



Standard Specification for Middle Distillate Fuel Oil—Military Marine Applications¹

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1. Scope*

1.1 This specification covers a 100 % middle distillate fuel oil with no residual fuel oil contamination for use in military marine applications (non-aviation gas turbine engines, compression ignition/diesel engines, and other non-automotive applications), and emergency generator applications (military or commercial).

1.2 This specification, unless otherwise provided by agreement between the purchaser and the supplier, prescribes the required properties of middle distillate fuel at the time and place of delivery. Nothing in this specification shall preclude observance of federal, state, or local regulations that may be more restrictive.

1.3 During handling and use of all middle distillate fuels, the generation and dissipation of static electricity can create fire and explosion hazards. For more information on this subject see Guide [D4865](#).

1.4 The values stated in SI units are to be regarded as the standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

- [D56](#) Test Method for Flash Point by Tag Closed Cup Tester
- [D86](#) Test Method for Distillation of Petroleum Products at Atmospheric Pressure

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](#) on Burner, Diesel, Non-Aviation Gas Turbine, and Marine Fuels.

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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.

- [D93](#) Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
- [D129](#) Test Method for Sulfur in Petroleum Products (General Bomb Method)
- [D130](#) Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
- [D445](#) Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
- [D482](#) Test Method for Ash from Petroleum Products
- [D524](#) Test Method for Ramsbottom Carbon Residue of Petroleum Products
- [D613](#) Test Method for Cetane Number of Diesel Fuel Oil
- [D975](#) Specification for Diesel Fuel Oils
- [D976](#) Test Method for Calculated Cetane Index of Distillate Fuels
- [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
- [D1319](#) Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption
- [D1552](#) Test Method for Sulfur in Petroleum Products (High-Temperature Method)
- [D2500](#) Test Method for Cloud Point of Petroleum Products
- [D2622](#) Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry
- [D2709](#) Test Method for Water and Sediment in Middle Distillate Fuels by Centrifuge
- [D3117](#) Test Method for Wax Appearance Point of Distillate Fuels
- [D3828](#) Test Methods for Flash Point by Small Scale Closed Cup Tester
- [D4052](#) Test Method for Density and Relative Density of Liquids by Digital Density Meter
- [D4057](#) Practice for Manual Sampling of Petroleum and Petroleum Products
- [D4177](#) Practice for Automatic Sampling of Petroleum and Petroleum Products

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

- D4294** Test Method for Sulfur in Petroleum and Petroleum Products by Energy Dispersive X-ray Fluorescence Spectrometry
- D4530** Test Method for Determination of Carbon Residue (Micro Method)
- D4865** Guide for Generation and Dissipation of Static Electricity in Petroleum Fuel Systems
- D5304** Test Method for Assessing Middle Distillate Fuel Storage Stability by Oxygen Overpressure
- D5453** Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence
- D5771** Test Method for Cloud Point of Petroleum Products (Optical Detection Stepped Cooling Method)
- D5772** Test Method for Cloud Point of Petroleum Products (Linear Cooling Rate Method)
- D5773** Test Method for Cloud Point of Petroleum Products (Constant Cooling Rate Method)
- D6450** Test Method for Flash Point by Continuously Closed Cup (CCCFP) Tester
- D6469** Guide for Microbial Contamination in Fuels and Fuel Systems
- 2.2 *Government Standards*:³
- 26 CFR Part 48** Manufacturers and Realtors Excise Taxes
- 40 CFR Part 80** Regulation of Fuels and Fuel Additives

3. Terminology

3.1 Definitions:

3.1.1 *long-term storage, n*—storage of fuel for longer than 12 months after it is received by the user.

3.1.2 *middle distillate, n*—a generic refinery/supplier term that usually denotes a fuel primarily intended for use in compression ignition/diesel engine applications, and also in non-aviation gas turbine engines and other non-automotive applications such as a burner fuel.

3.1.3 *storage stability, n*—the resistance of fuel to formation of degradation products when stored at ambient temperatures.

