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Supersedes CAN/CGSB-3.2-2017

Heating fuel oil

Canadian General Standards Board CGSB

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NATIONAL STANDARD OF CANADA **CAN/CGSB-3.2-2020**

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Heating fuel oil

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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-3.2 supersedes the 2017 edition.

Changes since the previous edition

- Explicit inclusion of synthetic hydrocarbons
- Additional test method for kinematic viscosity
- Revised referee test method for water and sediment
- Additional test method for biodiesel content
- New requirement for lubricity
- Revised wording for cautions on conductivity depletion and fuel colour
- New cautions regarding synthetic hydrocarbons and fuel lubricity
- Added an informative Annex C Significance of requirements for Type 2 fuel oil containing 1 to 5% biodiesel

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Heating fuel oil

1 Scope

This standard applies to three types of middle distillate fuel oils that are suitable for use in liquid fuel burning equipment without preheating (Types 0, 1 and 2), and three types of fuel oils that contain residual fuel components and require preheating (Types 4, 5 and 6).

The heating fuel oils covered by this standard are intended for use in oil burning equipment to generate heat for domestic and industrial purposes.

Types 0, 1 and 2 fuel oils are primarily for use in domestic oil burning appliances. They may also be used for some industrial purposes.

a) Type 0 fuel oil is intended for use in fuel domestic oil burning appliances that have outside storage and where ambient temperatures as low as -48°C could be encountered.

b) Type 1 fuel oil is intended primarily for use in sleeve-type and wick-feed burners, excluding space heaters (see 9.1), and in most vaporizing pot-type burner applications. It is also intended for atomizing burners in which Type 2 fuel oil cannot be used satisfactorily. During periods of lower ambient temperature, Type 1 fuel oil may be used in place of Type 2 to minimize waxing problems.

c) Type 2 fuel oil is a heavier distillate than Type 1 and is intended for use in most atomizing-type burner applications. This type of fuel oil is used in most domestic oil burning appliances and in some medium capacity commercial and industrial burners. Type 2 may contain up to 5% biodiesel (See Annex C).

Types 4, 5 and 6 fuel oils are primarily for use as industrial fuels: suitable for use in the pulp and paper industry, metallurgical operations, heat or power generation, etc.

a) Type 4 is an industrial fuel oil intended primarily for burner installations equipped with limited preheating facilities or with no preheating.

b) Type 5 is a residual fuel oil for burner installations equipped with limited preheating facilities that require a fuel oil of lower viscosity than Type 6.

c) Type 6 is a high-viscosity residual fuel oil for use in burners equipped with preheating facilities to handle such fuels.

See Annex B for regulations that apply to heating fuel oil.

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*

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

2.1.1 Source

The above may be obtained from the Canadian General Standards Board, Sales Centre, Gatineau, QC, 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.

It may also be obtained from the Government of Canada Publications, Publishing and Depository Services, Public Services and Procurement Canada, Ottawa, ON, K1A 0S5. Telephone: 1-800-635-7943 or 613-941-5995. Fax: 1-800-565-7757 or 613-954-5779. Email: publications@tpsgc-pwgsc.gc.ca. Web site: http://publications.gc.ca/site/eng/home.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.

3 Terms and definitions

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

3.1
biodiesel (*biodiesel*)
blendstock for middle distillate fuels comprised of 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 with fatty acid methyl esters (FAME) being the most common (see 6.25).

3.2
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.

3.3
operability temperature (*température de service*)
lowest temperature at which the fuel oil is designed to provide satisfactory performance under the conditions of storage and use (see 6.23, 6.24 and 9.2).

3.4
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).

3.5
2.5 percentile low-end design temperature (*température minimale de calcul de 2,5 %*)
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.

4 Classification

4.1 Heating fuel oils shall be supplied in the following types, as specified (see 8.1).

4.1.1 Types

Type 0 Type 4

Type 1 Type 5

Type 2 Type 6

5 General requirements

5.1 The heating fuel oils, unless otherwise specified (see 5.4 and 6.17), shall consist of conventional hydrocarbons (i.e. petroleum-derived from natural gas liquid condensates, crude oil, heavy oil, shale oil and oil sands), synthetic hydrocarbons (see 9.12) or mixtures of conventional and synthetic hydrocarbons.

5.2 The heating fuel oils may contain additives designed to improve the characteristics or performance of the fuel oil. Additives include those that enhance low-temperature flow properties, storage life, static charge dissipation, water haze dissipation, lubricity and inhibit corrosion.

