



Standard Specification for Fuel Oils¹

This standard is issued under the fixed designation D 396; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last approval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

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

1. Scope

1.1 This specification (Note 1) covers grades of fuel oil intended for use in various types of fuel-oil-burning equipment under various climatic and operating conditions. These grades are described as follows:

1.1.1 Grades 1, 1 Low Sulfur, 2 and 2 Low Sulfur are middle distillate fuels for use in domestic and small industrial burners. Grades 1 and 1 Low Sulfur are particularly adapted to vaporizing type burners or where storage conditions require low pour point fuel.

1.1.2 Grades 4 (Light) and 4 are heavy distillate fuels or distillate/residual fuel blends used in commercial/industrial burners equipped for this viscosity range.

1.1.3 Grades 5 (Light), 5 (Heavy), and 6 are residual fuels of increasing viscosity and boiling range, used in industrial burners. Preheating is usually required for handling and proper atomization.

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

NOTE 2—A more detailed description of the grades of fuel oils is given in X1.3.

1.2 This specification is for the use of purchasing agencies in formulating specifications to be included in contracts for purchases of fuel oils and for the guidance of consumers of fuel oils in the selection of the grades most suitable for their needs.

1.3 Nothing in this specification shall preclude observance of federal, state, or local regulations which can be more restrictive.

1.4 All values are stated in SI units and are regarded as standard.

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 D 4865.

¹ This specification is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.E on Burner, Diesel, Non-aviation Gas Turbine, and Marine Fuels.

Current edition approved June 10, 2001. Published August 2001. Originally published as D 396 – 34 T. Last previous edition D 396 – 98.

2. Referenced Documents

2.1 ASTM Standards:

- D 56 Test Method for Flash Point by Tag Closed Tester²
- D 86 Test Method for Distillation of Petroleum Products at Atmospheric Pressure²
- D 93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester²
- D 95 Test Method for Water in Petroleum Products and Bituminous Materials by Distillation²
- D 97 Test Method for Pour Point of Petroleum Products²
- D 129 Test Method for Sulfur in Petroleum Products (General Bomb Method)²
- D 130 Test Method for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test²
- D 445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (the Calculation of Dynamic Viscosity)²
- D 473 Test Method for Sediment in Crude Oils and Fuel Oils by the Extraction Method²
- D 482 Test Method for Ash from Petroleum Products²
- D 524 Test Method for Ramsbottom Carbon Residue of Petroleum Products²
- D 975 Specification for Diesel Fuel Oils²
- D 1266 Test Method for Sulfur in Petroleum Products (Lamp Method)²
- D 1298 Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method²
- D 1552 Test Method for Sulfur in Petroleum Products (High-Temperature Method)²
- D 2500 Test Method for Cloud Point of Petroleum Products²
- D 2622 Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-Ray Fluorescence Spectrometry²
- D 2709 Test Method for Water and Sediment in Middle Distillate Fuels by Centrifuge²

² Annual Book of ASTM Standards, Vol 05.01.

- D 3245 Test Method for Pumpability of Industrial Fuel Oils³
- D 3828 Test Methods for Flash Point by Small Scale Closed Tester³
- D 4052 Test Method for Density and Relative Density of Liquids by Digital Density Meter³
- D 4057 Practice for Manual Sampling of Petroleum and Petroleum Products³
- D 4294 Test Method for Sulfur in Petroleum and Petroleum Products by Energy-Dispersive X-Ray Fluorescence Spectrometry³
- D 4865 Guide for Generation and Dissipation of Static Electricity in Petroleum Fuel Systems³
- D 5949 Test Method for Pour Point of Petroleum Products (Automatic Pressure Pulsing Method)⁴
- D 5950 Test Method for Pour Point of Petroleum Products (Automatic Tilt Method)⁴

- D 5985 Test Method for Pour Point of Petroleum Products (Rotational Method)⁴
- D 6469 Guide to Microbial Contamination in Fuels and Fuel Systems⁵
- 2.2 *Other Documents:*⁶
- 26 CFR Part 48 Diesel Fuel Excise Tax; Dye Color and Concentration
- 40 Part 80 Regulation of Fuel and Fuel Additives

3. General Requirements

3.1 The grades of fuel oil specified herein shall be homogeneous hydrocarbon oils, free from inorganic acid, and free from excessive amounts of solid or fibrous foreign matter.

3.2 All grades containing residual components shall remain uniform in normal storage and not separate by gravity into light and heavy oil components outside the viscosity limits for the grade.

⁵ Annual Book of ASTM Standards, Vol 05.04.