3.2 Acronyms:

3.2.1 *CCCFP, n*—continually closed cup flash point

3.2.2 *IMO, n*—International Maritime Organization

4. Test Methods, Alternate Test Methods, and Significance of Properties

4.1 The requirements listed in **Table 1** shall be determined in accordance with the following methods. The referee test methods are listed in **Table 1**. Where allowed, alternative methods that are not specified in **Table 1** are specified in 4.1.1-4.1.12 or in the footnotes to **Table 1**. Test significance is included in some cases.

4.1.1 *Ash*—Test Method **D482**.

4.1.2 *Carbon Residue*—Test Method **D4530** or **D524**. Note that only one of the two methods is required and that the limiting value is different for each test. Both methods use a

TABLE 1 Detailed Requirements for Middle Distillate Fuel Oil—Military Marine Applications^{A,B}

Property	Referee Test Method ^C	Requirements
Ash, mass %, max.	D482	0.01
One of the following shall be met:		
Carbon residue, 10 % distillation residue, mass %, max. (Ramsbottom or Micro)	D524 D4530	0.20 0.14
One of the following shall be met:		
Cetane no., min.	D613	40 ^D
Cetane index, min.	D976	40 ^D
Cloud point, °C, max.	D2500	-1
Copper corrosion rating, max. at 50°C for 3 h	D130	No. 3
Density at 15°C, kg/m ³ , max.	D1298	876
Distillation, °C, 90 % Point, max.	D86	357
Flash point, °C, min.	D93	60
Storage stability, mg/100 mL, max.	D5304^E	3.0
Sulfur, mass %, max.	D129^F	0.50 ^F
Viscosity (kinematic), mm ² /S at 40°C	D445	
Min.		1.9
Max.		4.1
Water and Sediment, vol %, max.	D2709	0.05

^A For sale in the United States, U.S. Regulation **26 CFR Part 48** requires that fuel greater than 0.05 mass % sulfur that is sold for tax exempt purposes must be dyed by Solvent Red 164 at a concentration spectrally equivalent to 3.9 lb per thousand barrels of the solid dye standard Solvent Red 26 at or beyond the terminal storage tanks or the tax must be collected.

For sale in the United States, U.S. Regulation **40 CFR Part 80** requires that fuel greater than 0.05 mass % sulfur must be dyed by Solvent Red 164 so its presence is visually apparent. At or beyond terminal storage tanks, such fuel is required by **26 CFR Part 48** to contain the dye Solvent Red 164 at a concentration spectrally equivalent to 3.9 lb per thousand barrels of the solid dye standard Solvent Red 26.

For sale in the United States, U.S. Regulation **40 CFR Part 80** requires that one of the following properties must be met: (1) cetane index, min of 40 by Test Methods **D976** or (2) aromatics vol %, max of 35 by Test Method **D1319**.

^B Modifications of individual limiting requirements may be agreed upon among purchaser, seller, and fuel manufacturer.

^C Alternate test methods are indicated in Section 4. Where multiple methods are listed, the first method listed shall be the referee method.

^D Certain marine engine and other applications may require higher cetane number/index minima and will be set by agreement between seller and buyer.

^E Only nylon membrane filter media (0.8 µm pore size) are acceptable as specified in Test Method **D5304**. Do not use glass fiber (Type A/E) filter media to obtain test results.

^F Where allowed by law, this sulfur maximum level is 1.0 mass %. Test Method **D129** is the referee method for sulfur level greater than 0.1 mass %. Test Method **D2622** is the referee method for sulfur levels less than or equal to 0.1 mass %.

10 % distillation bottoms aliquot. In cases of dispute, Test Method **D524** shall be the referee method.

4.1.3 *Cetane Number or Index*—Test Method **D613** or **D976**. For some marine engine applications, higher minimum values may be required. In cases of dispute, Test Method **D613** shall be the referee method.

4.1.4 *Cloud Point*—Test Method **D2500**. Test Method **D3117** may also be used since the two are closely related. The automatic Test Methods **D5771**, **D5772**, or **D5773** may be used as alternates. In case of dispute, Test Method **D2500** shall be the referee method.

