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CAN/CGSB-3.520-2020

Supersedes CAN/CGSB-3.520-2017

Diesel fuel containing low levels of biodiesel (B1–B5)

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NATIONAL STANDARD OF CANADA **CAN/CGSB-3.520-2020**

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

ICS 75.160.20

Published February 2020 by the
Canadian General Standards Board
Gatineau, (Quebec) 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 Services and Procurement Canada.

This National Standard of Canada CAN/CGSB-3.520 supersedes the 2017 edition.

Changes since the previous edition

- Explicit inclusion of synthetic hydrocarbons
- Modified definitions of 2.5% low-end design temperature, ultra-low sulphur diesel, biodiesel, diesel fuel, low level biodiesel blend
- Addition of a definition for synthetic hydrocarbons
- New paragraph 6.1.3 regarding bias in alternate test methods
- Additional test methods for biodiesel and kinematic viscosity
- Change in referee test method for water and sediment
- Various editorial changes to align 3.517, 3.520 and 3.522
- Revised wording for cautions on fuel colour
- Revised wording on stability and ignition quality in Annex C
- Added ASTM D8183 test method for ignition quality
- Added discussion on distillation in Annex C, C.7
- Added discussion on net energy content to Annex C, C.18
- Added discussion on synthetic hydrocarbons to Annex C, C.20
- Deleted reference to CAN/CGSB-3.0 No 20.9 CGSB cetane index of diesel fuels

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1 Scope

This standard applies to two types of diesel fuel, Type A, Bx and Type B, Bx. Both are suitable for use in high-speed diesel engine powered equipment for on-road and off-road applications and in select equipment powered by medium speed diesel engines.

Bx represents biodiesel fuel containing x percent by volume of biodiesel component in the range of 1.0 to 5.

Type A, Bx is intended for use in selected applications such as urban buses, underground mining or when ambient temperatures require better low temperature properties than provided by Type B, B*x*.

Fuel meeting this standard may be used for underground mining applications that were formerly covered by CAN/CGSB-3.16 (See footnote b and Annex C for notes related to flashpoint).

Users of fuel meeting this standard are advised to refer to the owner's manual of their vehicle, engine or equipment, or to consult with their equipment's manufacturer, regarding the suitability of the specific fuel blend prior to its use[1,2].

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 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. 28.8 — *Visual haze rating of liquid fuels*

No. 140.1 — *Low temperature flow test (LTFT) for diesel fuels*

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[1] Users of this standard may obtain additional information on the use of Fatty Acid Alkyl Esters (FAAE) and the use of biodiesel fuel blends from the Fuel Injection Equipment (FIE) Manufacturers and from the Truck and Engine Manufacturers Association (EMA) at www.truckandenginemanufacturers.org.

[2] See Precautions in section 9.

CAN/CGSB-3.2 — *Heating fuel oil*

CAN/CSGB-3.16 — *Mining Fuel Diesel* (standard withdrawn in June 2013)

CAN/CGSB-3.517 — *Diesel fuel*

CAN/CGSB-3.524 — *Biodiesel (B100) for blending in middle distillate fuels*

CAN/CGSB 3.522 — *Diesel fuel containing biodiesel (B6–B20).*

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 Canadian Fuels Association

Weather Data.

2.2.1 Source

Web site: http://www.canadianfuels.ca/Fuels-and-Transportation/Conventional-Transportation-Fuels/.

2.3 ASTM International

Annual Book of ASTM Standards (see Annex A).

2.3.1 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 1-800-267-8220, fax: 613 237-4251, Web site: www.global.ihs.com.

2.4 SAE International

SAE Paper 952370 — *The lubricity of winter diesel fuels.*

SAE Paper 961180 — *The lubricity of winter diesel fuels — Part 2: pump rig test results.*

SAE Paper 981363 — *Continued evaluation of diesel fuel lubricity by Pump Rig Tests.*

2.4.1 Source

The above may be obtained from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, U.S.A., telephone: 877-606-7323, fax: 724-776-0790, Web site: https://www.sae.org/publications.

3 Terms and definitions

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

3.1
2.5% low-end design temperature (*température minimale de calcul de 2,5 %*)
the temperature at or below which 2.5% of the hourly outside air temperatures are observed to occur for an indicated half month. The 2.5% low-end design temperature for most weather stations in Canada by half month period is available on the Canadian Fuels Association Web site (see 2.2). This dataset is based upon a statistical analysis of hourly weather readings from weather stations across Canada over the thirty-year period from 1981 to 2010 inclusive.

3.2
biodiesel (*biodiesel*)
mono-alkyl esters of long chain fatty acids derived from renewable sources. In its neat form, biodiesel is commonly designated as B100 or fatty acid alkyl esters (FAAE) with fatty acid methyl esters (FAME) being the most common.

