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CAN/CGSB-3.524-2022

Supersedes CAN/CGSB-3.524-2017



Biodiesel (B100) for blending in middle distillate fuels

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Biodiesel (B100) for blending in middle distillate fuels

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

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Preface

This National Standard of Canada CAN/CGSB-3.524-2022 supersedes the 2017 edition.

Changes since the previous edition

- Government regulations and regulatory information has been updated as required.
- An additional alternate test method (ASTM D7945) has been added for viscosity.
- ASTM D974 has been added as an alternate test method for acid number.
- ASTM D7170 has been deleted as an alternate for ignition quality as it has been withdrawn by ASTM.
- ASTM D8183 has been added as an alternate test method for ignition quality.
- Section C.7 Ash has been deleted as the information given is covered under section C.17 Calcium, magnesium, sodium and potassium.

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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Biodiesel (B100) for blending in middle distillate fuels

1 Scope

This National Standard of Canada applies to one grade of biodiesel that is intended for use as a blending component in middle distillate fuels.

Biodiesel meeting this standard is not intended for use as a fuel in its neat form.

See Annex B for regulations that apply to diesel fuels.

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 in this standard are provided in metric units from the International System of Units (SI units). This standard expresses the industry standard nominal measurements in North America of “% by mass” and “% by volume”. The SI equivalent expressions for these units are “% (m/m)” and “% (V/V)” respectively.

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 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

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

No. 28.8 — *Visual haze rating of liquid fuels*

No. 142.0 — *Cold soak filter blocking tendency of biodiesel (B100)*

2.1.1 Contact information

The above may be obtained from the Canadian General Standards Board. Telephone: 1-800-665-2472. E-mail: ncr.cgsb-ongc@tpsgc-pwgsc.gc.ca. Web site: <http://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 Contact information

The above may be obtained from ASTM International. Telephone: 610-832-9585. Fax: 610-832-9555. Web site: www.astm.org. It can also be obtained from IHS Canada. Telephone: 613-237-4250 or 1-800-387-4408. Fax: 613-237-4251. E-mail: gic@ihscanada.ca. Web site: <https://ihsmarket.com>.

2.3 European Committee for Standardization

EN 14107 — *Fat and oil derivatives - Fatty acid methyl esters (FAME) - Determination of phosphorus content by inductively coupled plasma (ICP) emission spectrometry*

EN 14110 — *Fat and oil derivatives - Fatty acid methyl esters (FAME) - Determination of methanol content*

EN 14112 — *Fat and oil derivatives - Fatty acid methyl esters (FAME) - Determination of oxidation stability (accelerated oxidation test)*

EN 14538 — *Fat and oil derivatives - Fatty acid methyl ester (FAME) - Determination of Ca, K, Mg and Na content by optical emission spectral analysis with inductively coupled plasma (ICP OES)*

EN 15751 — *Automotive fuels - Fatty acid methyl ester (FAME) fuel and blends with diesel fuel - Determination of oxidation stability by accelerated oxidation method*

2.3.1 Contact information

The above may be obtained from the European Committee for Standardization (CEN) National Members, CEN/TC19 Secretariat. Email: astm@nen.nl. Web site: www.cen.eu.

3 Terms and definitions

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

biodiesel

mono-alkyl esters of long-chain fatty acids derived from renewable sources. In its neat form, biodiesel is commonly designated as B100. In the context of this standard the biodiesel is intended as a blending component in a finished diesel fuel or heating oil.

diesel fuel

middle distillate fuel composed of conventional hydrocarbons, synthetic hydrocarbons or mixtures of conventional and synthetic hydrocarbons that boils in the range of 130 °C to 400 °C and that is intended for use as a fuel in compression-ignition engines.

heating fuel oil

distillate fuel oil intended for use in liquid-fuel-burning equipment for the generation of heat for domestic and industrial purposes.

4 General requirements

4.1 The biodiesel specified shall be long chain alkyl esters and may contain additives designed to improve its properties or performance, for example, diesel ignition quality, low-temperature flow properties and electrical conductivity.

4.2 The biodiesel shall be a stable homogeneous liquid free from foreign matter that is likely to clog filters or nozzles, or to damage equipment. Haze may be assessed using CAN/CGSB-3.0 No. 28.8 or ASTM D4176, Procedure 2.