5.3 The heating fuel oils shall be a stable homogeneous liquid, free of foreign matter that is likely to clog filters or nozzles, or to damage equipment.

5.4 In Types 0, 1 and 2 fuel oils, 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 fuel. Types 4, 5 and 6 fuel oils may contain used lubricating oils or other fluids provided that the fuel oil is used in specifically designed equipment and the relevant authority approves their use.

5.5 The heating fuel oils shall remain undyed except when it is required for taxation purposes by provincial or territorial regulation.

6 Detailed requirements

6.1 Specified limiting values

6.1.1 The heating fuel oil 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 6.19).

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 referee method listed in the standard shall be used.

	Property	Limit	Specified limiting values						
			Types of fuel oil						Test method
			0	1	2	4	5	6	ASTM
6.3	Flash point, °C (see 6.19)	Min.	40.0	40.0	40.0	54.0	54.0	60.0	D93[a], D3828[b] or D7094
6.4	Kinematic viscosity, at 40°C, mm^2/s (cSt)[c]	Min.	1.20	1.30	1.70[d]	5.5	—	—	D445[a], D7042 or D7945[e]
		Max.	2.00	2.50	3.60	24.0	—	—	
6.5	Kinematic viscosity[f], at 50°C, mm^2/s (cSt)[c]	Min.	—	—	—	—	15	100.	D445[a] or D7042
		Max.	—	—	—	—	100.	650.	
6.6	Distillation (see 6.20)								D86[a], D2887 or D7345
	a) 10% recovered, °C	Max.	—	215	—	—	—	—	
	b) 90% recovered, °C	Max.	—	300.	360.	—	—	—	
	c) end point, °C	Max.	300.	—	—	—	—	—	
6.7	Water and sediment, % by volume (see 6.21)	Max.	0.02	0.02	0.02	—	—	—	D1796 (modified) or D2709[a]
			—	—	—	0.50	1.00	1.00	D95 and D473
6.8	Sulphur, % by mass (see 6.22 and 8.2)	Max.	0.30	0.30	0.50	—	—	—	D1266, D1552, D2622, D4294, D5453[a] or D7039
6.9	Copper strip corrosion, 3 h at minimum test temperature of 50°C[g] (see 9.4)	Max.	No. 1	No. 1	No. 1	—	—	—	D130
6.10	Carbon residue on 10% bottoms, % by mass	Max.	0.1	0.1	0.3	—	—	—	D524 or D4530[a]
6.11	Ash, % by mass	Max.	0.010	0.010	0.010	0.10	0.10	0.20	D482
6.12	Electrical conductivity, at point, time, and temperature of delivery to purchaser, pS/m (see 9.5)	Min.	25	25	25	—	—	—	D2624

	Property	Limit	Specified limiting values						
			Types of fuel oil						Test method
			0	1	2	4	5	6	ASTM
6.13	Density, at 15°C, kg/m^3 (kg/L)[h]	Max.	840. (0.840)	850. (0.850)	900. (0.900)	—	—	—	D1298, D4052[a] or D7042
6.14	Total sediment, % by mass	Max.	—	—	—	0.10	0.15	0.20	D4870
6.15	Pour point, °C (see 6.23, 8.1 and 9.2)	Max.	-48	Report	Report	—	—	—	D97 or D5949[a]
			—	—	—	Report	—	—	D97
6.16	Cloud point, °C (see 6.24 and 8.1)	Max.	-48	Report	Report	—	—	—	D2500 and D5773[a]
6.17	Biodiesel, % by volume (see 6.25 and Annex C)	Min.	—	—	—	—	—	—	D7371 or D7806
		Max.	0	0	5	—	—	—	
6.18	Lubricity, as wear scar diameter in micrometers (µm) (see 9.13)	Max.	520	520	520	—	—	—	D6079[a] or D7688

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

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

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

[d] 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.

[e] ASTM D7945 only has valid precision data for Types 2 and 4.

[f] Approximate viscosity equivalents at 100°C are as follows:

Temperature:	50°C	100°C
Viscosity (cSt):	15	5
	100	15
	150	20
	650	50

[g] Copper corrosion testing for 2 h at 100°C has been shown to be more severe than 3 h at 50°C.

[h] The SI unit for density is the kilogram per cubic meter (kg/m^3). The litre is not a SI unit, however, it is widely used in conjunction with SI units. For conversion, 1 cubic meter is 1000 litres exactly.

6.19 Flash point

The test values shall be reported to the nearest 0.5°C in accordance with ASTM D93, D3828 or D7094 (see 6.3 and table footnote b).

6.20 Distillation

When testing in accordance with ASTM D2887, use the method in the appendix 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.