3.3
conventional hydrocarbons (*hydrocarbures classiques*)
hydrocarbons derived from natural gas liquid condensates, crude oil, heavy oil, shale oil and oil sands, which are generally accompanied by low levels of naturally occurring non-hydrocarbons.

3.4
diesel fuel (*carburant diesel*)
middle distillate fuel composed of conventional hydrocarbons, synthetic hydrocarbons or mixtures of conventional and synthetic hydrocarbons that boils in the range of 130°–400°C and that is intended for use as a fuel in compression-ignition engines.

3.5
low-level biodiesel fuel blend (*carburant diesel à faible teneur en biodiesel*)
middle distillate fuel composed of hydrocarbons (which may contain naturally occurring, petroleum-derived non-hydrocarbons) that boils in the range of 130°-400°C , contains from 1.0% to 5% by volume biodiesel, and that is intended for use as a fuel in compression-ignition engines.

3.5.1
Bx (*Bx*)
fuel comprised of *x* percent by volume of a biodiesel mixed with diesel fuel.

3.6
representative fuel (*carburant représentatif*)
sample of finished fuel with inspection properties that are typical of the fuel as commercially supplied.

3.7
synthetic hydrocarbons (*hydrocarbures synthétiques*)
hydrocarbons derived from non-petroleum sources such as biomass, natural gas, coal, fats and oils by processes such as gasification, reforming, Fischer-Tropsch synthesis, hydroprocessing or hydrocracking (including co-processing with petroleum).

3.8
ultra low sulphur diesel (ULSD) (*carburant diesel à très faible teneur en soufre*)
diesel fuel with a maximum sulphur content of 15 mg/kg.

4 Classification

4.1 The low-level biodiesel fuel blend shall be supplied in the following types, as specified (see 8.1):

4.1.1 Types

Type A, B*x*

Type B, B*x*.

4.1.2 See 6.24.1 and 6.24.2 for decimal requirements for *x*.

5 General requirements

5.1 The fuel specified shall be a blend of diesel fuel and biodiesel that may contain additives designed to improve their properties or performance, for example, diesel ignition quality, low-temperature flow properties and electrical conductivity. Synthetic hydrocarbons may be present in any concentration in the diesel fuel component of fuel complying with this standard (see Annex C, C.20).

5.2 The fuel shall be a stable homogeneous liquid free from foreign matter that is likely to clog filters or nozzles, or to damage equipment.

5.3 There shall be no intentional additions 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 fuel.

6 Detailed requirements

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

NOTE The precision statements of some of the quoted test methods in this standard may not be fully applicable.

6.1 Specified limiting values

6.1.1 The low-level biodiesel fuel blend 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.

6.1.2 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 6.5).

6.1.3 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.

6.1.4 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 $P = 0.5$.

6.1.5 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

6.2.1 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.

6.2.2 Validated test methods shall correlate with methods referenced in the standard. Differences in precision, sensitivity and bias between methods referenced in the standard and the validated methods shall be noted when using results from validated methods.

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

6.2.4 In the event of a dispute, the procedures given in 6.1 shall be used.

6.2.5 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.

6.3 Low-temperature flow properties

6.3.1 Low-temperature flow properties of the fuel shall be designed (see 8.1) to give satisfactory performance at the temperatures indicated by the 2.5% low-end design temperature data for the period and location of intended use.

6.3.2 The following shall be reported:

a) The 2.5% low-end temperature to which the fuel is designed.

b) The test method used to determine the operability temperature:

   i) Cloud point (ASTM D2500, D5771, D5772 or D5773. In the event of a dispute, ASTM D5773 shall be the referee method.); or

   ii) Low-temperature flow test (LTFT) for diesel fuels (CAN/CGSB-3.0 No. 140.1 or ASTM D4539. In the event of a dispute, CAN/CGSB-3.0 No. 140.1 shall be the referee method).

c) The test method result.

	Property	Specified limiting values				
		Type A, B*x*		Type B, B*x*		Test method
		Min.	Max.	Min.	Max.	ASTM
6.4	Biodiesel Content, % by volume (see 6.24)	1.0	5	1.0	5	see 6.24.3
6.5	Flash point[a], °C (see 6.18 and 8.2)	40.0	—	40.0	—	D93[b], D3828[c] or D7094
6.6	Kinematic viscosity at 40°C, mm^2/s (cSt)[d]	1.30	3.60	1.70[e]	4.10	D445[b], D7042 or D7945[f]
6.7	Distillation, 90% recovered, °C (see 6.19)	—	290.	—	360.	D86[b], D2887 or D7345