4.3 There shall be no intentional addition of used lubricating oils, used solvents, triglycerides (such as raw vegetable oils, animal fats, fish oils or used cooking oils), or other fluids which are not normal components of the biodiesel.

5 Detailed requirements

For an explanation of the significance of tests and the methods used in this standard, see Annex C.

Note: The precision statement of some of the quoted test methods in this standard may not be fully applicable.

5.1 The biodiesel meeting this standard may contain up to 0.5 % by volume middle distillate. Metered volumes shall be reported.

5.2 Specified limiting values

5.2.1 The biodiesel 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.

5.2.2 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. There is one exception (see 5.5 and 5.23).

5.2.3 If an alternate test method referenced in this standard provides a bias correction to the referee method, adherence to the specified limiting value shall be based on the bias-corrected result.

5.2.4 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 $P = 0.5$.

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

5.3 Test methods

5.3.1 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.

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

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

5.3.4 In the event of a dispute, the procedures given in 5.2 shall be used.

5.3.5 If parties in a dispute cannot agree on an analytical method to resolve a 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.

Table 1 — Specified limiting values

Specified limiting values				
Property	Min.	Max.	Test method ASTM, EN or CGSB	
5.4	Kinematic viscosity at 40 °C, mm ² /s (cSt) ^a	1.9	6.0	D445 ^b , D7042 or D7945
5.5	Flash point, °C (see 5.23)	93.0	—	D93 ^b , D3828 or D7094
5.6	Methanol content; either			
	a) % by mass (see 5.24)	—	0.20	EN 14110
	or			
	b) Flash point, °C (see 5.23 and 5.24)	130.0	—	D93 ^b , D7094 or D3828
5.7	Cloud point, °C (see 5.25)	Report	—	D2500, D5771, D5772 or D5773 ^b , D7397
5.8	Sulphur, mg/kg (ppm mass, see 5.26)	Report	—	D2622, D5453 ^b or D7039
5.9	Density at 15 °C, kg/m ³	Report	—	D1298 ^b or D4052
5.10	Carbon residue, % by mass (see 5.27)	—	0.05	D524 or D4530 ^b
5.11	Water content, mg/kg (ppm mass)	—	400	D6304
5.12	Particulate contamination, mg/L	—	20.	D7321
5.13	Acid number, mg KOH/g	—	0.50	D664 ^b or D974
5.14	Oxidation stability, h	8	—	EN 14112 or EN 15751 ^b
5.15	Free glycerin, % by mass	—	0.020	D6584
5.16	Total glycerin, % by mass	—	0.240	D6584
5.17	Phosphorus content, mg/kg (ppm mass)	—	4	EN 14107
5.18	Alkaline I metals, Na + K, mg/kg (ppm mass)	—	4	EN 14538
5.19	Alkaline II metals, Ca + Mg, mg/kg (ppm mass)	—	2	EN 14538
5.20	Cold soak filterability test, s	—	240.	D7501
5.21	Cold soak filter blocking tendency	—	1.8	CAN/CGSB-3.0 No. 142.0

Specified limiting values			
Property	Min.	Max.	Test method ASTM, EN or CGSB
5.22 Ignition quality, cetane number (CN), derived cetane number (DCN) or indicated cetane number (ICN) [see 7.1 b)]	Report, if required	Report, if required	D613 ^b , D6890, D7668 ^c or D8183 ^c
<p>^a The SI unit for kinematic viscosity is the square metre per second (m²/s). The preferred multiple for fluids in this viscosity range is the square millimetre per second (mm²/s), which is equivalent to a centiStokes (that is 1 mm²/s = 1 cSt).</p> <p>^b Referee method to be used in the event of a dispute.</p> <p>^c The precision data for test methods D7668 and D8183 were obtained from results using externally provided pre-blended calibration reference materials. Test method D8183 requires the use of these pre-blended calibration materials but test method D7668 does not.</p>			

5.23 Flash point

The test values determined in accordance with ASTM D93, D3828 or D7094 shall be reported to the nearest 0.5 °C.

5.24 Methanol content

Methanol content is controlled either by direct measurement of methanol or by a minimum flash point. See Annex C, C.2.2.

5.25 Cloud point

Cloud point may be specified (see 7.1) as required by the conditions of storage or use or as agreed by contract.

5.26 Sulphur

See Annex B for regulations regarding sulphur in diesel fuel.