4.1.5 *Copper Corrosion*—Test Method **D130**; 3 h at 50°C.

4.1.6 *Density*—Test Method **D1298**. The automated Test Method **D4052** may be used as an alternate. A maximum value is also required for water removal in military marine applications.

4.1.7 *Distillation*—See **D86**.

4.1.8 *Flash Point*—Test Methods **D93**, except where other methods are prescribed by law. Test Method **D6450** and **D3828** may be used as an alternative provided that data is available to

³ Available from U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401.

show correspondence with Test Methods **D93** values. Test Method **D56** 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. Test Method **D56** will give slightly lower values. In cases of dispute, Test Methods **D93** shall be the referee method.

4.1.9 Storage Stability—Test Method **D5304**.

4.1.9.1 After a storage stable fuel is purchased, it is the responsibility of the buyer/user to ensure continued stability by maintaining storage tanks free of water and microbial growth, by avoiding extreme temperature changes, by maintaining appropriate tank wall conditions, by avoiding copper or zinc contamination or exposure, and by minimizing multiple supplier mixing in a given tank.

4.1.10 Sulfur—Table 2 shows the referee test methods for

TABLE 2 Sulfur

Sulfur Test Method	Range, mass %
D129 (referee) ^A	0.1 to 1.0 ^B
D2622 (referee) ^C	0.0003 to 1.0 ^B
D1266 ^D	0.01 to 0.4
D1552 ^D	0.06 to 1.0 ^B
D4294 ^D	0.0150 to 1.0 ^B
D5453 ^D	0.00010 to 0.8000

^A For fuel sulfur greater than 0.1 mass %.

^B Test method upper range limit exceeds 1.0 mass %, the maximum allowed in this specification; see Table 1, Footnote F.

^C For fuel sulfur less than or equal to 0.1 mass %.

^D Alternate test method.

sulfur, the alternate sulfur test methods, and the range over which each test method applies.

4.1.11 Viscosity—Test Method **D445**.

4.1.12 Water and Sediment—Test Method **D2709**.

4.2 Sampling—Sampling shall be in accordance with Practice **D4057**, **D4177**, or as prescribed by agreement between seller and buyer.

4.3 Guides/Other Information—For information on microbial growth in middle distillate fuel, see Guide **D6469**. For information on safety and fire hazards, see Guide **D4865**. For information on fuel lubricity issues, see Specification **D975**, Appendix X3.

5. Workmanship

5.1 The fuel shall be visually free of undissolved water, sediment, and suspended matter. The fuel shall be 100 % middle distillate fuel oil, containing no residual fuel oil contamination.

6. Requirements

6.1 The specified product is primarily defined by its properties as listed in Table 1.

7. Keywords

7.1 compression ignition; diesel; diesel fuel oil; emergency generator; marine; middle distillate; middle distillate fuel oil; non-aviation gas turbine; petroleum products; stable; storage stability

SUMMARY OF CHANGES

Committee D02 has identified the location of selected changes to this standard since the last issue (D6985 - 04) that may impact the use of this standard. (Approved November 1, 2004.)

- (1) Removed 3.1.2 and 4.1.8.1.
- (2) Revised 1.1 and 4.1 to reflect changes in scope.
- (3) Modified Table 1 and 4.1.7 to add 90 % distillation maximum to the specification.
- (4) Modified 2.1 and 4.1.4 to add alternate test methods for measuring cloud point.
- (5) Modified 2.1 and 4.1.6 to include Test Method **D4052** as an alternate test method for measuring density.
- (6) Modified 2.1 and 4.2 to add Practice **D4177** for automatic

sampling of petroleum products.

- (7) Modified Table 1 to add density measurement temperature and to remove “Middle Distillate (No Residual Contamination).”
- (8) Added information on Middle Distillate composition to 5.1 on Workmanship.
- (9) Modified 2.1, 4.1.3, 4.1.6, and Table 1 to remove Test Method **D4737** from the specification.

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