	Property	Specified limiting values				
		Type A, B*x*		Type B, B*x*		Test method
		Min.	Max.	Min.	Max.	ASTM
6.8	Water and sediment, % by volume (see 6.20)	—	0.02	—	0.02	D1796 (modified) or D2709[b]
6.9	Acid number, mg KOH/g	—	0.10	—	0.10	D664 or D974[b]
6.10	Sulphur[g], mg/kg	—	15	—	15	D2622, D5453[b] or D7039
6.11	Copper strip corrosion, 3 h at a minimum test temperature of 50°C	—	No. 1	—	No. 1	D130
6.12	Carbon residue on 10% bottoms, % by mass (see 6.21)	—	0.1	—	0.2	D524 or D4530[b]
6.13	Ash, % by mass	—	0.010	—	0.010	D482
6.14	Ignition quality, cetane number (CN), derived cetane number (DCN) or indicated cetane number (ICN) (see 6.22 and 8.2)	40.0	—	40.0	—	D613[b], D6890, D7668[h] or D8183[h]
6.15	Electrical conductivity, at point, time and temperature of delivery to purchaser, pS/m (see 9.1)	25	—	25	—	D2624
6.16	Low-temperature flow properties (see 8.1)	As specified in 6.3				
6.17	Lubricity (see 9.2)	As specified in 6.23				

[a] A higher flash point may be specified in special applications such as marine on-board use (see Annex B, B.1). For underground mining applications, the authority having jurisdiction may specify a different flash point requirement (see Annex B, B.2).

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

[c] The results obtained by ASTM D3828 can be more than 2°C lower than those obtained by ASTM D93, the referee method.

[d] The SI unit for kinematic viscosity is the square metre per second. The preferred multiple for fluids in this viscosity range is the square millimetre per second, which is equivalent to a centiStokes (i.e. 1 mm^2/s = 1 cSt).

[e] If the 2.5% low-end design temperature is -10°C or colder for the period and location of intended use, then the minimum viscosity shall be 1.50 cSt. If the 2.5% low-end design temperature is -20°C or colder for the period and location of intended use, then the minimum viscosity shall be 1.30 cSt.

[f] This test method only has valid precision data for fuels exceeding 2.06 cSt.

[g] Maximum limit may be higher for some applications when allowed by federal regulation (see Annex B, B.1.1.3).

[h] 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.

6.18 Flash point

The test values shall be reported to the nearest 0.5°C in accordance with ASTM D93, D3828 or D7094 (see 8.2).

6.19 Distillation

When testing in accordance with ASTM D2887, the method in the annex shall be used to convert the results to estimates of ASTM D86. In the event of a dispute, the automated method of ASTM D86 shall be the referee test method.

6.20 Water and sediment

The test in ASTM D1796 shall be modified by substituting the centrifuge tube specified in ASTM D2273 for that in ASTM D1796.

6.21 Carbon residue

Testing may be performed prior to the addition of any additives to the fuel.

6.22 Ignition quality

The calculated cetane index according to ASTM D976 or D4737, or other calculation techniques that approximate cetane number by ASTM D613, may be used for control purposes. ASTM D976 and D4737 should not be used for determining the ignition quality of fuel containing cetane improver additive or biodiesel.

6.23 Lubricity requirements

Either the diesel fuel or the finished biodiesel fuel blend shall provide acceptable lubricity performance in accordance with any one of the following criteria:

6.23.1 Pump wear with a representative fuel in a distributor-type diesel fuel injection pump in a vehicle field test

The required vehicle field test methodology is described in SAE Paper 952370. An acceptable pump-wear result is defined as an overall pump rating of 4.0 or less using the rating method described in SAE Paper 961180.

6.23.2 Pump wear with a representative fuel in a distributor-type diesel fuel injection pump rig test

The required pump rig test methodology is described in SAE Paper 981363. SAE Papers 961180 and 952370 provide additional background information. An acceptable pump-wear result is defined as an overall pump rating of 4.0 or less using the rating method described in SAE Papers 981363 and 961180.

6.23.3 Lab bench test results with a representative fuel using the high frequency reciprocating rig test

The required high frequency reciprocating rig test is described in ASTM D6079 and D7688, and shall be run at 60°C. An acceptable test result is defined as a wear scar diameter of less than or equal to 460 µm. In the event of a dispute, ASTM D6079 shall be the referee test method for this criterion.

6.24 Biodiesel component

The biodiesel component (see 3.2) shall comply with CAN/CGSB-3.524.

6.24.1 A minimum concentration of 1.0% by volume biodiesel is specified to differentiate this standard from similar standards. The concentration of 1.0% is intentionally stated to one decimal place to ensure that the minimum concentration of biodiesel in a fuel identified as a low-level biodiesel fuel blend shall be at least 0.95% by volume.

6.24.2 Percentage concentrations of biodiesel (B*x*) shall be expressed in whole numbers, such as B5 for 5% by volume. Normal rounding practices in accordance with the rounding-off method of ASTM E29 apply.

6.24.3 The biodiesel component shall comply with CAN/CGSB-3.524. Metered or measured volumes of added biodiesel shall be the primary measurement of biodiesel concentration. If an analytical test method has to be used for biodiesel concentration then use ASTM D7371 or D7806.