5.27 Carbon residue

Testing shall be performed on the neat biodiesel sample and not on a 10% distillation bottoms.

6 Inspection

6.1 Sampling

6.1.1 Sampling equipment and procedures shall be designed and used to obtain representative fuel samples of a product. Sampling 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.

6.1.2 Sample volume should be consistent with the requirement of the testing laboratory or the authority having jurisdiction or both. Unless otherwise specified (see 7.1), a sample of at least 3 L shall be collected.

7 Options

7.1 Limiting values

Limiting values for the following may be specified (see Annex C, C.1.3):

- a) sulphur;
- b) cetane number;
- c) cloud point;
- d) sample size (see 6.1.2).

8 Precautions

8.1 Alternate B100 standards or specifications

This standard is intended to address performance requirements for Canada. Other international standards or specifications may not take into consideration Canadian conditions such as the cold climate.

8.2 Manufacturing processes

Contaminants and trace components from manufacturing processes or treatments can be carried over in trace quantities into the biodiesel and can cause unexpected problems. Moreover, these materials might not be detected by the requirements listed in this standard. It is recommended that adequate quality assurance procedures be put in place to ensure that any manufacturing processes capable of such contamination are identified and controlled. Clay, sand, acids, caustic, soaps, sterol glucosides, saturated monoglycerides and other potential precipitates are examples of possible contaminants and trace minerals.

8.3 Material incompatibility of biodiesel

Biodiesels are incompatible with some elastomeric materials, and they can lead to corrosion of some non-ferrous metals particularly when free water is present. The degradation products that are formed can cause operational issues.

8.4 Impact of free water on storage and handling of biodiesel

In the presence of free water, biodiesel can be more vulnerable to degradation than conventional petroleum-derived diesel fuel. See Annex C, C.18 for guidance on storage and handling, and ASTM D6469 for information on microbial contamination.

Annex A (normative)

Referenced ASTM International publications (see 2.2)

A.1 Annual Book of ASTM Standards

ASTM D93 – Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester

ASTM D445 – Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)

ASTM D524 – Standard Test Method for Ramsbottom Carbon Residue of Petroleum Products

ASTM D613 – Standard Test Method for Cetane Number of Diesel Fuel Oil

ASTM D664 – Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration

ASTM D974 – Standard Test Method for Acid and Base Number by Color-Indicator Titration

ASTM D1298 – Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method

ASTM D2500 – Standard Test Method for Cloud Point of Petroleum Products and Liquid Fuels

ASTM D2622 – Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry

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

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

ASTM D3828 – Standard Test Methods for Flash Point by Small Scale Closed Cup Tester

ASTM D4052 – Standard Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter

ASTM D4057 – Standard Practice for Manual Sampling of Petroleum and Petroleum Products

ASTM D4176 – Standard Test Method for Free Water and Particulate Contamination in Distillate Fuels (Visual Inspection Procedures)

ASTM D4177 – Standard Practice for Automatic Sampling of Petroleum and Petroleum Products

ASTM D4530 – Standard Test Method for Determination of Carbon Residue (Micro Method)

ASTM 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

ASTM D5771 – Standard Test Method for Cloud Point of Petroleum Products and Liquid Fuels (Optical Detection Stepped Cooling Method)

ASTM D5772 – Standard Test Method for Cloud Point of Petroleum Products and Liquid Fuels (Linear Cooling Rate Method)

ASTM D5773 – Standard Test Method for Cloud Point of Petroleum Products and Liquid Fuels (Constant Cooling Rate Method)

ASTM D5854 – Standard Practice for Mixing and Handling of Liquid Samples of Petroleum and Petroleum Products

ASTM D6304 – Standard Test Method for Determination of Water in Petroleum Products, Lubricating Oils, and Additives by Coulometric Karl Fischer Titration

ASTM D6469 – Standard Guide for Microbial Contamination in Fuels and Fuel Systems

ASTM D6584 – Standard Test Method for Determination of Total Monoglycerides, Total Diglycerides, Total Triglycerides, and Free and Total Glycerin in B-100 Biodiesel Methyl Esters by Gas Chromatography

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 D6890 – Standard Test Method for Determination of Ignition Delay and Derived Cetane Number (DCN) of Diesel Fuel Oils by Combustion in a Constant Volume Chamber

