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An American National Standard

Standard Specification for Kerosine[1]

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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 two grades of kerosine suitable for use in critical kerosine burner applications:

1.1.1 *No. 1-K*—A special low-sulfur grade kerosine suitable for use in nonflue-connected kerosine burner appliances and for use in wick-fed illuminating lamps.

1.1.2 *No. 2-K*—A regular grade kerosine suitable for use in flue-connected burner appliances and for use in wick-fed illuminating lamps.

1.2 This specification is intended for use in purchasing, as a reference for industry and governmental standardization, and as a source of technical information.

1.3 This specification, unless otherwise provided by agreement between the purchaser and the supplier, prescribes the required properties of kerosine at the time and place of custody transfer.

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

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

NOTE 1—The generation and dissipation of static electricity can create problems in the handling of kerosines. For more information on the subject, see Guide D 4865.

2. Referenced Documents

2.1 *ASTM Standards:*

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[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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D 56 Test Method for Flash Point by Tag Closed Tester[2]
D 86 Test Method for Distillation of Petroleum Products at Atmospheric Pressure[2]
D 130 Test Method for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test[2]
D 156 Test Method for Saybolt Color of Petroleum Products (Saybolt Chromometer Method)[2]
D 187 Test Method for Burning Quality of Kerosine[2]
D 445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (the Calculation of Dynamic Viscosity)[2]
D 1266 Test Method for Sulfur in Petroleum Products (Lamp Method)[2]
D 2386 Test Method for Freezing Point of Aviation Fuels[2]
D 2622 Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-Ray Fluorescence Spectrometry[2]
D 3227 Test Method for (Thiol Mercaptan) Sulfur in Gasoline, Kerosine, Aviation Turbine, and Distillate Fuels (Potentiometric Method)[2]
D 3828 Test Methods for Flash Point by Small Scale Closed Tester[3]
D 4294 Test Method for Sulfur in Petroleum ~~and Petroleum~~ Products by Energy Dispersive X-Ray Fluorescence Spectrometry[3]
D 4865 Guide for Generation and Dissipation of Static Electricity in Petroleum Fuel Systems[3]
D 4952 Test Method for Qualitative Analysis for Active Sulfur Species in Fuels and Solvents (Doctor Test)[3]
D 5453 Test Method for Determination of Total Sulfur in Light Hydrocarbons, Motor Fuels and Oils by Ultraviolet Fluorescence[4]
D 5901 Test Method for Freezing Point of Aviation Fuels (Automatic Optical Method)[4]
D 5972 Test Method for Freezing Point of Aviation Fuels (Automatic Phase Transition Method)[4]
D 6469 Guide for Microbial Contamination in Fuels and Fuel Systems[5]

2.2 *IP Standard:*

IP 10 Burning Test—24 Hour[6]

2.3 *Other Documents:*

26 CFR, Part 48 Diesel Fuel Excise Tax; Dye, Color, and Concentration[7]

3. General Requirements

3.1 Kerosine shall be a refined petroleum distillate consisting of a homogeneous mixture of hydrocarbons essentially free of water, inorganic acidic or basic compounds, and excessive amounts of particulate contaminants. Additive usage can be established by mutual agreement of the supplier and the purchaser.

4. Detailed Requirements

4.1 The kerosine shall conform to the detailed requirements prescribed in Table 1.

4.2 The kerosine shall conform to the following requirements when tested for burning quality as specified:

4.2.1 *Time of Burning*—A minimum of 16 h continuous burning after the first weighing shall be required.

4.2.2 *Rate of Burning*—After the first weighing, the rate of burning shall be 18 to 26 g/h with the Institute of Petroleum (IP) Test Method, IP 10.

4.2.3 *Appearance of Chimney at End of Tests*—The chimney shall have no more than a light, white deposit.

4.2.4 *Flame Characteristics at End of Test*—At the end of test, the width of the flame shall not vary by more than 6 mm, and the height of the flame shall not have lowered by more than 5 mm from the respective measurements recorded at the start of the test.

NOTE 2—The significance of ASTM specifications for kerosine is discussed in Appendix X1.

