulations*, P.C. 2005-45, February 1, 2005
<http://laws-lois.justice.gc.ca/eng/regulations/SOR-2005-22/FullText.html>.

SOR/2006-103 [Vol. 139, No. 4 — February 23, 2005].
Denatured Alcohol Regulations, C.R.C., c. 568 — Schedule (Sections 5 and 7) Specifications for the Composition and Authority for Use of Specially Denatured Alcohol.

SOR/2006-103, May 18, 2006 [Vol. 140, No. 11 — May 31, 2006].

Excise Act, 2001.

Regulations Amending the Denatured and Specially Denatured Alcohol Regulations, P.C. 2006-402 May 18, 2006.

See <http://laws-lois.justice.gc.ca/eng/regulations/SOR-2005-22/FullText.html>.

C.2 Provincial and territorial regulations

C.2.1 Alberta

C.2.1.1 Renewable fuels requirements

The *Renewable Fuels Standard Regulation* defines the renewable fuels requirements (Alberta Reg. 29/2010).

C.2.2 British Columbia

C.2.2.1 Requirements

The applicability and detailed compliance requirements are specified under the *Renewable and Low Carbon Fuel Requirements Regulation* (BC Regulation 394/2008).⁴

⁴ Available from the BC Laws site at <http://www.bclaws.ca>.

C.2.3 Manitoba

C.2.3.1 General Requirements and Vapour Pressure

The general requirements are specified under the latest version of the *Dangerous Goods Handling and Transportation Act*, including the *Dangerous Goods Handling and Transportation Regulation (55/2003)* and the *Storage and Handling of Petroleum Products and Allied Products Regulation (188/2001)*.⁵

C.2.4 Ontario

C.2.4.1 Detailed Requirements

The detailed requirements for denatured fuel ethanol that is used to make ethanol-blended gasoline are controlled under the latest version of *Ethanol in Gasoline Regulation (535/05)*.⁶

C.2.5 Quebec

C.2.5.1 General Requirements

The general requirements are controlled under the latest version of the *Loi sur les produits pétroliers*, RLRQ, chapitre P-30.01, *Règlement sur les produits pétroliers*, RLRQ, chapitre P-30.01, r.2 or *Petroleum Products Act*, CQLR, chapter P-30.01, *Petroleum Products Regulation*, CQLR, chapter P-30.01, r.2. This regulation lists Quebec quality requirements for aviation gasolines, aviation turbine fuels, automotive gasolines, gasolines containing denatured fuel ethanol for use in automotive spark ignition fuels, diesel fuels, diesel fuels containing biodiesel (B100) for blending in middle distillate fuels, fuel oil types 0, 1 and 2, and fuel oil types 4, 5 and 6.

Amendments and editions published apply only 90 days after the last day of the month that the French text of the amendments or editions was published. The Direction générale des hydrocarbures et des biocombustibles of the ministère de l'Énergie et des Ressources naturelles is responsible for the application and revision of this regulation. Web site: www.mern.gouv.qc.ca/English/energy/index.jsp.

⁵ Available from the Government of Manitoba, www.gov.mb.ca/conservation/envprograms/haz-waste/prov-leg/index.html.

⁶ Available from the Ontario e-Laws Ontario Statutes and Regulations Web site at <http://www.e-laws.gov.on.ca>.