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Standard Specification for Commercial Boiler Fuels With Used Lubricating Oils¹

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This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification covers four grades of fuel oil made of at least 25 % used lubricating oils. The four grades of fuel are intended for use in various types of fuel-oil-burning industrial equipment and commercial boilers under various climatic and operating conditions. These fuels are not intended for use in residential heaters.

1.1.1 Grades RFC4, RFC5L, RFC5H and RFC6 are used lubricating oil blends of increasing viscosity, with or without middle distillate or residual fuel oil, or both, that are intended for use in industrial burners and commercial boilers equipped to handle these types of fuels. This specification is for applications where Specification D6448 would not meet the performance or other requirements of the burner or boiler in question.

NOTE 1—For information on the significance of the terminology and test methods used in this specification, see Appendix X1.

1.2 This specification is for use in contracts for the purchase of fuel oils derived from used lubricating oil and for the guidance of consumers of such fuels. This specification does not address the frequency with which any particular test must be run.

1.3 Nothing in this specification shall preclude observance of national or local regulations which can be more restrictive. In some jurisdictions, used oil is considered a hazardous waste and fuels derived from used oil are required to meet certain criteria before use as a fuel.

NOTE 2—For United States federal requirements imposed on used oil generators, transporters and transfer facilities, reprocessors, marketers, and burners, see 40 CFR Part 279.

NOTE 3—The generation and dissipation of static electricity can create problems in the handling of distillate burner fuel oils. For more information on the subject, see Guide D4865.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4.1 *Exception*—Table 1 and Table X1.1 include inch-pound values in parentheses for information only.

2. Referenced Documents

2.1 ASTM Standards:²

D56 Test Method for Flash Point by Tag Closed Cup Tester
D93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester

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

D97 Test Method for Pour Point of Petroleum Products

D129 Test Method for Sulfur in Petroleum Products (General High Pressure Decomposition Device Method)

D240 Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter

D396 Specification for Fuel Oils

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

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

D482 Test Method for Ash from Petroleum Products

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

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

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

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

D1552 Test Method for Sulfur in Petroleum Products (High-Temperature Method)

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

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

¹ This specification is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.P0 on Recycled Products.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

*A Summary of Changes section appears at the end of this standard

TABLE 1 Detailed Requirements for Non-Industrial Burner Fuels from Used Lubricating Oils

Properties	Test Method ^A	Limits ^B			
		RFC4	RFC5L	RFC5H	RFC6
Physical					
Viscosity at 100°C mm ² /s ^C	D445				
min	5.0	9.0	15.0
max	...	<5.0	8.9	14.9	50.0
Flash point, °C (°F), min	D93 , Procedure B	38 (100)	55 (130)	55 (130)	60 (140)
Water and sediment, ^D % volume max	D1796	1.0	1.0	2.0	2.0
Pour point, °C (°F), max	D97	-6 (21)	^E	^E	^E
Density, kg/m ³ at 15°C ^F	D1298	Report	Report	Report	Report
Chemical					
Acid no., mg KOH/g, max	D664	0.15	0.15	0.30	0.30
Ash, % mass, max ^G	D482	0.2	0.3	0.3	Report
Sulfur, % mass ^H	D129	Report	Report	Report	Report
Performance					
Gross heating value, MJ/kg (BTU/gal), ^I min	D240	40.0 (130 000)	41.5 (135 000)	41.5 (135 000)	43.0 (140 000)
Contaminants ^J					
Arsenic, ppm, max.	^K			5	
Cadmium, ppm, max	^K			2	
Chromium, ppm, max	D5185^K			10	
Lead, ppm, max	D5185^K			100	
Total halogens, ppm, max	D5384^K			1000	
PCBs, ppm, max	D6160			50 ^L	

^A See Section 8 for details and additional test methods.

^B Units given in parentheses are for informational purposes only.

^C 1 cSt = 1 mm²/s.

^D Solids content shall not exceed 0.5 %. Filtration may be required to obtain appropriate particle size for use. A deduction in quantity shall be made for all water and sediment in excess of 1.0 mass % for Grades RFC5H and RFC6.

^E Buyer and seller to agree.

^F Density in kg/L at 15°C multiplied by 1000 = kg/m³.

^G Buyer and seller may agree on a higher ash content.

^H Local jurisdictions may limit the sulfur content in burner fuels.

^I Assumes 7.5 lb/US gal.

^J These are US EPA current limits (40 CFR Part 279 and 40 CFR Part 761). If state or local requirements for used oil are more stringent, the burner fuel offered shall comply with the more stringent requirements.

^K US EPA SW-846 6010. Where Test Method **D5185** is listed, Test Method **D5185** will be the referee test method.

^L In the United States, current unrestricted use IAW 40 CFR Part 279 is <2 ppm. PCBs are permitted in qualified incinerators as defined in 40 CFR Part 761. US EPA prohibits blending down oils of >50 ppm to <50 ppm and oils <50 ppm to less than 2 ppm.

