INTERNATIONAL STANDARD

ISO 22854

First edition
2008-10-01

Liquid petroleum products — Determination of hydrocarbon types and oxygenates in automotive-motor gasoline — Multidimensional gas chromatography method

Produits pétroliers liquides — Détermination des groupes d'hydrocarbures et de la teneur en composés oxygénés de l'essence automobile pour moteurs — Méthode par chromatographie multidimensionnelle en phase gazeuse

STANDARDSISO.COM : Click to view the full PDF of ISO 22854:2008

Reference number
ISO 22854:2008(E)

© ISO 2008

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

STANDARDSISO.COM : Click to view the full PDF of ISO 22854:2008

COPYRIGHT PROTECTED DOCUMENT

© ISO 2008

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

STANDARDSISO.COM : Click to view the full PDF of ISO 22854:2008

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 22854 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 19, *Gaseous and liquid fuels, lubricants and related products of petroleum, synthetic and biological origin*, in collaboration with Technical Committee ISO/TC 28, *Petroleum products and lubricants*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

STANDARDSISO.COM : Click to view the full PDF of ISO 22854:2008

© ISO 2008 – All rights reserved

Introduction

This first edition of ISO 22854 is an update of the first edition of EN 14517:2004 [10]. Recent round-robin work has been incorporated to check whether the precision data for additional oxygenates fall within the ones given in Table 5. The scope has been updated. An instrument configuration has been added to the informative Annex A, describing an optimal set-up for the apparatus. In addition, Tables 1 and 2, with response factors, have been updated based on recent experimental data.

Originally the document was used for determination of saturated, olefinic and aromatic hydrocarbons in automotive motor gasoline according to European fuel specifications. The method is applicable for finished automotive motor gasoline with a total aromatic content up to 50 % (V/V) and a total olefin content from about 1,5 % (V/V) up to 30 % (V/V).

The inter-laboratory study within CEN had been performed on automotive motor gasoline samples with a maximum of 30 % (V/V) olefin content. Within some countries, the need for higher olefin percentages was expressed and an inter-laboratory study had been set up to determine precision data for automotive motor gasoline samples with higher olefin contents of up to 50 % (V/V). In the first round robin, no samples with a high-olefin content in this range were delivered and hence they could not be taken into account (see test after Note 3 in the Scope). Once further results are known, this International Standard will be updated.

Applicability of this test method has also been verified for the determination of *n*-propanol, acetone, and diisopropyl ether (DIPE). However, no precision data have been determined for these compounds. The derived precision data for methanol do not comply with the precision calculation as presented in this International Standard. No precision calculation for methanol has been established as the need for such data has not been expressed. If any of these oxygenated compounds are present in the automotive motor gasoline sample, it is appropriate that their contents best be verified by use of other appropriate test methods, for instance as given in EN 228 [1].

The test method as described in this International Standard is harmonized with ASTM D 6839 [2].

STANDARDSISO.COM : Click to view the full PDF of ISO 22854:2008

STANDARDSISO.COM : Click to view the full PDF of ISO 22854:2008

Liquid petroleum products — Determination of hydrocarbon types and oxygenates in automotive-motor gasoline — Multidimensional gas chromatography method

1 Scope

This International Standard specifies the gas chromatographic (GC) method for the determination of saturated, olefinic and aromatic hydrocarbons in automotive motor gasoline. Additionally, the benzene content, oxygenate compounds and total oxygenate content can be determined.

This International Standard is applicable to automotive motor gasoline with a total content of aromatics of up to 50 % (V/V); a total olefin content from about 1,5 % (V/V) up to 30 % (V/V); oxygenate compounds, from 0,8 % (V/V) up to 15 % (V/V); a total oxygen content from about 1,5 % (m/m) to about 3 % (m/m); and a benzene content of up to 2 % (V/V).

NOTE 1 For the purposes of this document, the terms "% (m/m)" and "% (V/V)" are used the represent, respectively, the mass fraction and the volume fraction.

NOTE 2 While developing this method, the final boiling point was limited to 215 °C.

