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An American National Standard



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Standard Test Method for Determination of Aromatic Hydrocarbon Types in Aviation Fuels and Petroleum Distillates – High Performance Liquid Chromatography Method with Refractive Index Detection¹

This standard is issued under the fixed designation D 6379; 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.

INTRODUCTION

This test method is intended to be technically equivalent to IP 436-98 with an identical title. The ASTM format for test methods has been used, and where possible, equivalent ASTM test methods have replaced the IP or ISO standards.

The test method is intended to be used as one of several possible alternative instrumental test methods that are aimed at quantitative determination of hydrocarbon types in fuels. This does not imply that a correlation necessarily exists between this and any other test method intended to give this information, and it is the responsibility of the user to determine such correlation if necessary.

1. Scope

1.1 This test method covers a high performance liquid chromatographic test method for the determination of mono-aromatic and di-aromatic hydrocarbon contents in aviation kerosenes and petroleum distillates boiling in the range from 50 to 300°C, such as Jet A or Jet A-1 fuels. The total aromatic content is calculated from the sum of the individual aromatic hydrocarbon-types.

NOTE 1—Samples with a final boiling point greater than 300°C that contain tri-aromatic and higher polycyclic aromatic compounds are not determined by this test method and should be analysed by IP 391, or other suitable equivalent test methods.

1.2 This test method is calibrated for distillates containing from 10 to 25 % m/m mono-aromatic hydrocarbons and from 0 to 7 % m/m di-aromatic hydrocarbons.

1.3 The precision of this test method has been established for kerosene boiling range distillates containing from 10 to 25 % m/m mono-aromatic hydrocarbons and from 0 to 7 % m/m di-aromatic hydrocarbons.

1.4 Compounds containing sulfur, nitrogen, and oxygen are possible interferents. Mono-alkenes do not interfere, but conjugated di- and poly-alkenes, if present, are possible interferents.

1.5 *This standard does not purport to address 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 limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

D 4057 Practice for Manual Sampling of Petroleum and Petroleum Products²

D 4177 Practice for Automatic Sampling of Petroleum and Petroleum Products²

2.2 IP Standards:³

IP 391 Determination of Aromatic Hydrocarbon Types in Diesel Fuels and Distillates — High Performance Liquid Chromatography Refractive Index Method

IP 436 Test Method for Determination of Automatic Hydrocarbon Types in Aviation Fuels and Petroleum Distillates—High Performance Liquid Chromatography Method with Refractive Index

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *non-aromatic hydrocarbons, n*—compounds that have a shorter retention time on the specified polar column than the mono-aromatic hydrocarbons.

¹ This test method is under the jurisdiction of ASTM Committee D-2 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.04 on Hydrocarbon Analysis.

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In the IP, this test method is under the jurisdiction of the Standardization Committee.

² *Annual Book of ASTM Standards*, Vol 05.02.

³ Available from Institute of Petroleum, 61 New Canvondish St., London, W. I., England.

3.1.2 *mono-aromatic hydrocarbons (MAHs)*, *n*— compounds that have a longer retention time on the specified polar column than the non-aromatic hydrocarbons but a shorter retention time than the di-aromatic hydrocarbons.

3.1.3 *di-aromatic hydrocarbons (DAHs)*, *n*— compounds that have a longer retention time on the specified polar column than the MAHs.

3.1.4 *total aromatic hydrocarbons*, *n*—sum of the MAHs and DAHs.

NOTE 2—The elution characteristics of aromatic and non-aromatic compounds on the specified polar column have not been specifically determined for this test method. Published and unpublished data indicate the major constituents for each hydrocarbon type as follows: (a) Non-aromatic hydrocarbons: acyclic and cyclic alkanes (paraffins and naphthenes), mono-alkenes (if present). (b) MAHs: benzenes, tetralins, indanes, thiophenes, conjugated poly-alkenes. (c) DAHs: naphthalenes, biphenyls, indenenes, fluorenes, acenaphthenes, benzothiophenes.

4. Summary of Test Method

4.1 The sample is diluted 1:1 with the mobile phase, such as heptane, and a fixed volume of this solution injected into a high performance liquid chromatograph fitted with a polar column. This column has little affinity for the non-aromatic hydrocarbons and exhibits a pronounced selectivity for aromatic hydrocarbons. As a result of this selectivity, the aromatic hydrocarbons are separated from the non-aromatic hydrocarbons into distinct bands in accordance with their ring structure, that is, MAHs and DAHs.