ASTM 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

ASTM D7042 – Standard Test Method for Dynamic Viscosity and Density of Liquids by Stabinger Viscometer (and the Calculation of Kinematic Viscosity)

ASTM D7094 – Standard Test Method for Flash Point by Modified Continuously Closed Cup (MCCCFP) Tester

ASTM D7321 – Standard Test Method for Particulate Contamination of Biodiesel B100 Blend Stock Biodiesel Esters and Biodiesel Blends by Laboratory Filtration

ASTM D7397 – Standard Test Method for Cloud Point of Petroleum Products and Liquid Fuels (Miniaturized Optical Method)

ASTM D7501 – Standard Test Method for Determination of Fuel Filter Blocking Potential of Biodiesel (B100) Blend Stock by Cold Soak Filtration Test (CSFT)

ASTM D7668 – Standard Test Method for Determination of Derived Cetane Number (DCN) of Diesel Fuel Oils— Ignition Delay and Combustion Delay Using a Constant Volume Combustion Chamber Method

ASTM D7945 – Standard Test Method for Determination of Dynamic Viscosity and Derived Kinematic Viscosity of Liquids by Constant Pressure Viscometer

ASTM D8183 – Standard Test Method for Determination of Indicated Cetane Number (ICN) of Diesel Fuel Oils using a Constant Volume Combustion Chamber—Reference Fuels Calibration Method

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

Annex B (informative)

Federal, provincial and other regulations applicable to diesel fuels^{1, 2}

B.1 Federal regulations

B.1.1 *Canadian Environmental Protection Act*

The following federal regulations have been enacted under the *Canadian Environmental Protection Act*, 1999.

B.1.1.1 *Fuels information regulations, No. 1* (C.R.C. c. 407 amended by SOR/DORS/79-280, 80-138 and 2000-104)

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

B.1.1.2 *Contaminated Fuel Regulations* (SOR/DORS/91-486)

These regulations prohibit the importation of fuels that have been contaminated with hazardous wastes.

B.1.1.3 *Sulphur in Diesel Fuel Regulations* (SOR/DORS/2002-254)

These regulations define the sulphur limits for fuels for use in diesel engines.

B.1.1.4 *Renewable Fuels Regulations* (SOR/DORS/2010-189)

These regulations define the renewable fuel content requirements for gasoline, diesel and heating oil.

B.1.2 Other federal regulations

The following federal regulations also apply to fuels meeting this standard.

B.1.2.1 *Marine Machinery Regulations* (SOR/DORS 90/264)

These regulations, enacted under the *Canada Shipping Act, 2001*, specify details related to the construction, installation and inspection of marine machinery. Safety requirements for diesel fuels used in marine applications are also specified.

B.1.2.2 *Transportation of Dangerous Goods Regulations* (SOR/DORS/2001-286)

These regulations, enacted under the *Transportation of Dangerous Goods Act, 1992*, give detailed packaging, labelling and documentation requirements for transporting fuels in Canada.

¹ 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.

² The requirements in jurisdictions other than those listed above will be added, as information becomes available in future revisions or amendments to this standard or both.

B.2 Provincial and territorial regulations

B.2.1 Alberta

B.2.1.1 *Renewable Fuels Standard Regulation* (Alta. reg. 29/2010)

This regulation, enacted under the *Emissions Management and Climate Resilience Act*, defines the requirements for renewable fuels in Alberta.

B.2.1.2 *Mines Safety Regulation* (Alta. reg. 292/1995)

This regulation, enacted under the *Occupational Health and Safety Act*, specifies diesel fuel requirements for underground mining applications.

B.2.2 British Columbia

B.2.2.1 *Renewable and Low Carbon Fuel Requirements Regulation*

Requirements for renewable fuel volumes and reduction of fuel carbon intensity are controlled under the *Greenhouse Gas Reduction (Renewable and Low Carbon Fuel Requirements) Act* and the *Renewable and Low Carbon Fuel Requirements Regulation* (BC Reg. 394/2008)³.

B.2.2.2 *Occupational Health and Safety Regulation* (B.C. reg. 296/97)

This regulation, enacted under the *Workers Compensation Act*, specifies diesel fuel requirements for underground mining applications.

B.2.3 Manitoba

B.2.3.1 *Storage and Handling of Petroleum Products and Allied Products Regulation* (Man. reg. 188/2001)

General requirements are controlled under 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).⁴ However, these two regulations do not address fuel quality.