5. Test Methods

5.1 The requirements enumerated in this specification shall be determined in accordance with the following ASTM methods except as noted.

5.1.1 *Flash Point*—Test Method D 56, except where other methods are prescribed by law. Test Method D 3828 may be used as an alternate with the same limits. In case of a dispute, Test Method D 56 shall be used as the referee method.

5.1.2 *Distillation*—Test Method D 86.

5.1.3 *Viscosity*—Test Method D 445.

5.1.4 *Sulfur*—Test Method D 1266. Test Methods D 2622, D 4294, or D 5453 can also be used. In case of a dispute, Test Method D 1266 is the referee sulfur test method for this specification.

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[2] *Annual Book of ASTM Standards*, Vol 05.01.
[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] Standard Methods for Analysis and Testing of Petroleum and Related Products, Institute of Petroleum, 61 New Cavendish St., London, W7M 8AR, Vol 1.
[7] Available from Superintendent of Documents, U.S.Government Printing Office, Washington, DC 20402.

TABLE 1 Detailed Requirements for Kerosine

Property	ASTM Test[A] Method	Limit[B]
Flash Point °C, min	D 56	38
Distillation temperature °C	D 86	
10 % volume recovered, max		205
Final boiling point, max		300
Kinematic viscosity at 40°C, mm^2/s	D 445	
min		1.0
max		1.9
Sulfur, % mass	D 1266	
No. 1-K, max		0.04
No. 2-K, max		0.30
Mercaptan sulfur, % mass, max[C]	D 3227	0.003
Copper strip corrosion rating max, 3 h at 100°C	D 130	No. 3
Freezing point, °C, max	D 2386	−30
Burning quality, min	D 187	pass (see 4.2)
~~Saybolt color, min~~	~~D 156~~	~~+ 16~~
Saybolt color, min	D 156	+ 16[D]

[A] The test methods indicated are the approved referee methods. Other acceptable methods are indicated in Section 2.

[B] To meet special operating conditions, modifications of individual limiting requirements, except sulfur, can be agreed upon among purchaser, seller and manufacturer.

[C] The Mercaptan sulfur determination can be waived if the fuel is considered sweet by Test Method D 4952.

[D] Appendixes X1.1 and X1.12 contain additional information on color, red dye, and potential application problems.

5.1.5 *Mercaptan Sulfur*—Test Method D 3227.

5.1.6 *Copper Strip Corrosion*—Test Method D 130, 3 h test at 100°C.

5.1.7 *Freezing Point*—Test Method D 2386. Automatic Test Methods D 5901 and D 5972 can be used as alternates with the same limits. In case of a dispute, Test Method D 2386 shall be used as referee.

5.1.8 *Burning Quality*—Test Method D 187.

5.1.9 *Saybolt Color*—Test Method D 156.

6. Keywords

6.1 fuel oil; kerosine; petroleum and petroleum products

APPENDIX

(Nonmandatory Information)

X1. SIGNIFICANCE OF STANDARD SPECIFICATIONS FOR KEROSINE

X1.1 *Color*—An indication of the overall purity of the product, and is a useful parameter ~~to ensure~~ in ensuring the freedom from trace contamination with heavier products which may render the kerosine to be unsuitable for designated critical applications. Kerosine that is subjected to long term storage, excessive heat, or both, particularly in summer storage in above ground tanks, can become unsuitable for use due to degradation and associated loss of Saybolt Color quality. Some contaminants can adversely affect the performance of kerosine, particularly in wick-fed, unvented applications like 1-K space heaters. Detection of these contaminants may require additional testing, such as sulfur content or distillation. Unless gross contamination is present, these tests may not readily identify the presence of contamination.

X1.1.1 *Red Dye* —Kerosine sold exempt from federal motor fuel excise tax sold from terminals may contain the dye Solvent Red 164 at a concentration spectrally equivalent to 3.9 lb per 1000 barrels of the solid dye standard Solvent Red 26, where required in the United States of America (for example, by 26 CFR, Part 48). If clear, undyed fuel is desired for tax-exempt applications, the Internal Revenue Service has provided other options, such as blocked pumps, for consideration. The addition of red dye makes it more difficult to detect contamination by visual inspection. Kerosine subjected to dying must meet the minimum Saybolt Color of +16 prior to the introduction of red dye.