6.24.4 Blending of biodiesel and the diesel fuel component shall be performed so that the final blend is homogeneous.

7 Inspection

7.1 Sampling

7.1.1 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.

7.1.2 Sample volume should be consistent with the requirement of the testing laboratory or the authority having jurisdiction or both. Unless otherwise specified (see 8.2), a sample of at least 2.7 L shall be collected.

8 Options

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

a) Type of fuel (see 4.1);

b) Low-temperature design requirements for period and location of intended use (see 6.3).

8.2 The following options may be specified if the requirements are more stringent than those stipulated in this standard:

a) Flash point (see 6.5);

b) Ignition quality (see 6.14 and 9.10);

c) Sample size (see 7.1.2).

9 Precautions

9.1 Conductivity depletion

Due to the normal depletion of fuel conductivity during commingling, storage, and distribution, or at low temperatures, the fuel should be sufficiently treated with conductivity-improver additive to ensure that the electrical conductivity requirement in 6.15 is met. The temperature at the point of use and the method of distribution could require a substantially higher conductivity level than 25 pS/m at the point of additive treatment. It should also be noted that samples in clear bottles exposed to sunlight can show a rapid depletion in conductivity. For more information, refer to Annex C, C.14, ASTM D4865 and D2624.

NOTE Negative interactions can occur between some biodiesels and conductivity additives.

9.2 Fuel lubricity

Some processes that are used to desulphurize diesel fuel, if severe enough, can also reduce the natural lubricating qualities of the diesel fuel. Most biodiesels exhibit very good lubricity. Since diesel injection systems require the fuel to act as a lubricant, the fuel should have sufficient lubricity to give adequate protection against excessive fuel injection system wear. Additives are available that can improve diesel fuel lubricity. Lubricity additives can have unwanted side effects, particularly when used at excessive concentrations or in combination with other additives or contaminants. Adding over 1% by volume of biodiesel generally results in acceptable lubricity.

9.3 Heating oil application

At times, low-level biodiesel fuel blends can be used in a heating oil application. In these cases, refer to CAN/CGSB-3.2 for detailed requirements.

9.4 Manufacturing processes

Contamination from manufacturing processes or treatments can be carried over in trace quantities into the biodiesel fuel blend and cause unexpected problems. These contaminants 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 manufacturing processes capable of such contamination are identified and controlled. Sodium, calcium, chlorides, sulphates, clay, sand, acids, caustic, soaps, and amine process additives are examples of possible contaminants or potential precipitates.

9.5 Visual haze

The solubility of water in fuel is a function of temperature. When fuel is exposed to low ambient temperatures, water can separate and cause a hazy or cloudy appearance. It has been a common industry practice to perform the visual haze test at 4°C for fuel destined for use in winter and at 15°C for fuel destined for use in summer. Experience has indicated that fuel passing these requirements has been acceptable in the appropriate season. For further information on the visual haze test, refer to CAN/CGSB-3.0 No. 28.8 or to ASTM D4176, Procedure 2.

9.6 Impact of biodiesel on stability

Manufacturers of diesel fuel injection equipment and diesel engines have expressed concerns with the degradation of biodiesel fuel blends when equipment designs expose the fuel to high temperatures. Fuel blends with poor stability can lead to problems such as filter plugging, sediment formation and lacquering of fuel injection equipment. Note that there is a stability requirement for the biodiesel component (CAN/CGSB-3.524).

9.7 Fuel flammability

A number of properties should be considered in assessing the overall flammability hazard of a fuel. Flash point is the minimum fuel temperature at which a mixture of air and fuel vapour can form and be ignited by a spark or flame under specified laboratory conditions. However, the flash point is only an indication of the potential flammability risk of a fuel. Oxygen concentration in the atmosphere is an additional factor affecting flammability. Investigation of fuel-related fires in marine vessel engine rooms and underground mining applications has shown that these fires are generally initiated through direct contact of a fuel spray or spill with hot surfaces having a temperature exceeding the auto-ignition temperature of the fuel. The flash point of the fuel has little bearing on the probability of such fires occurring. Similarly, fires in fuel tanks are typically initiated as a result of hot work (e.g., welding) on the exterior surface of the tank causing fuel adhering to the interior tank wall surface to evaporate and spontaneously ignite after having exceeded its auto-ignition temperature.

9.8 Fuel colour

Fuels having unusual shades of colour should be investigated to determine fitness for use.

9.8.1 Existing fuel colour

Although this standard does not have a colour requirement, colour can be a useful indicator of fuel quality or contamination. Fuel can present several different hues or colours depending on feedstock types and/or manufacturing processes.

9.8.2 Change in fuel colour

Fuel in long term storage can darken owing to oxidation of trace components. If the darkening is accompanied by the formation of sediment, the fuel could be rendered unacceptable for use.

9.9 Hydrogen sulphide

Hydrogen sulphide (H_2S) can occasionally be found in limited concentration in the vapour phase above diesel fuels. H_2S is toxic at low concentrations in air. Additives are available that can react with H_2S in the liquid phase and reduce the concentration of H_2S both in the fuel and in the vapour phase.