D2983 Test Method for Low-Temperature Viscosity of Lubricants Measured by Brookfield Viscometer

D3228 Test Method for Total Nitrogen in Lubricating Oils and Fuel Oils by Modified Kjeldahl Method

D3245 Test Method for Pumpability of Industrial Fuel Oils (Withdrawn 2010)³

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

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

D4057 Practice for Manual Sampling of Petroleum and Petroleum Products

D4175 Terminology Relating to Petroleum, Petroleum Products, and Lubricants

D4177 Practice for Automatic Sampling of Petroleum and Petroleum Products

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

D4629 Test Method for Trace Nitrogen in Liquid Petroleum Hydrocarbons by Syringe/Inlet Oxidative Combustion and Chemiluminescence Detection

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

D4868 Test Method for Estimation of Net and Gross Heat of Combustion of Burner and Diesel Fuels

D5185 Test Method for Determination of Additive Elements, Wear Metals, and Contaminants in Used Lubricating Oils and Determination of Selected Elements in Base Oils by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)

D5291 Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants

D5384 Test Methods for Chlorine in Used Petroleum Products (Field Test Kit Method)

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

D6160 Test Method for Determination of Polychlorinated Biphenyls (PCBs) in Waste Materials by Gas Chromatography

³ The last approved version of this historical standard is referenced on www.astm.org.

D6448 Specification for Industrial Burner Fuels from Used Lubricating Oils

D6450 Test Method for Flash Point by Continuously Closed Cup (CCCFP) Tester

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

2.2 *ISO Standard*:⁴

ISO 8217 Petroleum Products—Fuel (Class F)—Specifications for Marine Fuels

2.3 *U.S. Code of Federal Regulations*:⁵

40 CFR Part 761 Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions

40 CFR Part 279 Standards for the Management of Used Oil

2.4 *US EPA Standards*:⁶

SW-846 Test Methods for Evaluating Solid Wastes Physical/Chemical Methods

SW-846 5050 Bomb Preparation Method for Solid Waste

SW-846 6010 Inductively Coupled Plasma-Atomic Emission Spectrometry

SW-846 9056A Determination of Inorganic Anions by Ion Chromatography

SW-846 9075 Test Method for Total Chlorine in New and Used Petroleum Products by X-Ray Fluorescence Spectrometry (XRF)

SW-846 9076 Test Method for Total Chlorine in New and Used Petroleum Products by Oxidative Combustion and Microcoulometry

SW-846 9077 Test Methods for Total Chlorine in New and Used Petroleum Products (Field Test Kit Methods)

3. Terminology

3.1 For definitions of other terms used in this specification, refer to Terminology **D4175**.

3.2 *Definitions*:

3.2.1 *burner fuel oil, n*—any petroleum liquid suitable for the generation of heat by combustion in a furnace or firebox as a vapor or a spray, or a combination of both.

3.2.1.1 *Discussion*—Different grades are characterized primarily by viscosity grades.

3.2.2 *reclaiming, n*—the use of cleaning methods during recycling primarily to remove insoluble contaminants, thus making the oil suitable for further use. The methods may include settling, heating, dehydration, filtration, and centrifuging.

3.2.3 *recycling, n—in petroleum technology*, the acquisition of oil that has become unsuitable for its intended use, and processing it in order to regain useful materials.

3.2.4 *re-refining, n*—the use of refining processes during recycling to produce high quality base stocks for lubricants or other petroleum products. Re-refining may include distillation, hydrotreating, or treatments employing acid, caustic, solvent, clay, or both, or other chemicals, or a combination thereof.

3.2.5 *used oil, n—in petroleum product recycling*, oil whose characteristics have changed since being originally manufactured, and which is suitable for recycling.

3.2.6 *waste oil, n—in petroleum technology*, oil having characteristics making it unsuitable either for further use or for economic recycling.

3.3 *Definitions of Terms Specific to This Standard*:

3.3.1 *commercial boiler, n*—indirect heating units which transfer thermal energy to water or other fluids or gases for use in heating and having a heat input between 0.3 to 10×10^6 BTU/h.

3.3.2 *industrial burner, n*—a device which produces heat for industrial use through the combustion of liquid hydrocarbon fuels.

3.3.2.1 *Discussion*—Industrial burners are typically designed for one of two applications: (1) *industrial furnaces*—integral components of manufacturing processes that provide direct heating; for example, in aggregate, cement, lime, or phosphate kilns; coke ovens; or blast, smelting, melting, refining, or drying ovens and (2) *industrial boilers*—large indirect heating units which transfer thermal energy to water or other fluids or gases for use in heating in industrial settings and in manufacturing processes. These boilers can be classified as utility/large industrial boilers with a heat input greater than 100×10^6 BTU/h or small industrial boilers with a heat input of between 10 to 100×10^6 BTU/h.

3.3.3 *reprocessing, n—in petroleum product recycling*, the preparation of used oil to be suitable as a fuel.

3.3.3.1 *Discussion*—Reprocessing includes procedures such as settling, filtration, blending, distillation, or chemical treatment.

3.4 *Acronyms*:

3.4.1 *ISO*—International Organization for Standardization.

3.4.2 *RCRA*—Resource Conservation and Recovery Act (United States).

3.4.3 *US EPA*—United States Environmental Protection Agency.

3.5 *Abbreviations*:

3.5.1 *CFR*—Code of Federal Regulations.

3.5.2 *IAW*—in accordance with.

3.5.3 *RFC4*—recycled fuel, commercial boilers, grade number 4.

3.5.4 *RFC5L*—recycled fuel, commercial boilers, grade number 5 light.

3.5.5 *RFC5H*—recycled fuel, commercial boilers, grade number 5 heavy.

3.5.6 *RFC6*—recycled fuel, commercial boilers, grade number 6.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

⁵ Available from U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401 (www.gpoaccess.gov).

⁶ Available from Environmental Protection Agency, Ariel Rios Bldg., 1200 Pennsylvania Ave., N.W., Washington, DC 20460 (www.epa.gov). Downloadable files available at <http://www.epa.gov/epawaste/hazard/testmethods/sw846/index.htm>.