Biodiesel requirements are specified under the *Biodiesel (General) Regulation*, Man Reg 178/2008 as amended (M.R. 147/2020) and specifies CGSB standards for diesel and biodiesel blends including CAN/CGSB-3.524.

B.2.3.2 *Operation of Mines Regulation* (Man. reg. 228/94)

This regulation, enacted under the *Workplace Safety and Health Act*, specifies diesel fuel requirements for underground mining applications.

B.2.4 New Brunswick

B.2.4.1 *Underground Mine Regulation* (N.B. reg. 96-105)

This regulation, enacted under the *Occupational Health and Safety Act*, specifies diesel fuel requirements for underground mining applications

³ Available from the BC Laws site at www.bclaws.gov.bc.ca.

⁴ Available from the Government of Manitoba at <https://web2.gov.mb.ca/laws/regs>.

B.2.5 Newfoundland and Labrador

B.2.5.1 *Mines Safety of Workers Regulations* (C.N.L.R. 1145/96)

These regulations, enacted under the *Occupational Health and Safety Act*, specify diesel fuel requirements for underground mining applications.

B.2.6 Northwest Territories

B.2.6.1 *Mine Health and Safety Regulations* (N.W.T. reg. 125-95)

These regulations, enacted under the *Mine Health and Safety Act*, specify diesel fuel requirements for underground mining applications.

B.2.7 Nova Scotia

B.2.7.1 *Underground Mining Regulations* (N.S. reg. 153/2003)

These regulations, enacted under the *Occupational Health and Safety Act*, specify diesel fuel requirements for underground mining applications.

B.2.8 Nunavut

B.2.8.1 *Mine Health and Safety Regulations* (N.W.T. (Nu.) reg. 125-95)

These regulations, enacted under the *Mine Health and Safety Act*, specify diesel fuel requirements for underground mining applications.

B.2.9 Ontario

B.2.9.1 *Liquid Fuels Handling Code, 2017*

This code, published by the Technical Standards and Safety Authority and adopted by reference under the *Technical Standards and Safety Act, 2000*, specifies safety related requirements for handling liquid fuels.

B.2.9.2 *Mines and Mining Plants* (R.R.O. 1990, reg. 854)

This regulation, enacted under the *Occupational Health and Safety Act*, specifies diesel fuel requirements for underground mining applications.

B.2.9.3 *Fuel Products*

Bio-based content requirements are controlled under *Ontario Regulation 663/20, Cleaner Transportation Fuels: Renewable Content Requirements for Gasoline and Diesel Fuels*.⁵ This Regulation refers to a Guideline entitled “Technical Guideline: Cleaner Transportation Fuels” published by the Ontario Ministry of Environment, Conservation and Parks which includes requirements for fuels.

⁵ Available from the Ontario e-laws Ontario Statutes and Regulations web site at <http://www.e-laws.gov.on.ca>.

B.2.10 Quebec

B.2.10.1 General requirements

The general requirements are controlled under the latest version of the *Loi sur les produits pétroliers*, (RLRQ, c. P-30.01) *Règlement sur les produits pétroliers*, (RLRQ, c. P-30.01 r.2) or *Petroleum Products Act*, (CQLR, c. P-30.01) *Petroleum Products Regulation*, (CQLR, c. P-30.01 r.2)⁶. 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 combustibles propres et des réservoirs of the ministère de l'Énergie et des Ressources naturelles is responsible for the application and revision of this regulation. Web site: <https://mern.gouv.qc.ca/en/energy-transition/>.

B.2.10.2 *Regulation Respecting Occupational Health and Safety in Mines* (R.R.Q., c. S-2.1, r. 14)

This regulation, also known as *Règlement sur la santé et la sécurité du travail dans les mines*, was enacted under the *Act respecting Occupational health and safety (Loi sur la santé et la sécurité du travail)* and specifies diesel fuel requirements for underground mining applications.

B.2.11 Saskatchewan

B.2.11.1 General requirements

Biodiesel requirements as specified in the *Renewable Diesel Act*, SS 2012, c R-19.001 and the *Renewable Diesel Regulations*, RRS c R-19.001 Reg 1.

B.2.11.2 *Mines Regulations, 2003* (R.R.S. c. O-1.1 reg. 2)

These regulations, enacted under the *Occupational Health and Safety Act, 1993*, specify diesel fuel requirements for underground mining applications.

