



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.E0.01 on Burner Fuels.

Current edition approved Nov. 10, 2002. Published November 2002. Originally published as D 396–34T. Last previous edition D 396–02.

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 Liquids²
- 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 5453 Test Method for Determination of Total Sulfur in Light Hydrocarbons, Motor Fuels and Oils by Ultraviolet Fluorescence⁴
- 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 CFR 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.

4. Detailed Requirements

4.1 The various grades of fuel oil shall conform to the limiting requirements shown in Table 1. A representative sample shall be taken for testing in accordance with Practice D 4057.

4.2 Modifications of limiting requirements to meet special operating conditions agreed upon between the purchaser, the seller, and the supplier shall fall within limits specified for each grade, except as stated in supplementary footnotes for Table 1.

5. Test Methods

5.1 The requirements enumerated in this specification shall be determined in accordance with the following ASTM test methods,⁷ except as may be required under 5.1.1.

5.1.1 *Flash Point*—Test Method D 93 (Procedure A) for Grades No. 1, No. 1 Low Sulfur, No. 2, No. 2 Low Sulfur, and No. 4 (Light), and Test Method D 93 (Procedure B) for Grades No. 4, No. 5 (Light), No. 5 (Heavy), and No. 6, except where other methods are prescribed by law. For Grades No. 1, No. 1 Low Sulfur, No. 2, No. 2 Low Sulfur, and No. 4 (Light), Test Method D 3828 may be used as an alternate with the same limits. For Grades No. 1, No. 1 Low Sulfur, No. 2, and No. 2 Low Sulfur, Test Method D 56 may be used as an alternate with the same limits, provided the flash point is below 93°C and the viscosity is below 5.5 mm²/s at 40°C. This test method will give slightly lower values. In cases of dispute, Test Method D 93, with the appropriate procedure, shall be used as the referee method.

5.1.2 *Pour Point*—Test Method D 97. For all grades, the automatic Test Methods D 5949, D 5950, and D 5985 can be used as alternates with the same limits. In case of dispute, Test Method D 97 shall be used as the referee method. Alternative test methods that indicate flow point properties can be used for low sulfur residual fuels by agreement between purchaser and supplier.

5.1.3 *Water and Sediment*—The water and sediment in Grade Nos. 1 and 2 shall be determined in accordance with Test Method D 2709 and in Grade Nos. 4, 5, and 6 by Test Method D 95 and Test Method D 473. A density of 1.0 kg/L shall be used for the Test Method D 95 water.

5.1.4 *Carbon Residue*—Test Method D 524.

5.1.5 *Ash*—Test Method D 482.

5.1.6 *Distillation*—Distillation of Grade No. 1 and No. 2 oils shall be determined in accordance with Test Method D 86.

5.1.7 *Viscosity*—Viscosity shall be determined in accordance with Test Method D 445.

5.1.8 *Density*—Practice D 1298. Test Method D 4052 can be used as an alternate with the same limits. In case of dispute, Practice D 1298 shall be used as the referee method.

5.1.9 *Corrosion*—Test Method D 130, 3 h test at 50°C.

5.1.10 *Sulfur*—Test Method D 129 for Grades 1, 2, 4, 5, and 6 and Test Method D 2622 for Grades 1 Low Sulfur and 2 Low Sulfur. Test Methods D 1552, D 2622, and D 4294 can also be used for all grades. In addition, Test Method D 1266 can be used for Grades 1 and 1 Low Sulfur, but only with samples having sulfur contents of 0.4 mass % and less (down to 0.01 %). Test Method D 5453 can be used for Grades 1 and 2 fuel oils, but only with samples having sulfur contents of 0.8 mass % and less (down to 0.001 %). In case of dispute, Test Method D 129 is the referee test method for Grades 1, 2, 4, 5, and 6 of this specification and Test Method D 2622 is the referee test method for Grades 1 Low Sulfur and 2 Low Sulfur.

³ Annual Book of ASTM Standards, Vol 05.02.

⁴ Annual Book of ASTM Standards, Vol 05.03.

⁵ Annual Book of ASTM Standards, Vol 05.04.

⁶ Available from U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401.

⁷ For information on the precision of the ASTM test methods for fuel oils refer to "An Evaluation of Methods for Determination of Sulfur in Fuel Oils" by A. R. Crawford, Esso Mathematics and Systems Inc. and G. V. Dyroff, Esso Research and Engineering Co., 1969. This document is available from the Publications Section, API Library, American Petroleum Institute, 1220 L St., NW, Washington, DC 20005.