⁶ Available from Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.

³ Annual Book of ASTM Standards, Vol 05.02.

⁴ Annual Book of ASTM Standards, Vol 05.03.

TABLE 1 Detailed Requirements for Fuel Oils^A

Property	ASTM Test Method ^B	No. 1 Low Sulfur ^C	No. 1 ^C	No. 2 Low Sulfur ^C	No. 2 ^C	Grade No. 4 (Light) ^C	No. 4	No. 5 (Light)	No. 5 (Heavy)	No. 6
Flash Point °C, min	D 93	38	38	38	38	38	55	55	55	60
Water and sediment, % vol, max	D 2709	0.05	0.05	0.05	0.05	...	...	...	...	...
	D 95 + D 473	...	...	...	...	(0.50) ^D	(0.50) ^D	(1.00) ^D	(1.00) ^D	(2.00) ^D
Distillation temperature °C	D 86									
10 % volume recovered, max		215	215	...	...	...	...	...	...	...
90 % volume recovered, min		...	...	282	282	...	...	...	...	...
90 % vol recovered, max		288	288	338	338	...	...	...	...	...
Kinematic viscosity at 40°C, mm ² /s	D 445	min	1.3	1.3	1.9	1.9	>5.5	...	...	...
		max	2.1	2.1	3.4	3.4	5.5	24.0 ^E	...	...
Kinematic viscosity at 100°C, mm ² /s	D 445	min	...	...	...	...	...	5.0	9.0	15.0
		max	...	...	...	...	...	8.9 ^E	14.9 ^E	50.0 ^E
Ramsbottom carbon residue on 10 % distillation residue % mass, max	D 524	0.15	0.15	0.35	0.35	...	...	...	...	...
Ash, % mass, max	D 482	...	...	...	...	0.05	0.10	0.15	0.15	...
Sulfur, % mass max ^F	D 129	...	0.50	...	0.50	...	...	...	...	...
	D 2622	0.05	...	0.05	...	...	...	...	...	...
Copper strip corrosion rating, max, 3 h at 50°C	D 130	No. 3	No. 3	No. 3	No. 3	...	...	...	...	...
Density at 15°C, kg/m ³	D 1298	min	...	...	...	...	...	...	...	...
		max	850	850	876	876	>876 ^G	...	...	...
Pour Point °C, max ^H	D 97	-18	-18	-6	-6	-6	-6	...	...	I

^A It is the intent of these classifications that failure to meet any requirement of a given grade does not automatically place an oil in the next lower grade unless in fact it meets all requirements of the lower grade. However, to meet special operating conditions modifications of individual limiting requirements may be agreed upon among the purchaser, seller and manufacturer.

^B The test methods indicated are the approved referee methods. Other acceptable methods are indicated in Section 2 and 5.1.

^C Under United States regulations, Grades No. 1, No. 1 Low Sulfur, No. 2, No. 2 Low Sulfur, and No.4 (Light) are required by 40 CFR Part 80 to contain a sufficient amount of the dye Solvent Red 164 so its presence is visually apparent. At or beyond terminal storage tanks, they are required by 26 CFR Part 48 to contain the dye Solvent Red 164 at a concentration spectrally equivalent to 3.9 lbs per thousand barrels of the solid dye standard SolventRed 26.

^D The amount of water by distillation by Test Method D 95 plus the sediment by extraction by Test Method D 473 shall not exceed the value shown in the table. For Grade No. 6 fuel oil, the amount of sediment by extraction shall not exceed 0.50 mass %, and a deduction in quantity shall be made for all water and sediment in excess of 1.0 mass %.

^E Where low sulfur fuel oil is required, fuel oil falling in the viscosity range of a lower numbered grade down to and including No. 4 can be supplied by agreement between the purchaser and supplier. The viscosity range of the initial shipment shall be identified and advance notice shall be required when changing from one viscosity range to another. This notice shall be in sufficient time to permit the user to make the necessary adjustments.

^F Other sulfur limits may apply in selected areas in the United States and in other countries.

^G This limit ensures a minimum heating value and also prevents misrepresentation and misapplication of this product as Grade No. 2.

^H Lower or higher pour points can be specified whenever required by conditions of storage or use. When a pour point less than - 18°C is specified, the minimum viscosity at 40°C for grade No. 2 shall be 1.7 mm²/s and the minimum 90 % recovered temperature shall be waived.

^I Where low sulfur fuel oil is required, Grade No. 6 fuel oil will be classified as Low Pour (+ 15°C max) or High Pour (no max). Low Pour fuel oil should be used unless tanks and lines are heated.