



Designation: D4814 – 24

Standard Specification for Automotive Spark-Ignition Engine Fuel¹

This standard is issued under the fixed designation D4814; 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 reapproval. 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 U.S. Department of Defense.

1. Scope*

1.1 This specification covers the establishment of requirements of liquid automotive fuels for ground vehicles equipped with spark-ignition engines.

1.2 This specification describes various characteristics of automotive fuels for use over a wide range of operating conditions. It provides for a variation of the volatility and water tolerance of automotive fuel in accordance with seasonal climatic changes at the locality where the fuel is used. For the period May 1 through September 15, the maximum vapor pressure limits issued by the United States (U.S.) Environmental Protection Agency (EPA) are specified for each geographical area except Alaska, Hawaii, and the U.S. Territories. Variation of the antiknock index with seasonal climatic changes and altitude is discussed in [Appendix X1](#). This specification neither necessarily includes all types of fuels that are satisfactory for automotive vehicles, nor necessarily excludes fuels that can perform unsatisfactorily under certain operating conditions or in certain equipment. The significance of each of the properties of this specification is shown in [Appendix X1](#).

1.3 The spark-ignition engine fuels covered in this specification are gasoline and its blends with oxygenates, such as alcohols and ethers and where gasoline is the primary component by volume in the blend. The concentrations and types of oxygenates are not specifically limited in this specification. The composition of fuel is limited by economic, legal, and technical consideration, but its properties, including volatility, are defined by this specification. In many countries, regulatory authorities having jurisdiction have set laws and regulations that limit the concentration of oxygenates and certain other compounds found in spark-ignition engine fuel. In the United States, oxygenate types and concentrations are limited to those approved under the U.S. Environmental Protection Agency's (EPA) substantially similar rule (see [X3.3.1](#)), waivers, and

partial waivers including some restrictions on vehicle and equipment use (see [X3.3.2](#)). With regard to fuel properties, including volatility, this specification can be more or less restrictive than the EPA rules, regulations, and waivers. Refer to [Appendix X3](#) for discussions of EPA rules relating to fuel volatility, lead and phosphorous contents, sulfur content, benzene content, deposit control additive certification, and use of oxygenates in the fuel. Contact the EPA for the latest versions of the rules and additional requirements.

1.4 This specification does not address the emission characteristics of reformulated spark-ignition engine fuel. Reformulated spark-ignition engine fuel is required in some areas to lower emissions from automotive vehicles, and its characteristics are described in Monograph 12 (MONO12) on reformulated spark-ignition engine fuel.² However, in addition to the legal requirements found in MONO12, reformulated spark-ignition engine fuel should meet the performance requirements found in this specification.

1.5 This specification represents a description of automotive fuel as of the date of publication. The specification is under continuous review, which can result in revisions based on changes in fuel, automotive requirements, or test methods, or a combination thereof. All users of this specification, therefore, should refer to the latest edition.

NOTE 1—If there is any doubt as to the latest edition of Specification D4814, contact ASTM International Headquarters.

1.6 The type of fuel under consideration must first be identified in order to select applicable tests. Test Method [D4815](#) provides a procedure for determining oxygenate concentration in mass percent. Test Method [D4815](#) also includes procedures for calculating mass oxygen content and oxygenate concentration in volume percent. [Appendix X4](#) provides a procedure for calculating the mass oxygen content of a fuel using measured oxygenate type, oxygenate concentration in volume percent, and measured density or relative density of the fuel.

1.7 The following applies to all specified limits in this standard: For purposes of determining conformance with these

¹ This specification is under the jurisdiction of ASTM Committee [D02](#) on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee [D02.A0.01](#) on Gasoline and Gasoline-Oxygenate Blends.

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² MONO12, "U.S. Reformulated Spark-Ignition Engine Fuel and the U.S. Renewable Fuel Standard" is available from ASTM International Headquarters.

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

TABLE 1 Vapor Pressure and Distillation Class Requirements^A

	Vapor Pressure/Distillation Class							ASTM Test Method
	AAA	AA	A	B	C	D	E	
Vapor Pressure, ^B at 37.8 °C (100 °F) max, kPa (psi)	51 (7.4)	54 (7.8)	62 (9.0)	69 (10.0)	79 (11.5)	93 (13.5)	103 (15.0)	D4953, D5191, D5482, or D6378 D86 or D7345 ^{D, E}
Distillation Temperatures, °C (°F), at % Evaporated ^C								
10 volume %, max	70. (158)	70. (158)	70. (158)	65 (149)	60. (140.)	55 (131)	50. (122)	
50 volume %								
min ^F	77 (170.)	77 (170.)	77 (170.)	77 (170.)	77 (170.)	77 (170.) ^G	77 (170.) ^G	
max	121 (250.)	121 (250.)	121 (250.)	118 (245)	116 (240.)	113 (235)	110. (230.)	
90 volume %, max	190. (374)	190. (374)	190. (374)	190. (374)	185 (365)	185 (365)	185 (365)	
End Point, max	225 (437)	225 (437)	225 (437)	225 (437)	225 (437)	225 (437)	225 (437)	
Distillation Residue, volume %, max	2	2	2	2	2	2	2	D86 or D7345 ^{D, E}
Driveability Index, ^H max, °C (°F)	597 (1250.)	597 (1250.)	597 (1250.)	591 (1240.)	586 (1230.)	580. (1220.)	569 (1200.)	Derived ^{I, J}