9.10 Ignition Quality

Fuel having a higher ignition quality (cetane number, derived cetane number or indicated cetane number) can be necessary for some engines. Conditions of operation can also dictate the specification of a higher ignition quality. Users should consult the equipment manufacturer for further details.

Annex A
(normative)

Referenced ASTM International publications (see 2.3)

Annual Book of ASTM Standards

D86 Standard Test Method for Distillation of Petroleum Products and Liquid Fuels at Atmospheric Pressure

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

D130 Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test

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

D482 Standard Test Method for Ash from Petroleum Products

D524 Standard Test Method for Ramsbottom Carbon Residue of Petroleum Products

D613 Standard Test Method for Cetane Number of Diesel Fuel Oil

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

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

D976 Standard Test Methods for Calculated Cetane Index of Distillate Fuels

D1796 Standard Test Method for Water and Sediment in Fuel Oils by the Centrifuge Method (Laboratory Procedure)

D2273 Standard Test Method for Trace Sediment in Lubricating Oils

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

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

D2624 Standard Test Methods for Electrical Conductivity of Aviation and Distillate Fuels

D2709 Standard Test Method for Water and Sediment in Middle Distillate Fuels by Centrifuge

D2887 Standard Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography

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

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

D4057 Standard Practice for Manual Sampling of Petroleum and Petroleum Products

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

D4177 Standard Practice for Automatic Sampling of Petroleum and Petroleum Products

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

D4539 Standard Test Method for Filterability of Diesel Fuels by Low-Temperature Flow Test (LTFT)

D4737 Standard Test Method for Calculated Cetane Index by Four Variable Equation

D4865 Standard Guide for Generation and Dissipation of Static Electricity in Petroleum Fuel Systems

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

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

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

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

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

D6079 Standard Test Method for Evaluating Lubricity of Diesel Fuels by the High-Frequency Reciprocating Rig (HFRR)

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

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

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

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

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

D7345 Standard Test Method for Distillation of Petroleum Products and Liquid Fuels at Atmospheric Pressure (Micro Distillation Method)

D7371 Standard Test Method for Determination of Biodiesel (Fatty Acid Methyl Esters) Content in Diesel Fuel Oil Using Mid Infrared Spectroscopy (FTIR-ATR-PLS Method)

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

D7688 Standards Test Methods for Evaluating Lubricity of Diesel Fuels by the High-Frequency Reciprocating Rig (HFRR) by Visual Observation

D7806 Standard Test Method for Determination of the Fatty Acid Methyl Ester (FAME) Content of a Blend of Biodiesel and Petroleum-Based Diesel Fuel Oil Using Mid-Infrared Spectroscopy

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

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

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[3,4,5]

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 used 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 The following federal regulations also apply to fuels meeting this standard:

B.1.2.1 ***Marine Machinery Regulations*** (SOR 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.

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[3] 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.

[4] 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.

[5] This list is provided for information only and may not be complete. Please advise the CGSB of any other regulation that could apply on this standard.

B.2 Provincial regulations

B.2.1 Alberta

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

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

B.2.2 British Columbia

B.2.2.1 ***Renewable and Low Carbon Fuel Requirements Regulation*** (B.C. Reg. 394/2008 as amended by B.C. reg. 320/2009 and B.C. reg. 379/2010)

These regulations define the requirements for renewable fuels in British Columbia. The regulation is available online at http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/394_2008.

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)

This regulation, enacted under the *Dangerous Goods Handling and Transportation Act*, specifies requirements for storage and handling of fuels in Manitoba.

B.2.3.2 ***Biodiesel (General) Regulation*** (Man. reg. 178/2008)

This regulation defines the quality requirements for biodiesel and biodiesel blended with diesel in Manitoba. The regulation is available at the following address: https://www.canlii.org/en/mb/laws/regu/man-reg-178-2008/.

B.2.3.3 ***Biodiesel Mandate for Diesel Fuel Regulation*** (Man. reg. 147/2009)

This regulation defines the volume requirements for biodiesel content in diesel in Manitoba.

B.2.3.4 ***Operation of Mines Regulation*** (Man. reg. 212/2011)

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.

B.2.5 Newfoundland and Labrador

B.2.5.1 ***Mines Safety of Workers Regulations*** (NRL 5/12)

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. 296/2008)

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*[6], 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 ***Greener Diesel — Renewable Fuel Content Requirements for Petroleum Diesel Fuel*** (Ontario regulation 97/14)

This regulation, enacted under the *Environmental Protection Act*, defines the requirements for renewable fuels in Ontario.

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, 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: https://mern.gouv.qc.ca/english/energy/index.jsp.

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[6] Available from Service Ontario Publications, Toronto, ON, Canada, telephone: 1-800-668-9938, fax: 613-545-4223. Also available on-line at www.publications.serviceontario.ca/.

