Designation: D8368 – 22a

Standard Test Method for Determination of Totals of Aromatic, Polyaromatic and Fatty Acid Methyl Esters (FAME) Content of Diesel Fuel Using Gas Chromatography with Vacuum Ultraviolet Absorption Spectroscopy Detection (GC-VUV)[1]

This standard is issued under the fixed designation D8368; 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 covers a standard procedure for the determination of group type totals of aromatic, polyaromatic, and FAME content in diesel fuel using gas chromatography and vacuum ultraviolet absorption spectroscopy detection (GC-VUV).

1.1.1 Polyaromatic totals are the result of the summation of diaromatic and tri-plus aromatic group types. Aromatics are the summation of monoaromatic and polyaromatic group types. FAME content is the result of summation of individual fatty acid methyl esters.

1.1.2 This test method is applicable for renewable diesel fuels from hydrotreated vegetable oil (HVO) or animal fat, gas to liquid (GTL) diesel, light cycle oil, wide boiling range aromatic solvents and biodiesel blends.

1.2 Concentrations of group type totals are determined by percent mass or percent volume. The applicable working ranges are as follows:

Total Aromatics %Volume	0.088 to 77.000
Total Aromatics %Mass	0.104 to 79.451
MonoAromatics %Mass	0.076 to 67.848
Diaromatics %Mass	0.027 to 34.812
Tri-plus aromatics %Mass	0.45 to 6.77
PAH %Mass	0.028 to 41.586
FAME %Volume	1.08 to 21.67

1.3 Diesel fuel containing biodiesel, (FAME, that is, fatty acid methyl esters including soy methyl esters, rapeseed methylesters, tallow methylesters and canola methylesters) can be analyzed by this test method. The FAME component completely elutes from the analytical column independent of feedstock.

1.4 Individual hydrocarbon components are not reported by this test method; however, any individual component determinations are included in the appropriate summation of the totals of aromatic, polyaromatic, monoaromatic, diaromatic, tri-plus aromatic, or FAME groups.

1.4.1 Individual components are typically not baseline-separated by the procedure described in this test method. The coelutions are resolved at the detector using VUV absorbance spectra and deconvolution algorithms.

1.5 This test method may apply to other hydrocarbon streams boiling between heptane (98 °C) and triacontane (450 °C), but has not been extensively tested for such applications.

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

1.7 *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.*

1.8 *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]

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

[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**

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

3.1.2 *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.

3.1.3 *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.

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

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

3.2 *Definitions of Terms Specific to This Standard:*

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

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

3.2.3 *polyaromatic hydrocarbons, n*—all hydrocarbon compounds containing two or more aromatic rings, including diaromatics and tri plus aromatics.

3.2.4 *relative response factor, n—in vacuum ultraviolet spectroscopy*, the relative response factor for a given compound is calculated from the compound's absorption cross section (expressed in cm^2/molecule) and methane's cross section.

3.2.4.1 *Discussion*—The absorption cross section is averaged over the 125 nm to 240 nm wavelength region.

3.2.4.2 *Discussion*—A compound's relative response factor is a function of the type and number of chemical bonds.

3.2.4.3 *Discussion*—A compound's relative response factor is relative to the response of methane, which is taken to have a relative response factor of 1.

3.2.5 *tri plus aromatic hydrocarbons, n*—hydrocarbon compounds containing three aromatic rings; this group includes phenanthrene, anthracene and alkylated derivatives of these hydrocarbons.

3.3 *Abbreviations:*

3.3.1 *ARV*—accepted reference value

3.3.2 *AU*—absorbance units

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

3.3.4 *LTL*—lower 95 % confidence/99 % coverage tolerance level

3.3.5 *PAH*—polyaromatic hydrocarbons

3.3.6 *RI*—retention index

3.3.7 *RRF*—relative response factor

3.3.8 *UTL*—upper 95 % confidence/99 % coverage tolerance level

4. Summary of Test Method

4.1 A 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.[3,4] 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 Total response areas are determined for sequential time intervals over the entire chromatogram. The calculation of the results is based on the deconvoluted response areas of each of the classes of saturate, aromatic, monoaromatic, diaromatic, tri-plus aromatic, and fatty acid methyl esters. The total aromatics class includes the summation of monoaromatics, diaromatics, and tri-plus aromatics. The total polyaromatics class includes a summation of the diaromatics and tri-plus aromatics. The percent mass concentrations are calculated from the response areas using specific component or class and carbon number based relative response factors. The volume percent concentrations are calculated from the mass concentrations by applying specific component or class and carbon number based density values. The mass and volume percent calculations are software automated, whereby the RRFs and densities are a function of elution time in a static database library.

NOTE 1—Appendix X1 and Appendix X2 provide further RRF details.

[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.

[4] The vacuum ultraviolet absorption apparatus is covered by a patent. Interested parties are invited to submit information regarding the identification of an alternative(s) to this patented item to the ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.[1]