6.21 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. For Types 4, 5 and 6, ASTM D95 determines water by distillation and ASTM D473 determines sediment by extraction.

6.22 Sulphur

Sulphur content is established by government regulations in effect where the fuel oil is to be used, or by contractual agreement.

6.23 Pour point

Pour point, except for Type 0, may be specified as required for the conditions of storage and use or as agreed by contract. Pour-depressed and flow-improved fuel oil that is designed to provide satisfactory performance under the conditions of storage and use may also be used.

6.24 Cloud point

Cloud point for Types 1 and 2 may be specified as required by the conditions of storage and use or as agreed by contract.

6.25 Biodiesel

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.

7 Inspection

7.1 Sampling

7.1.1 Sampling equipment and procedures shall be designed and used to obtain representative samples of a product. Sampling lines and hoses 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), or if the amount required is not known, 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) Pour point or cloud point except for Type 0 (see 6.15/6.23 and 6.16/6.24).

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

a) Sulphur (see 6.8)

b) Sample size (see 7.1.2).

9 Precautions

9.1 Wick-type kerosene heaters

Fuel oils meeting the requirements of this standard are not intended for use in wick-type kerosene burning space heaters. When in doubt, consult the equipment operating instructions or the manufacturer of the appliance.

9.2 Pour point

The pour point of the biodiesel fuel blend should be suitable as required for the conditions of storage and use or as agreed by contract. The addition of biodiesel can degrade the low temperature properties of the heating fuel oil. The effectiveness of some fuel additives can be affected when biodiesel is blended into the fuel.

9.3 Storage stability

Furnace burner manufacturers have expressed concerns with the stability of blends of biodiesel and middle distillate fuel. Poor oxidative stability of biodiesel blends can result in sediment formation and lacquering of furnace burner injection equipment. The inclusion of biodiesel in Type 2 heating fuel oil can degrade the storage stability of the finished fuel blend and long term storage (greater than 6 months) is not recommended. The impact of specific storage conditions has not been completely determined. The oxidation stability requirement of the B100 component is specified in CAN/CGSB-3.524.

9.4 Water and copper

Water in storage tanks and copper in the fuel supply system can increase the rate of fuel degradation in long term storage. Heating oil storage tanks should be clean and free of water to help avoid corrosion and microbial contamination (see C.4.3). Incorporating metal deactivator additives into the fuel can help to mitigate the effects of copper contamination.

9.5 Conductivity depletion

Due to the normal depletion of fuel oil conductivity during commingling, storage and distribution, or at low temperatures, the fuel oil should be sufficiently treated with conductivity-improver additive to ensure that the electrical conductivity requirement in 6.12 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 be noted that samples in clear bottles exposed to sunlight can also show a rapid depletion in conductivity. For more information, refer to ASTM D2624 and D4865.

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

9.6 Fuel colour

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

9.6.1 Existing fuel colour

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

9.6.2 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.

9.7 Manufacturing processes

Contamination from manufacturing processes or treatments can be carried over in trace quantities into the fuel and cause unexpected problems. Moreover, 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, caustics, soaps, and amine process additives are examples of possible contaminations or potential precipitates.

9.8 Visual haze

The solubility of water in fuel is a function of temperature. When fuel is exposed to low ambient temperatures, water can separate causing a haze or cloudy appearance in heating fuel oil Types 0, 1 and 2. It has been a common industry practice to predict the solubility of water in fuel by performing the visual haze test at 4°C for fuel destined for winter use, and at 15°C for fuel intended for summer use. 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.

9.9 Mercaptan sulphur

The plugging of domestic heating oil burner fuel screen filters or nozzles can be caused by the formation of copper mercaptide gels. Limiting the amount of mercaptan sulphur in heating fuel oil Types 0, 1 and 2 can reduce this problem. Eliminating the use of copper and copper alloys in heating fuel systems as well as the use of metal deactivator additives can also mitigate this problem.

9.10 Hydrogen sulphide

Hydrogen sulphide (H_2S) is often found in the vapour phase above Types 4, 5 and 6 fuel oils and occasionally in more limited concentration in the vapour phase above Types 0, 1 and 2 fuel oils. 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. Some sulphur compounds present in Types 4, 5 and 6 can, over time, react to form additional H_2S and this should be considered in determining the additive treat rate.

9.11 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.

9.12 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 middle-distillate hydrocarbons 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) and synthesized paraffinic diesel (SPD). As with petroleum hydrocarbons, fuel suppliers should consider potential impacts of significant and abrupt changes in blend properties (e.g., density, aromatic content) associated with the use of synthetic hydrocarbons.