NOTE 3 For oxygenate compounds, precision data have been established on automotive motor gasoline samples containing ethyl-*tert*-butyl ether (ETBE), methyl-*tert*-butyl ether (MTBE), *tert*-amyl-methyl ether (TAME), *iso*-propanol, *iso*-butanol, *tert*-butanol, methanol and ethanol. The derived precision data for methanol do not comply with the precision calculation as presented in this International Standard. Applicability of this International Standard has also been verified for the determination of *n*-propanol, acetone, and *di*-isopropyl ether (DIPE). However, no precision data have been determined for these compounds.

Although this test method can be used to determine higher-olefin contents of up to 50 % (V/V), the precision for olefins was tested only in the range from about 1,5 % (V/V) to about 30 % (V/V).

Although specifically developed for the analysis of automotive motor gasoline that contains oxygenates, this test method can also be applied to other hydrocarbon streams having similar boiling ranges, such as naphthas and reformates.

NOTE 4 There can be an overlap between C9 and C10 aromatics. However, the total is accurate. Isopropyl benzene is resolved from the C8 aromatics and is included with the other C9 aromatics.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3170:2004, *Petroleum liquids — Manual sampling*

ISO 3171:1988, *Petroleum liquids — Automatic pipeline sampling*

STANDARDSISO.COM : Click to view the full PDF of ISO 22854:2008

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
hydrocarbon group
family of hydrocarbons such as saturated hydrocarbons, olefinic hydrocarbons, etc.

3.1.1
saturated hydrocarbon
saturate
type of straight-chain or cyclic hydrocarbon that contains no double bonds with a carbon number of 3 to 12

EXAMPLE *n*-Paraffins, iso-paraffins, naphthenes and poly-naphthenes.

3.1.2
olefinic hydrocarbon
olefin
type of hydrocarbon that contains double or triple bonds with a carbon number of 3 to 10

EXAMPLE *n*-Olefins, *iso*-olefins and cyclic olefins.

3.1.3
aromatic hydrocarbon
aromatic
type of cyclic hydrocarbon that contains double or triple bonds

EXAMPLE Benzene, toluene and higher homologous series with a carbon number of 6 to 10 and naphthalenes, with a carbon number of up to 12.

3.2
oxygenate
oxygenated compound
type of straight-chain or cyclic hydrocarbon that contains an oxygen group, the addition of which is allowed according to current petrol specifications

EXAMPLE Alcohols and ethers.

NOTE See Clause 1, Note 3.

3.3
partial group
PG
one carbon number in an individual group, being either a single compound like toluene or an isomeric mixture, such as *n*-butane and *iso*-butane

STANDARDSISO.COM : Click to view the full PDF of ISO 22854:2008

© ISO 2008 – All rights reserved

4 Principle

4.1 The automotive motor gasoline sample being analysed is separated into hydrocarbon groups by means of gas chromatographic analysis using special column-coupling and column-switching procedures.

The automotive motor gasoline sample is injected into the gas chromatographic system and, after vaporization, is separated into the different groups. Detection is always done by a flame ionization detector (FID).

4.2 The mass concentration of each detected compound or hydrocarbon group is determined by the application of relative response factors (see 9.1) to the area of the detected peaks, followed by normalization to 100 %. For automotive motor gasoline samples containing oxygenates that cannot be determined by this test method, the hydrocarbon results are normalized to 100 % minus the value of oxygenates as determined by another method. The liquid volume concentration of each detected compound or hydrocarbon group is determined by the application of density values (see 9.2) to the calculated mass concentration of the detected peaks followed by normalization to 100 %.

IMPORTANT — It is essential to the correct execution of the method that great care be taken to ensure that all compounds are correctly identified. This is especially true for the identification of oxygen-containing compounds because of their wide range of response factors. It is, therefore, highly recommended for correct identification to verify possibly unknown oxygenates using a reference mixture that contains these pure compounds.

4.3 After this analysis, the automotive motor gasoline is separated into hydrocarbon groups and then by carbon number. By the use of the corresponding relative response factors, the mass distributions of the groups in the automotive motor gasoline sample can be calculated.