B.2.10.2 ***Regulation Respecting Occupational Health and Safety in Mines*** (CQLR., 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 *An Act respecting Occupational health and safety* and specifies diesel fuel requirements for underground mining applications.

B.2.11 Saskatchewan

B.2.11.1 ***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.

Annex C
(informative)

Significance of requirements for low-level biodiesel fuel blends

C.1 Introduction

C.1.1 The properties of commercial diesel fuels depend on the refining practices employed and the nature of the feedstocks from which they are produced. For example, diesel fuel produced within the boiling range of 130°-400°C may have many possible combinations of various properties such as volatility, ignition quality, and viscosity.

C.1.2 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 are then removed from the biodiesel fuel component.

C.1.3 Biodiesel is an oxygenate as 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 electrolyte, which can accelerate corrosion.

C.2 Types of fuel

C.2.1 CAN/CGSB-3.520 is intended as a statement of permissible limits of significant fuel properties for combinations of a wide variety of diesel fuels with low levels of biodiesel. Limiting values of significant properties are prescribed for two types of fuel. These types and their general applicability for use in diesel engines are broadly indicated as follows.

C.2.2 Type B, B*x* is seasonally adjusted to meet the low temperature operability requirements for the period and location of intended use for most locations in Canada. This adjustment affects the other properties of the fuel.

C.2.3 Type A, B*x* is applicable for use where the low temperature operability of Type B, B*x* is insufficient. (See Annex C, C10.6 and C.15.9.)

C.2.4 CAN/CGSB-3.517 is a parallel standard for diesel fuel with less than 1.0% by volume of biodiesel.

C.3 Selection of a particular biodiesel fuel blend

The selection of a particular biodiesel fuel blend for use in a given engine requires consideration of the following factors:

a) Legal requirements

b) Expected ambient temperatures at location and time of use

c) Availability

d) Maintenance frequency and requirements

e) Engine size and design

f) Speed and load changes

g) Engine manufacturer’s recommendations and fuel specifications.

Some of these factors (a-g) may influence the required fuel properties outlined in C.4 to C.20.

C.4 Flash point

C.4.1 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.4.2 The flash point of biodiesel is higher than that of diesel fuels. However, the actual flash point of a biodiesel can be related to the concentration of alcohol remaining after its production. CAN/CGSB-3.524 allows the use of flash point to limit the remaining alcohol in the biodiesel.

C.5 Ignition quality

C.5.1 Cetane number, derived cetane number and indicated cetane number are measures of the ignition quality of the fuel, and influence combustion characteristics. The ignition quality requirements depend on engine design and size, nature of speed and load variations, and starting and atmospheric conditions. Higher ignition quality fuels generally give better performance in aspects such as cold startability, reduced white smoke after start-up and lower combustion noise.

C.5.2 Test methods ASTM D6890, and D7668, which give a derived cetane number, are applicable to biodiesel fuel blends. Test method D8183 gives an indicated cetane number and is also applicable to biodiesel fuel blends.

C.6 Viscosity and lubricity

C.6.1 A minimum viscosity is specified to minimize power loss due to injection pump and injector leakage and ensure sufficient hydrodynamic lubrication of fuel system components. Maximum viscosity is limited to ensure fuel pumpability and proper functioning of the injection system.

C.6.2 For some diesel engines, the fuel is a lubricant for the injection system, therefore, it must have sufficient lubricity to ensure fuel system durability and hence emission durability requirements. Fuel lubricity can be defined as the ability of a fuel to prevent or minimize wear in diesel fuel injection equipment.

C.7 Distillation

C.7.1 Fuel volatility requirements also depend on engine design and size, nature of speed and load variations, as well as starting and atmospheric conditions. More volatile fuels can provide better startability and reduced white smoke under cold engine operation.

C.7.2 Biodiesel has a narrow boiling range, typically between 300°C and 400°C. Adding biodiesel to a conventional Type A or Type B diesel fuel can raise the 90% distillation temperature. The maximum 90% distillation temperature limits of 290°C for Type A, B*x* and 360°C for Type B, B*x* are based on Canadian experience with petroleum-derived diesel fuel.

C.8 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.9 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. 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.10 Low-temperature operability

C.10.1 Low-temperature operability of diesel fuel and biodiesel fuel blends may be defined by either cloud point or low-temperature flow tests or some combination thereof.

C.10.2 Cloud point defines the temperature at which the smallest observable cluster of hydrocarbon crystals first appears in a fuel upon cooling under prescribed test conditions. It is the most common measure of low-temperature operability.

C.10.3 The low-temperature flow test was developed in order to predict low-temperature operability of fuels to which a flow improver additive has been added. A cloud point test on such additized fuels might not accurately predict the operability limit of the fuel due to the use of these additives.