B.2.12 Yukon

B.2.12.1 *Mine Safety Regulations* (Y.O.I.C. 1986B/164)

These regulations, enacted under the *Occupational Health and Safety Act*, specify diesel fuel requirements for underground mining applications.

⁶ Available on-line at <https://www.legisquebec.gouv.qc.ca>.

Annex C (informative)

Significance of requirements for biodiesel (B100)

C.1 Introduction

C.1.1 Biodiesel typically has a narrow distillation range. It is normally produced by a reaction of a vegetable oil (such as soybean or canola oil) or an animal fat with an alcohol (such as methyl alcohol) in the presence of a catalyst. This reaction produces mono-alkyl esters and glycerol (glycerin). Most of the glycerol and excess alcohol is then removed from the biodiesel fuel component.

C.1.2 Biodiesel is an oxygenate because it contains oxygen in the ester functional group. The polar nature of long chain alkyl ester molecules, due to the ester functional group, accounts for the differences between certain properties of the biodiesel component and those of hydrocarbon diesel fuel. For example, esters (and alcohol impurities) have higher solubility for water that can raise conductivity and act as electrolytes, which can accelerate corrosion.

C.1.3 The application of the options listed in 7.1 should be based upon information on the following parameters:

- a) intended usage;
- b) storage conditions;
- c) sulphur limits;
- d) cloud point limits;
- e) legal requirements.

C.2 Flash point

C.2.1 The flash point as specified is not directly related to engine performance. It is, however, of importance in connection with legal requirements, such as the *Transportation of Dangerous Goods (TDG) Regulations*, and safety precautions involved in fuel handling and storage. It is normally specified to meet insurance and fire regulations.

C.2.2 The flash point of biodiesel is higher than for diesel fuels. However, the actual flash point of a biodiesel can be related to the concentration of alcohol remaining after its production. This standard allows the use of flash point to limit the remaining alcohol in the biodiesel. The flash point specification, when used for alcohol control for biodiesel, is intended to be 130.0 °C minimum, which has been correlated to 0.2% alcohol by volume in studies.

C.3 Viscosity and lubricity

C.3.1 For some engines, it is advantageous to specify a minimum viscosity because of power loss due to injection pump and injector leakage. Maximum viscosity, on the other hand, is limited by considerations involved in engine design and size, fuel temperature and the characteristics of the injection system (such as fuel pumps, injectors, filters or screens).

C.3.2 While a biodiesel complying with this standard can have a viscosity up to 6.0 cSt at 40 °C, current fuel specifications limit the maximum viscosity of Type B diesel fuel to 4.1 cSt and Type 2 heating fuel oils to 3.6 cSt. These maximum viscosity limits could restrict the amount of biodiesel used in some blended fuels.

C.4 Carbon residue

Carbon residue is a measure of the carbon-depositing tendencies of a diesel fuel after evaporation and pyrolysis under prescribed conditions. While not directly correlating with engine deposits, this property can be considered a guide.

C.5 Sulphur

The use of sulphur levels higher than 15 mg/kg can contribute to the weight of particulates in the exhaust and can have a deleterious effect on catalytic after-treatment systems. Diesel fuel with a maximum sulphur level of 15 mg/kg is required to ensure compatibility with exhaust after-treatment technology of modern diesel-powered equipment.

C.6 Low-temperature operability

C.6.1 Cloud point defines the temperature at which a cloud or haze of wax crystals appears in the fuel under prescribed test conditions. It is the most common measure of low-temperature operability.

C.6.2 The low temperature operability of biodiesel can be a limiting factor in some applications. Biodiesel components typically have relatively high cloud points (-5 °C to 15 °C), depending upon the source of the feedstock.

C.6.3 The specified cold soak filter blocking tendency (CSFBT) (see C.15) limiting value is intended to ensure acceptable operability performance of blends of biodiesel with diesel fuels above the cloud point of the resulting blend. The CSFBT is complementary to ASTM D7501, *Standard Test Method for Determination of Fuel Filter Blocking Potential of Biodiesel (B100) Blend Stock by Cold Soak Filtration Test (CSFT)*. The CSFBT can detect trace constituents of low solubility that are not detected by ASTM D7501.