5 Reagents and materials

5.1 Gases

NOTE Installation of suitable moisture filters is recommended for helium and hydrogen lines.

5.1.1 Hydrogen, 99,999 % pure.

DANGER — Hydrogen is explosive when mixed with air at concentration between 4 % (V/V) and 75 % (V/V). See the equipment manufacturers' manuals concerning leaks in the system.

5.1.2 Helium, 99,999 % pure.

5.1.3 Compressed air.

5.2 Vials, airtight and inert, e.g. with rubber-membrane caps covered with self-sealing polytetrafluoroethylene (PTFE).

5.3 Reference solutions, finished automotive motor gasoline(s) used as reference and which contain components and concentration levels comparable to those of the test sample.

The composition of the reference solution should have been determined in a round robin or by other methods.

DANGER — Flammable. Harmful if inhaled.

NOTE Sulfur-containing compounds are irreversibly adsorbed in the olefins trap and can reduce its capacity to retain olefins. Sulfur can also be adsorbed in the alcohol and ether-alcohol-aromatic traps. Although the effect of low amounts of sulfur components on the various traps or columns is very small, it is important to exercise care with automotive motor gasoline samples with high levels of sulfur.

STANDARDSISO.COM : Click to view the full PDF of ISO 22854:2008

6 Apparatus

6.1 Gas chromatograph, computer-controlled, multidimensional GC equipment, injector, FID, suitable columns, traps and hydrogenation catalysts, of which an example is given in Annex A.

6.2 Switching valves, suitable switching valves that are used for the transfer of compounds from one column to the other in the gas chromatograph.

They shall have a chemically inactive surface and a small dead volume.

6.3 Traps, suitable short columns (see Annex A for an example) used for retaining certain selected chemical groups of the automotive motor gasoline using temperature control.

The absorption of the trapped compounds shall be reversible.

EXAMPLE A typical sequence is, for example, the following.

- First, the alcohols and higher-boiling aromatics are absorbed in a trap (sulfate column I). The remaining aromatics are separated from the other components by means of a polar column (for example, OV 275).
- The ethers are separated from the remaining fraction by means of another trap (sulfate column II).
- The olefins are separated from the saturates by the olefin trap (for example, silver salt) in two steps. This is necessary due to the limited capacity of such traps to retain high amounts of butene or total olefins. If the trap capacity is sufficient for the olefin concentration, the separation can be performed in one step.
- Next, the remaining saturated hydrocarbons are separated into paraffins and naphthenes according to their carbon number using a 13X molecular sieve column.
- The ethers are then eluted from the trap (sulfate column II) and separated and detected according to boiling point.
- The olefins are desorbed from the olefin trap and hydrogenated in the platinum column. They are separated and detected as the corresponding saturated compounds using a 13X molecular sieve.
- The alcohols and higher-boiling aromatics are eluted from the polar column and the trap (sulfate column I), separated using a non-polar column (for example, OV 101 methyl silicone) and detected according to boiling point.

Examples of typical chromatograms with this order of elution of the hydrocarbon fractions are shown in Figures B.1 and B.2.

7 Sampling

Unless otherwise required by national standards or by the regulations for the sampling of automotive motor gasoline, samples shall be taken in accordance with ISO 3170 for manual sampling or in accordance with ISO 3171 for automatic pipeline sampling.

8 Procedure

8.1 Conditioning

Condition the apparatus according to the manufacturer's instructions after shutdowns.

8.2 Preparation of a test sample

Cool the test sample to prevent loss by evaporation. Transfer a sufficient portion of the test sample to a vial (5.2) and immediately tightly close and seal it using the self-sealing PTFE cap.

It is advised to cool the test sample to a temperature between 0 °C and 5 °C.

STANDARDSISO.COM : Click to view the full PDF of ISO 22854:2008

© ISO 2008 – All rights reserved

8.3 Test sample injection volume

Size the injection volume of the test sample in such a way that the capacity of the columns is not exceeded and that the linearity of the detector is valid.

NOTE An injection volume of 0,1 µl has proven satisfactory.