C.10.4 The low-temperature operability of biodiesel fuel blends can limit availability in some jurisdictions and seasons. Biodiesel components typically have relatively high cloud points (-5 to +15°C) depending upon the source of the feedstock.

C.10.5 The viscosity of a fuel blend will increase under cold ambient temperatures. In some situations the fuel's viscosity can be the limiting low-temperature operability factor as opposed to wax formation in the fuel.

C.10.6 Precipitation of biodiesel fuel blend components above the cloud point has been reported, and is more likely if the fuel is stored for an extended period at low temperatures, or if it experiences temperatures near the cloud point during storage or handling, and if it contains free water or excessive rust or dirt.

C.11 Ash

C.11.1 Ash-forming materials can be present in diesel fuels as abrasive solids and soluble metallic soaps. Abrasive solids can contribute to injector, fuel pump, piston and ring wear, and also to engine deposits. Soluble metallic soaps have little effect on wear but can contribute to engine deposits.

C.11.2 CAN/CGSB-3.524 limits contamination by alkali metals resulting from catalysts used in esterification processes by directly limiting Na, K, Ca and Mg.

C.12 Acidity

C.12.1 There is directional evidence that acidic fuels can have poorer stability, can cause increased corrosion of mild steel, and can cause deposit formation in some types of fuel injection equipment.

C.12.2 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. CAN/CGSB-3.524 contains a specification on acidity.

C.13 Copper strip corrosion

This test serves as a measure of possible corrosion of copper, brass or bronze parts in the fuel system due to corrosive sulphur species.

C.14 Electrical conductivity

The ability of a fuel to dissipate electric charge that has been generated during pumping and filtering operations is controlled by its conductivity. If a fuel's conductivity is sufficiently high, the static electric charge dissipates fast enough to prevent its accumulation, so that dangerously high electrical potentials are avoided. Negative interactions can occur between some biodiesels and conductivity additives.

C.15 Recommended practices for the storage and handling of low-level biodiesel fuel blends

C.15.1 Recommended practices for storage and blending with diesel fuel to ensure precipitation does not occur in the finished fuel due to temperature, solubility, moisture and concentration effects are available as follows:

C.15.1.1 *Biodiesel Handling and Use Guide,* Fourth edition 2009 NREL/TP-540-43672, National Renewable Energy Laboratory, web site: http://www.nrel.gov/docs/fy09osti/43672.pdf.

C.15.1.2 *Guidelines for handling and blending FAME* (CONCAWE report No. 9/09), available as a PDF at www.concawe.org.

C.15.2 It is especially important to store biodiesel fuel blends under clean, dry and cool conditions. Biodiesel fuel blends are more susceptible to microbial attack than diesel fuel. This risk can be reduced by good housekeeping and ensuring that storage tanks and filter housings are regularly drained to keep them dry. For more information on microbial contamination, refer to ASTM D6469[7].

C.15.3 Organic sediment can appear in fuels in long-term storage. Filtration is recommended prior to use.

C.15.4 Where long-term storage of biodiesel fuel blends is contemplated, use of stability additives (e.g. anti-oxidants, metal deactivators and dispersants) should be considered. The fuel supplier should be consulted.

C.15.5 Users of biodiesel fuel blends are advised to be cautious of storing blended fuel for an extended period of time. A good practice would be not to exceed six month's storage.

C.15.6 Fuel storage containers and tanks should be opaque. Some translucent (plastic) tanks exposed to light have proven to be unsatisfactory for the storage of fuels.

C.15.7 When blending biodiesel and diesel fuel, each should be at least 5°C above their respective cloud point to prevent precipitation of trace components from some biodiesels. Such precipitates might not re-dissolve, and can plug filters on fuel dispensers or equipment. The blend of the two components should also be homogeneous. "Splash blending" or sequential blending of components can result in heterogeneous (non-uniform) batches of product, resulting in some product having very high concentrations of biodiesel, and some product having little or none.

C.15.8 Filter plugging problems

A number of contaminants in some biodiesels have relatively low solubility in diesel fuel and can precipitate from fuel blends, sometimes in a non-reversible manner. This includes sterol glucosides and some saturated monoglycerides. Exposure to cold temperatures over time can accelerate this precipitation and the formation of larger agglomerates. These can settle in the bottom of storage tanks and plug filters.

C.15.9 Low temperature bulk storage

Exercise caution if biodiesel fuel blends have experienced temperatures below -15°C as precipitates can occur in bulk storage.

C.16 Used lubricating oils or extraneous fluids

Used lubricating oils, extraneous fluids or 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.

[7] ASTM D6469 — Standard Guide for Microbial Contamination in Fuels and Fuel Systems.

C.17 Stability

C.17.1 Storage Stability

During storage, fuel can degrade at ambient temperature due to oxidation. These oxidative reactions produce acidic compounds, fuel soluble polymers and fuel-insoluble materials, such as gum, varnish/lacquer and sediment. The acids produced can further react with trace metal ions to produce soaps that can plug filters and also cause fuel injection equipment to malfunction. The gums that are produced can adhere to surfaces and cause fuel injection equipment to fail. Any sediment produced can plug fuel filters. Notably the presence of certain metals such as copper or zinc will accelerate these oxidative reactions.