9.13 Fuel lubricity

Some processes that are used to desulphurize heating fuel oil, if severe enough, can also reduce its natural lubricating qualities. Since fuel pumps on furnaces require the fuel to act as a lubricant, heating fuel oils require sufficient lubricity to give adequate protection against excessive fuel pump wear. Additives can be used to improve 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.

Annex A
(normative)

Referenced ASTM International publications

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

D95 Standard Test Method for Water in Petroleum Products and Bituminous Materials by Distillation

D97 Standard Test Method for Pour Point of Petroleum Products

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)

D473 Standard Test Method for Sediment in Crude Oils and Fuel Oils by the Extraction Method

D482 Standard Test Method for Ash from Petroleum Products

D524 Standard Test Method for Ramsbottom Carbon Residue of Petroleum Products

D1266 Standard Test Method for Sulfur in Petroleum Products (Lamp Method)

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

D1552 Standard Test Method for Sulfur in Petroleum Products by High Temperature Combustion and Infrared (IR) Detection or Thermal Conductivity Detection (TCD)

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

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

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

D4294 Standard Test Method for Sulfur in Petroleum and Petroleum Products by Energy Dispersive X-ray Fluorescence Spectrometry

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

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

D4870 Standard Test Method for Determination of Total Sediment in Residual Fuels

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

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

D5949 Standard Test Method for Pour Point of Petroleum Products (Automatic Pressure Pulsing Method)

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

D6469 Standard Guide for Microbial Contamination in Fuels and Fuel Systems

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

D7039 Standard Test Method for Sulfur in Gasoline, Diesel Fuel, Jet Fuel, Kerosine, Biodiesel, Biodiesel Blends, and Gasoline-Ethanol Blends by Monochromatic Wavelength Dispersive X-ray Fluorescence Spectrometry

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)

D7688 Standard Test Method 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

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 heating oil [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* [3]:

B.1.1.1 ***Fuels Information Regulations*, No. 1** (C.R.C. c. 407 amended by SOR/DORS/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 ***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 ***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.

B.2 Provincial regulations

B.2.1 Ontario

B.2.1.1 General requirements

The general requirements are controlled under the *Technical Standards and Safety Act, 2000*, S.O. 2000, c. 16, approved by Order in Council, March 5, 2001. Under this Act, the *Liquid Fuels Handling Code,* August 2017, was published by the Technical Standards and Safety Authority. The Code lists product standards (in Appendix B where CAN/CGSB-3.2 is referenced), which include a 120-day period for any new standards or amendments to take effect.

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[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 provinces other than those listed above will be added as information becomes available in future revisions and amendments to this standard.

[3] The Acts and Regulations may be obtained from Government of Canada Publications, Ottawa, Canada. Telephone: 1-800-635-7943 or 613-941-5995. Fax: 1-800-565-7757 or 613-954-5779. Web site: publications.gc.ca/helpAndInfo/cntcts-e.htm. Provincial Acts may be obtained from their relevant authority, however if a Web site becomes inoperative, the Canadian Legal Information Institute Web site, at www.canlii.com, may also be useful.

B.2.2 Quebec

B.2.2.1 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 [4]. 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.

B.2.2.2 ***Clean Air Regulation*** (CQLR c Q-2, r 4.1)

This regulation references CAN/CGSB-3.2-2007, *Heating Fuel Oil* published in July 2007 by the Canadian General Standards Board, a dated reference.

B.2.3 Manitoba

B.2.3.1 ***Gas and Oil Burner Regulation*** (Man. Reg. 104/87 as amended by Man. Reg. 94/2018)

This Regulation states:

No person shall sell or deliver fuel oil for use within the province in a fuel oil burner used for heating purposes unless the fuel oil meets the requirements for the supply of fuel oil set forth in CSA B139-15, *Installation Code for Oil-Burning Equipment*, as amended from time to time". CSA B139 states that "Only that type of fuel for which the oil-burning equipment is certified shall be used in a specific appliance" and "The fuel-oil-type specifications are outlined in CAN/CGSB 3.2.".

B.2.4 British Columbia

B.2.4.1 ***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.2.4.2 ***Spill Preparedness, Response and Recovery Regulation*** (B.C. Reg 185/2017)

This regulation refers to heating fuel CAN/CGSB-3.2-2015 or as amended from time to time.

B.2.5 Newfoundland and Labrador

[4] Available from Les Publications du Québec. Telephone: 1-800-463-2100 or 418-643-5150. Fax: 1-800-561-3479 or 418-643-6177. Also available on-line at www2.publicationsduquebec.gouv.qc.ca/home.php.