8.4 Verification of the apparatus and test conditions

Run the reference solution (5.3) and check for correct instrument parameters, cutting times and grouping times. If they are not correct, adjust the apparatus to the manufacturer's recommendations and rerun the reference solution.

Attention should be paid to components, such as benzene, olefins and oxygenates, that are near the boundaries of separation on the group-selective columns. Care should be taken to accurately identify the oxygen-containing compounds. It is recommended to verify the identity of possible oxygenates using a reference material that contains the pure component of interest. Annex B shows several chromatograms specifically for oxygenate compounds, providing evidence of their elution times and possible interferences.

8.5 Validation

Reprocess the validation reference solution and compare the obtained results with the consensus values. The absolute deviation from the consensus values shall not be greater than the reproducibility for the parameters as given in Clause 11.

It is strongly recommended to run the validation reference solution weekly to check the proper functioning of the equipment.

The validation reference solution(s) should contain the components in amounts similar to those found in the test samples. Validation of the apparatus should be performed prior to the analysis of any new oxygenates.

8.6 Preparation of the test sample

Prepare the test sample as specified in 8.2 and 8.3.

8.7 Preparation of the apparatus and test conditions

Set up the apparatus in accordance with 8.1 and check it out in accordance with 8.4.

9 Calculation

9.1 Calculation as percent mass fraction

The integrated peak areas are employed for the calculations. The peaks are arranged according to their presence in the groups described in Clause 3. Tables 1 and 2 give the relative response factors of partial groups and for oxygenated compounds. After correcting with the response factors, the mass contributions for all partial groups are calculated and normalized to 100 % (m/m). The partial groups are then classified according to the hydrocarbon type and carbon number.

If single compounds, e.g. oxygenate compounds, are determined by a different but accepted method, e.g. EN 1601 [3], ASTM D4815 [4], EN 13132 [5] or ASTM D5599 [6], they shall be excluded from integration. The total area is then not normalized to 100 %, but to 100 % minus the excluded quantified component. The external quantification shall be noted in the report.

STANDARDSISO.COM : Click to view the full PDF of ISO 22854:2008

Table 1 — FID relative response factors of partial groups

Carbon number	Relative response factor $F_{\mathrm{RR,PG}}$ *n*-paraffins, plus *iso*-paraffins	Naphthenes	*n*-olefins, plus *iso*-olefins	Olefins, cyclics	Aromatics
3	0,916	—	0,916	—	—
4	0,906	—	0,906	—	—
5	0,899	0,874	0,899	0,874	—
6	0,895	0,874	0,895	0,874	0,811
7	0,892	0,874	0,892	0,874	0,820
8	0,890	0,874	0,890	0,874	0,827
9	0,888	0,874	0,888	0,874	0,832
10	0,887	0,874	0,887	0,874	0,837
11+	0,887	—	—	—	0,840

Calculate the theoretical relative response factors, $F_{\mathrm{RR,PG}}$, of a particular carbon number for a hydrocarbon type group (response of methane set to unity) as given in Equation (1); (see Tables 1 and 2):

$$F_{\mathrm{RR,PG}} = \frac{\left[\left(M_{\mathrm{C}} \times n_{\mathrm{C}}\right) + \left(M_{\mathrm{H}} \times n_{\mathrm{H}}\right)\right] \times 0{,}748\,7}{M_{\mathrm{C}} \times n_{\mathrm{C}}} \tag{1}$$

where

M_{C} is the atomic mass of carbon, equal to 12,011;

n_{C} is the number of carbon atoms in the group;

M_{H} is the atomic mass of hydrogen, equal to 1,008;

n_{H} is the number of hydrogen atoms in the group;

0,748 7 is the correction factor to set the response of methane to unity.

For each partial group, PG, the percent mass fraction, w_{PG}, is calculated as given in Equation (2):

$$w_{\mathrm{PG}} = \frac{100 \times A_{\mathrm{PG}} \times F_{\mathrm{RR,PG}}}{\sum_{i}\left(A_{\mathrm{PG},i} \times F_{\mathrm{RR,PG},i}\right)} \tag{2}$$

where A_{PG} is the total, corrected signal area for partial group, PG.