4.2 The column is connected to a refractive index detector that detects the components as they elute from the column. The electronic signal from the detector is continually monitored by a data processor. The amplitudes of the signals (peak areas) from the sample aromatics are compared with those obtained from previously-run calibration standards in order to calculate

the percent m/m MAHs and DAHs in the sample. The sum of the MAHs and DAHs is reported as the total aromatic content (percent m/m) of the sample.

5. Significance and Use

5.1 Accurate quantitative information on aromatic hydrocarbon types can be useful in determining the effects of petroleum processes on production of various finished fuels. This information can also be useful for indicating the quality of fuels and for assessing the relative combustion properties of finished fuels.

6. Apparatus

6.1 *High Performance Liquid Chromatograph (HPLC)*—Any high performance liquid chromatograph capable of pumping the mobile phase at flow rates between 0.5 and 1.5 ml/min with a precision better than 0.5 % and a pulsation of <1 % full scale deflection under the test conditions described in Section 9. See Fig. 1.

6.2 *Sample Injection System*—The sample injection system shall be capable of injecting 10 μ L (nominal) of sample solution with a repeatability better than 2 %.

6.2.1 An equal and constant volume of the calibration and sample solutions shall be injected into the chromatograph. Both manual and automatic sample injection systems (using either complete or partial filling of the sample loop) will, when used correctly, meet the repeatability requirements laid down in 6.2. When using the partial loop filling mode, it is recommended that the injection volume should be less than half the total loop volume. For complete filling of the loop, best results are obtained by overfilling the loop at least six times.

6.2.2 Sample injection volumes other than 10 μ L (typically in the range from 3 to 20 μ L) may be used provided they meet

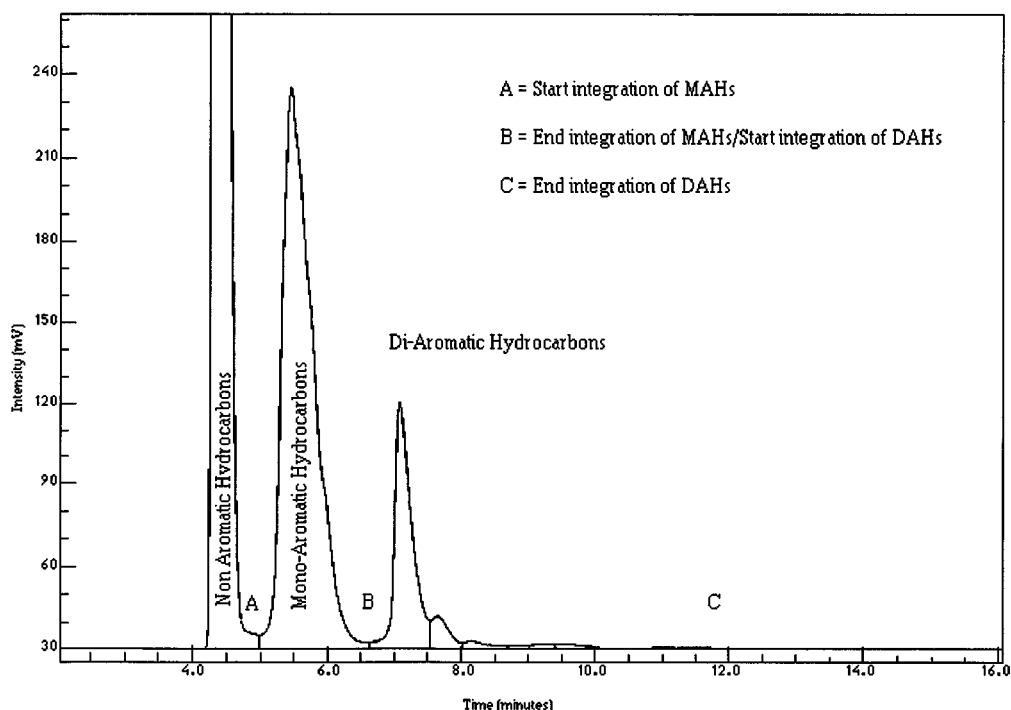


FIG. 1 Example Chromatogram of an Aviation Fuel Showing Integration Points and Aromatic Hydrocarbon Types