B.2.5.1 ***Heating oil Storage Tank System Regulations*** (NL Reg. 60/03 Amended by 103/03, 40/07, 17/09, 108/09, 90/10, 114/10, 71/11, 112/11)

These regulations apply to all systems with a capacity of 2500 litres or less that are or were connected to a heating appliance and are or were being used for the storage of heating oil and the delivery of heating oil to a connected heating appliance.

The regulation references CAN/CGSB-3.2-1999, a dated reference.

B.2.6 Alberta

B.2.6.1 General Requirements

Under the Alberta *Building Code Regulation* (Alberta Regulation 31/2015) The National Building Code 2019 Alberta Edition, published by the National Research Council of Canada as amended or replaced from time to time, is declared in force with respect to buildings. The National Building Code 2019 Alberta Edition references CSA B139-2015 “Installation Code for Oil-Burning Equipment”, as amended to April 1, 2019, where the CAN/CGSB-3.2 standard is specified for fuel oil.

B.3 Municipal regulations

B.3.1 Montréal

B.3.3.1 By-Law 90, Montréal Urban Community 1987 (as amended in 1996, 1998, 2000 and 2001) limits sulphur in light fuel oil (Types 0, 1, and 2), to a maximum of 0.4% by mass, intermediate fuel oil (Type 4) to 1.0% by mass and in heavy fuel oil (Types 5 and 6) to a maximum of 1.25 to 1.5% by mass depending upon location of use.

See http://ville.montreal.qc.ca/sel/sypre-consultation/afficherpdf?idDoc=7566&typeDoc=1.

Annex C
(informative)

Significance of requirements for Type 2 fuel oil containing 1% to 5% biodiesel

C.1 Introduction

C.1.1 The properties of commercial Type 2 fuel oil depend on the refining practices employed and the nature of the feedstocks from which they are produced. For example, Type 2 fuel oil produced within the boiling range of 130°- 400°C may have many possible combinations of various properties such as volatility, density 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 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 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 Type 2 fuel oil containing 1% to 5% biodiesel

C.2.1 CAN/CGSB-3.2 is intended as a statement of permissible limits of significant fuel properties used for specifying the wide variety of commercially available fuel oils. Limiting values of significant properties are prescribed.

C.2.2 Type 2 fuel oil is primarily for use in domestic oil burning appliances. Type 2 fuel oil is a heavier distillate than Type 1 and is intended for use in most atomizing-type burner applications. This type of fuel oil is used in most domestic oil burning appliances and in some medium capacity commercial and industrial burners. Type 2 may contain up to 5% biodiesel.

C.2.3 As Type 2 fuel oil may contain up to 5% biodiesel there are some relevant differences that should be considered as detailed below.

C.3 Blending and storage of Type 2 fuel oil containing 1% to 5% biodiesel

C.3.1 When blending biodiesel and Type 2 heating fuel oil, 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.

C.3.2 “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.3.3 Exercise caution if biodiesel fuel blends have experienced temperatures below -15°C as precipitates can occur in bulk storage.

C.4 Recommended practices for the storage and handling of low-level biodiesel fuel blends

C.4.1 Recommended practices for storage and blending with heating fuel oil to ensure precipitation does not occur in the finished fuel due to temperature, solubility, moisture and concentration effects are available as follows:

C.4.1.1 Biodiesel Handling and Use Guide, Fourth edition 2009 NREL/TP-540-43672, National Renewable Energy Laboratory, available at http://www.nrel.gov/docs/fy09osti/43672.pdf.

C.4.1.2 Guidelines for handling and blending FAME (CONCAWE report No. 9/09), available as a PDF at www.concawe.org.

C.4.2 Fuels should be stored under cool, clean, dry conditions. Free water should regularly be drained from storage tanks and filter housings.

C.4.3 It is especially important to store biodiesel fuel blends under clean, dry and cool conditions. Biodiesel fuel blends are more susceptible to microbial attack. This risk can be reduced by good housekeeping and ensuring that storage tanks are regularly drained to keep them dry. For more information on microbial contamination, refer to ASTM D6469.

C.4.4 Organic sediment can appear in fuels in long-term storage. Filtration is recommended prior to use.

C.4.5 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.4.6 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. Addition of anti-oxidants can significantly increase the storage life of biodiesel fuel blends.

C.4.7 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.4.8 Filter plugging problems – A number of contaminants in some biodiesels have relatively low solubility in heating fuel oil 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.