Designation: D8267 – 24

Standard Test Method for Determination of Total Aromatic, Monoaromatic and Diaromatic Content of Aviation Turbine Fuels Using Gas Chromatography with Vacuum Ultraviolet Absorption Spectroscopy Detection (GC-VUV)[1]

This standard is issued under the fixed designation D8267; 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.

1. Scope*

1.1 This test method is a standard procedure for the determination of total aromatic, monoaromatic and diaromatic content in aviation turbine fuels using gas chromatography and vacuum ultraviolet detection (GC-VUV).

1.2 Concentrations of compound classes and certain individual compounds are determined by percent mass or percent volume.

1.2.1 This test method is developed for testing aviation turbine engine fuels having concentration test results ranging from 0.487 % to 27.876 % by volume total aromatic compounds, 0.49 % to 27.537 % by volume monoaromatics and 0.027 % to 2.523 % by volume diaromatics.

NOTE 1—Samples with a final boiling point greater than 300 °C that contain triaromatics and higher polyaromatic compounds are not determined by this test method.

1.3 Individual hydrocarbon components are not reported by this test method, however, any individual component determinations are included in the appropriate summation of the total aromatic, monoaromatic or diaromatic groups.

1.3.1 Individual compound peaks are typically not baseline-separated by the procedure described in this test method, that is, some components will coelute. The coelutions are resolved at the detector using VUV absorbance spectra and deconvolution algorithms.

1.4 This test method has been tested for aviation turbine engine fuels including synthetic alternative jet fuels. This test method may apply to other hydrocarbon streams boiling between hexane (68 °C) and heneicosane (356 °C), but has not been extensively tested for such applications.

1.5 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 *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.*

1.7 *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 Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1840 Test Method for Naphthalene Hydrocarbons in Aviation Turbine Fuels by Ultraviolet Spectrophotometry

D4057 Practice for Manual Sampling of Petroleum and Petroleum Products

D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants

D4307 Practice for Preparation of Liquid Blends for Use as Analytical Standards

D6299 Practice for Applying Statistical Quality Assurance and Control Charting Techniques to Evaluate Analytical Measurement System Performance

D6300 Practice for Determination of Precision and Bias Data for Use in Test Methods for Petroleum Products, Liquid Fuels, and Lubricants

D6379 Test Method for Determination of Aromatic Hydrocarbon Types in Aviation Fuels and Petroleum Distillates—High Performance Liquid Chromatography Method with Refractive Index Detection

D6730 Test Method for Determination of Individual Components in Spark Ignition Engine Fuels by 100-Metre

[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.04.0L on Gas Chromatography Methods.

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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.

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

Capillary (with Precolumn) High-Resolution Gas Chromatography
D6792 Practice for Quality Management Systems in Petroleum Products, Liquid Fuels, and Lubricants Testing Laboratories
D7372 Guide for Analysis and Interpretation of Proficiency Test Program Results

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this test method, refer to Terminology D4175.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *diaromatics, n*—hydrocarbon compounds containing two aromatic rings; this group includes naphthalene, biphenyls, acenaphthene, acenaphthylene and alkylated derivatives of these hydrocarbons.

3.2.1.1 *Discussion*—Aviation turbine fuel specifications limit naphthalenes which includes naphthalene, acenaphthene, and alkylated derivatives of these hydrocarbons. The Test Method D1840 method for naphthalenes states that biphenyls interfere with the analysis. Biphenyls if present in typical aviation turbine fuel would be measured as naphthalenes in Test Method D1840, therefore the terms naphthalenes and diaromatics can be considered synonymous in the context of this test method.

3.2.2 *integration filter, n*—a mathematical operation performed on an absorbance spectrum for the purpose of converting the spectrum to a single-valued response suitable for representation in a two-dimensional chromatogram plot.

3.2.3 *library reference spectrum, n*—an absorbance spectrum representation of a molecular species stored in a library database and used for identification of a compound/compound class or deconvolution of multiple coeluting compounds.

3.2.4 *monoaromatic hydrocarbons, n*—hydrocarbon compounds containing one aromatic ring; including benzene, alkylsubstituted benzenes, indans, tetralins, alkyl-substituted indans, and alkyl-substituted tetralins.

3.2.5 *response area, n*—generally refers to a response summed over a given time interval and has units of absorbance units (AU).

3.2.5.1 *Discussion*—A time factor necessary to convert a response area to a true mathematical area cancels out of all critical calculations and is omitted.

3.3 *Abbreviations:*

3.3.1 *AU*—absorbance units

3.3.2 *GC-VUV*—gas chromatography with vacuum ultraviolet spectroscopy detection

3.3.3 *RI*—retention index

3.3.4 *RRF*—relative response factor

4. Summary of Test Method

4.1 An aviation turbine fuel sample is introduced to a gas chromatographic (GC) system. After volatilization, the effluent is introduced onto a GC column for separation, and then detected by a vacuum ultraviolet absorption spectroscopy detector.[3] The separation is accomplished using a 30 m, nonpolar phase capillary column and a moderately fast temperature ramp (typical operating parameters of this test method are given in Table 1). Coelutions are resolved by the detector using vacuum ultraviolet absorbance spectra and deconvolution.

4.2 The calculation of the results is based on the determination of the total response areas of each of the classes of saturate, aromatic and diaromatic compounds. The saturates class includes the summation of the paraffins, isoparaffins, and naphthenes. The total aromatics class includes the summation of monoaromatics and diaromatics. The percent mass concentrations are calculated from the response areas using class-based relative response factors, as appropriate. The volume percent concentrations are calculated from the mass concentrations by applying specific component or class-based density values as appropriate.

5. Significance and Use

5.1 The determination of class group composition of aviation turbine fuels is useful for evaluating quality and expected performance, as well as compliance with various industry specifications and governmental regulations.

6. Interferences

6.1 Interferences with this test method, if any, have not been determined.

7. Apparatus

7.1 *Gas Chromatograph,* equipped with automated oven temperature control and split/splitless inlet.

[3] The sole source of supply of the apparatus known to the committee at this time is VUV-Analytics, Cedar Park, Texas. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

TABLE 1 Typical Instrument Settings for GC-VUV Aviation Turbine Fuel Measurement

Column Dimensions	Capillary, 30 m × 0.25 mm ID × 0.25 µm film thickness
Column phase[A]	Nonpolar (for example, 100 % dimethyl polysiloxane)
Injector temperature	250 °C
Injection volume[B]	1.0 µL
Split ratio[B]	100:1
Column flow (constant flow mode)	2.0 mL/min
Oven initial temperature	50 °C
Initial hold time	0.1 min
Oven ramp	15 °C/min
Final oven temperature	260 °C
Final hold time	0 min
Detector makeup gas pressure (gauge)	as per manufacturer's instructions
Data scan rate	7.0 Hz
Detector flow cell temperature	275 °C
Transfer line temperature	275 °C

[A] Columns with low bleed phases such as MS grade have been successfully used for this application (see 11.6).
[B] Other injection volumes and split ratios may be used to achieve the required naphthalene response (see 13.2).