^A See 1.7 for determining conformance with specification limits in this table. When using this table to determine the conformance of gasoline volatility, the reader is advised to review other applicable national, state, provincial, or local requirements. (For example, in the U.S. these may include the EPA Substantially Similar rule, California Air Resources Board (CARB), Clean Burning Gasoline (CBG), other state or local and pipeline specifications). See Appendix X3 for a summary of applicable U.S. EPA regulations for spark-ignition engine fuels.

^B Consult EPA for approved test methods for compliance with EPA vapor pressure regulations.

^C At 101.3 kPa pressure (760 mm Hg).

^D Test Method D86 shall be the referee method.

^E Test Method D7345, results shall be reported as “Predicted D86” as determined by applying the corrections described in Test Method D7345 to convert to D86 equivalent values. The use of Test Method D7345 shall be limited to gasoline and gasoline-ethanol blends up to maximum 20 % by volume ethanol.

^F For gasolines that may be blended with 1 % to 15 % by volume ethanol or all other gasolines whose disposition with ethanol blending is not known, the minimum 50 % evaporated distillation temperature shall be 77 °C (170. °F) prior to blending with ethanol. For gasoline-ethanol blends that contain 1 % to 15 % by volume ethanol, the minimum 50 % evaporated distillation temperature shall be 66 °C (150. °F) for volatility classes AAA through C. For Classes D and E fuels containing 1 % to 15 % by volume ethanol, the minimum 50 % evaporated distillation temperature shall be 62.8 °C (145.0 °F). For the 62.8 °C (145.0 °F) minimum 50 % evaporated distillation temperature, no allowance shall be made for the precision of the test methods..

^G Gasolines known from the origin to retail that will not be blended with ethanol may meet a minimum 50 % evaporated distillation temperature of 66 °C (150. °F) for volatility classes D and E only. Gasolines meeting these limits are not suitable for blending with ethanol.

^H See 5.2.6 for Driveability Index equations for gasoline and gasoline-ethanol blends containing no more than 15 % by volume ethanol.

^I The DI specification limits are applicable at the fuel manufacturing facility and are not subject to correction for precision of the test method.

^J Since DI is an index and has no units, the standard temperature conversion from U.S. customary to SI units is not appropriate. The following equation is to be used to make the conversion: $DI_{C} = (DI_{F} - 176) / 1.8$

specifications, an observed value or a calculated value shall be rounded “to the nearest unit” in the right-most significant digit used in expressing the specification limit, in accordance with the rounding method of Practice E29. For a specification limit expressed as an integer, a trailing zero is significant only if the decimal point is specified. For a specified limit expressed as an integer, and the right-most digit is non-zero, the right-most digit is significant without a decimal point being specified. This convention applies to specified limits in Tables 1, 3, and X8.1, and it will not be observed in the remainder of this specification.

1.8 The values stated in SI units are the standard, except when other units are specified by U.S. federal regulation. Values given in parentheses are provided for information only.

NOTE 2—Many of the values shown in Table 1 were originally developed using U.S. customary units and were subsequently soft-converted to SI values. As a result, conversion of the SI values will sometimes differ slightly from the U.S. customary values shown because of round-off. In some cases, U.S. federal regulations specify non-SI units.

1.9 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

1.10 This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recom-

mendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 ASTM Standards:³

- D86 Test Method for Distillation of Petroleum Products and Liquid Fuels at Atmospheric Pressure
- D130 Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
- D287 Test Method for API Gravity of Crude Petroleum and Petroleum Products (Hydrometer/Method)
- D381 Test Method for Gum Content in Fuels by Jet Evaporation
- D439 Specification for Automotive Gasoline (Withdrawn 1990)⁴
- D525 Test Method for Oxidation Stability of Gasoline (Induction Period Method)
- D1266 Test Method for Sulfur in Petroleum Products (Lamp Method)
- D1298 Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method

³ 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.

⁴ The last approved version of this historical standard is referenced on www.astm.org.