X1.2 *Mercaptan Sulfur*—Mercaptans are limited to preclude undesirable side-reactions and to minimize the unpleasant odor.

X1.3 *Doctor Test* —The doctor test is an indirect indication of Mercaptan levels.

X1.4 *Sulfur*—Limited sulfur content of kerosine may be required for special uses or to meet legal requirements for sulfur dioxide emissions.

X1.5 *Distillation* —An indication of the volatility of a fuel. The maximum 10 % and final boiling point limits specified establish a suitable boiling range to readily vaporize the kerosine in normal applications.

X1.6 *Flash Point* —The flash point of kerosine is used primarily as an index of fire hazards. The minimum permissible flash point is usually regulated by federal, state, or municipal laws and is based on accepted practice in handling and use.

X1.7 *Freezing Point*—The temperature at which crystals of hydrocarbons formed on cooling disappear when the temperature of the fuel is allowed to rise. The waxy crystals may clog the wick in wick-fed systems and can block filter passages in fuel handling systems.

X1.8 *Viscosity* —The measure of internal resistance to flow, and ~~is~~ an indication of flowability and lubricity.

X1.9 *Burning Quality*—An indication of the kerosine performance in critical applications. The inherent burning quality potential of the bulk fuel, as determined by conventional parameters such as smoke point, luminometer number, or hydrogen content, cannot always be fully realized due to the adverse overriding effect of trace quantities of certain sulfur, oxygen, or nitrogen compounds that can be present in some kerosines. Thus, the burning quality of kerosine must be evaluated by designation of a suitable bench-type burning test.

X1.9.1 Burning tests are essentially performance tests and are a direct method for determining the quality of the kerosines for the specific purpose for which they are intended. However, it is not possible to make tests in all kinds of commercial equipment, or under all the combinations of such factors as location, time, temperature, humidity, air currents, and cleanliness. These difficulties are partially overcome by selecting equipment for the burning test that is known to be severe (Test Method D 187), and by extending the test beyond the typical time interval between cleanings of the lamp in its usual service.

X1.9.2 The most important features in Test Method D 187 are the shape and size of the flame. Changes in flame size or shape are generally caused by changes in the portion of the wick adjacent to the flame. Some wick crusts are *bushy* and increase flame size; others tend to enclose the surface of the wick and cause flame shrinkage. The worst type of deposit is an irregular one, sometimes localized as mushroom formations, that produces a distorted flame and usually causes smoking, which is quite objectionable to the user.

X1.9.3 The condition of the chimney at the end of the burning test is also important. Illuminating kerosine should not cause objectionable smoke deposit on the chimney. An appreciable black sooty deposit is obviously objectionable, but the operator must always assure himself that it is not caused by drafts or improper testing techniques. A heavy whitish deposit nearly always forms when a new chimney is put into service.

X1.10 *Corrosion* —An indication of the tendency to corrode copper and copper-alloy components that may be present in the kerosine handling and burner systems.

X1.11 *Microbial Contamination*—Refer to Guide D 6469 for a discussion of this form of contamination.

X1.12 *Potential Application Concerns*—It is recommended that 1-K kerosine used in unvented, wick-fed applications like space heaters be clear and undyed. Red dye can mask the presence of contaminants like diesel. Some of these contaminants may adversely affect the performance of unvented, wick-fed space heaters. Elevated sulfur content, higher aromatics, and olefin content, associated with diesel contamination, are known to increase performance problems with wick-fed, unvented applications and can be detrimental to health. Additionally, insufficient health testing on red-dyed 1-K for use in unvented, wick-fed applications, like 1-K space heaters, has also resulted in a recommendation for the exclusion of red-dyed 1-K usage at this time. Once additional testing is conducted, a review will be made and reconsideration given to red-dyed 1-K.