C.17.2 Thermal Stability

Heat transfer is a design function of fuel in modern diesel engines. In some engines, only a portion of the fuel that is circulated and pressurized by the fuel injection system is actually combusted. The remainder of the fuel is recycled back to the equipment's fuel tank. Over time the bulk temperature of this fuel can be well above ambient levels. Inadequate high-temperature stability of a fuel can result in the formation of insoluble degradation products that can then cause filter plugging.

C.17.3 Test methods

Traditional test methods for measuring the stability of diesel fuels, such as ASTM D2274 and ASTM D6468, are not suitable for diesel fuels containing biodiesel. To differentiate or monitor stability for these fuels, EN 15751 or ASTM D7545 may be used. Unlike the traditional methods, both measure an induction period based on the reaction of oxygen with the fuel. At present, performance of Canadian diesel fuels in EN 15751 and ASTM D7545 has not been established. EN 15751 is not applicable to blends containing less than 2% by volume of biodiesel. It is also known that ASTM D7545 can indicate significantly reduced stability in the presence of cetane improver (2-ethylhexyl nitrate), and variants of the method at lower temperatures (e.g., 120°C) are being considered to reduce this effect.

C.17.4 If a sample of biodiesel fuel blend is being collected for stability testing, use sample containers that will not affect the stability properties of biodiesel blends. Some plastic bottles can contain anti-oxidants that can be extracted by esters, affecting the results of stability tests on samples. Consult ASTM D4306 or IP 306 for guidance. Tests should be conducted as soon as possible or a nitrogen blanket is recommended.

C.18 Density and net energy content

While density is not a requirement of this standard, the density of a batch of fuel should be measured and reported on the Certificate of Analysis for quality control purposes and to allow calculation of the mass of a given volume of fuel. Knowledge of the original density of a batch of fuel is useful to someone receiving the fuel. If the density of the fuel as received is significantly different from its original density measurement, it indicates possible contamination and is cause for further product quality investigation. Liquid density can be measured in fuel using ASTM D1298, D4052 or D7042. The density of fuel varies depending on the refinery processes used, the crude from which the diesel fuel is produced and the overall composition of the fuel.

For diesel engine applications (as the water in the exhaust is still in vapour form), fuel consumption and power output are related to net energy content (also known as net calorific value, lower heating value or net heat of combustion). Lower fuel consumption or higher power output is generally obtained with fuels with a higher net energy content per unit volume. Biodiesel has a lower energy content than a hydrocarbon of similar density because of the oxygen content in biodiesel.

C.19 Biodiesel component in biodiesel fuel blends

C.19.1 In meeting the requirements of CAN/CGSB-3.524, the precision and bias statements for some ASTM test methods specified therein are unknown for the biodiesel component.

C.19.2 Composition

High levels of free glycerine and mono-, di- and tri-glycerides in the biodiesel component can cause injector deposits and filter plugging, as well as adversely affect low temperature operability. CAN/CGSB-3.524 has established performance requirements to minimize these problems.

C.19.3 Oxidative stability

ASTM D6751[8] contains a minimum induction period of 3 h by EN 15751[9] (often called the Rancimat stability test), the European biodiesel fuel standard, EN 14214[10], requires a minimum induction period of 8.0 h by EN 14112[11] or EN 15751, and CAN/CGSB-3.524 requires a minimum of 8 h by EN 14112 or EN 15751. In the Rancimat stability test, fuel is thermally stressed at 110°C in the presence of oxygen and the generation of volatile acids (collected by sparging through water) is determined by conductance.

C.20 Synthetic hydrocarbons

Synthetic hydrocarbons include hydrocarbons derived from non-petroleum sources such as biomass, natural gas, coal, fats and oils by processes such as gasification, reforming, Fischer-Tropsch synthesis, hydroprocessing or hydrocracking (including co-processing with petroleum). Other terms used to refer to synthetic hydrocarbons for diesel engines include: biomass-to-liquid (BTL) diesel, gas-to-liquid (GTL) diesel, coal-to-liquid (CTL) diesel, hydrogenation-derived renewable diesel (HDRD), hydrotreated vegetable oil (HVO), renewable hydrocarbon diesel (RHD), hydroprocessed esters and fatty acids (HEFA), and synthesized paraffinic diesel (SPD).

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[8] ASTM D6751 — Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels.

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

[10] EN 14214 — Automotive fuels — Fatty acid methyl esters (FAME) for diesel engines — Requirements and test methods (includes Amendment A1: 2009).

[11] EN 14112 — Fat and oil derivatives — Fatty acid methyl esters (FAME) — Determination of oxidation stability (accelerated oxidation test).