C.7 Acidity

Biodiesel, as manufactured, typically has a higher acid number than diesel fuel. This is due to the presence of long chain fatty acids that are not as corrosive as simple organic acids such as formic and acetic acid. The latter acids can be formed by oxidative degradation of biodiesel.

C.8 Used lubricating oils or extraneous fluids

Used lubricating oils, extraneous fluids, unconverted triglycerides (such as raw vegetable oils, animal fats, fish oil and used cooking oils) are not suitable components for use in biodiesel fuel blends. The addition of these materials to fuel blends can increase exhaust emissions, increase wear of engine components such as injectors, increase deposits in the engine, and cause premature fuel filter plugging.

C.9 Fuel colour

While this standard does not have a colour requirement, colour can be a useful indicator of fuel quality or contamination. Normally, fuel colour ranges from water white (colourless) to an amber or light brownish colour depending on feedstock type or manufacturing processes. Fuel in long-term storage can darken, due to oxidation. If the darkening is accompanied by the formation of sediment, the fuel could be rendered unacceptable for use. Fuels having unusual shades of colour should be investigated to determine fitness for use.

C.10 Oxidation stability

Products of oxidation in biodiesel can take the form of various acids or polymers, which, if in high enough concentration, can cause fuel system deposits and lead to filter clogging and fuel system malfunctions. Additives designed to retard the formation of acids and polymers can significantly improve the oxidation stability performance of biodiesel. See C.18 for additional information on long-term storage.

C.11 Free glycerin

High levels of free glycerin can cause deposits in diesel fuel injection equipment such as injectors and fuel pumps. Free glycerin can also build up in the bottom of storage tanks.

C.12 Total glycerin

Total glycerin includes free glycerin and the glycerin portion of any unreacted or partially reacted oil or fat. Low levels of total glycerin ensure that high conversion of the oil or fat into its mono-alkyl esters has taken place. High levels of mono-, di-, and triglycerides can cause injector deposits, can adversely affect cold weather operation and can plug filters.

C.13 Phosphorus

Phosphorus can poison or deactivate catalysts used in exhaust after-treatment systems so its level must be kept low.

C.14 Cold soak filtration test (CSFT)

The CSFT test method determines by filtration time after a cold soak, the suitability of a biodiesel (B100) to provide adequate low-temperature operability performance to at least the cloud point of the finished blend provided it meets all other requirements of this standard and has a cloud point below 20 °C.

C.15 Cold soak filter blocking tendency (CSFBT)

Minor components of some biodiesel, including saturated monoglycerides, can separate above the cloud point of a biodiesel fuel blend. The CSFBT test quantifies the propensity of these materials to separate from a biodiesel, diluted with isoparaffinic solvent, after a cold soak cycle.

C.16 Ignition quality: cetane number, derived cetane number and indicated cetane number

C.16.1 Cetane number as determined by ASTM D613 is a measure of the ignition quality of the fuel and influences combustion characteristics. The cetane number requirements depend on engine design and size, nature of speed and load variations, and starting and atmospheric conditions. Higher cetane number fuels generally give better performance in aspects such as cold startability, reduced white smoke after start-up and lower combustion noise.

C.16.2 Test methods ASTM D6890 and D7668, which give a derived cetane number, and test method ASTM D8183, which gives an indicated cetane number, are applicable to biodiesel fuel blends.

C.17 Calcium, magnesium, sodium and potassium

Calcium, magnesium, sodium and potassium can be present in biodiesel as abrasive solids or soluble metallic soaps. Abrasive solids can contribute to injector, fuel pump, piston, and ring wear, as well as to engine deposits. Soluble metallic soaps have little effect on wear, but they can contribute to filter plugging and engine deposits. The elements can form ash compounds that can also accumulate in diesel particulate filters and their removal requires special maintenance procedures. High levels of these ash compounds in the fuel can lead to increased engine backpressure and more frequent service intervals.

C.18 Storage and handling

C.18.1 Guidance on practices for storage, handling and blending of biodiesel is available at the following references.

C.18.1.1 *Guidelines for handling and blending FAME*, CONCAWE Report 9/09, available as a PDF at www.concawe.org.

C.18.1.2 *Biodiesel Handling and Use Guide*, Fifth Edition, 2016, National Renewable Energy Laboratory NREL/BK-5400-6621; DOE/GO-102016-4875.⁷

⁷ Can be found at the following link <https://www.osti.gov/biblio/1347103>.