STANDARDSISO.COM : Click to view the full PDF of ISO 22854:2008

© ISO 2008 – All rights reserved

Table 2 — FID relative response factors for oxygenated compounds

Oxygenate compound	$F_{\mathrm{RR,PG}}$ [a]
MTBE	1,33
DIPE	1,32
ETBE	1,31
TAME	1,24
methanol	3,80
ethanol	1,91
n-propanol	1,87
iso-propanol	1,74
n-butanol	1,55
iso-butanol	1,39
sec-butanol	1,39
tert-butanol	1,23
2-methyl-2-butanol	1,40

[a] The relative response factors for the oxygenate compounds have been determined experimentally.

9.2 Calculation as percent volume fraction

The conversion from percent mass fraction to percent volume fraction is done using the density of the partial groups. The density values at 15 °C, expressed in kilograms per cubic metre, of partial groups are shown in Table 3 and of oxygenate compounds, in Table 4.

Table 3 — Density of partial groups at 15 °C

Values in kilograms per cubic metre

Carbon number	Density [a] ρ_{PG}				
	***n*-paraffins, plus *iso*-paraffins**	**Naphthenes**	***n*-olefins, plus *iso*-olefins**	**Olefins, cyclics**	**Aromatics**
3	506,5	—	520,4	—	—
4	577,9	—	613,7	—	—
5	626,9	750,3	656,5	773,3	—
6	662,2	760,6	685,9	785,3	884,3
7	688,8	762,1	704,0	790,5	871,6
8	708,4	780,5	719,3	805,2	871,9
9	728,1	792,5	738,2	812,5	878,0
10	734,0	812,8	748,6	817,6	892,8
11+	759,0	—	—	—	894,4

[a] Group densities are calculated according to Reference [7]. In isomeric mixtures, the relative densities are weighted corresponding to their appearance in automotive motor gasoline.

STANDARDSISO.COM : Click to view the full PDF of ISO 22854:2008

The percent volume fraction, φ_{PG}, of the partial group PG is obtained from the mass fraction, w_{PG}, as given in Equation (3):

$$\varphi_{\mathrm{PG}} = \frac{100 \times w_{\mathrm{PG}} / \rho_{\mathrm{PG}}}{\sum_{i} \left(w_{\mathrm{PG},i} / \rho_{\mathrm{PG},i} \right)} \tag{3}$$

where

w_{PG} is the percent mass fraction of the partial group, PG;

ρ_{PG} is the density of the partial group, PG, expressed in kilograms per cubic metre.

Table 4 — Density of oxygenate compounds at 15 °C

Values in kilograms per cubic metre

Oxygenate compound	**Density** ρ_{PG}
MTBE	745,3
DIPE	729,2
ETBE	745,6
TAME	775,2
methanol	795,8
ethanol	794,8
n-propanol	813,3
iso-propanol	789,5
n-butanol	813,3
iso-butanol	810,6
sec-butanol	805,8
tert-butanol	791,0
2-methyl-2-butanol	813,5

9.3 Calculation of total oxygen content in percent mass fraction

Calculate the oxygen content, w_{O}, from all identified oxygenate compounds, i, according to Equation (4):

$$w_{\mathrm{O}} = \sum_{i} \left(\frac{n_{\mathrm{O}} \times M_{\mathrm{O}}}{M_i} \times w_i \right) \tag{4}$$

where

n_{O} is the number of oxygen atoms in the molecule, generally 1;

M_{O} is the atomic mass of oxygen;

M_i is the molecular mass of the oxygenated compound;

w_i is the per cent mass fraction of the compound in the mixture.

STANDARDSISO.COM : Click to view the full PDF of ISO 22854:2008

© ISO 2008 – All rights reserved

EXAMPLE This example calculation uses MTBE ($C_5H_{12}O$) as the only oxygenate compound and the following atomic masses:

C	12,011
H	1,008
O	16,000

$$\begin{aligned} w_{\text{O}} &= \sum_i \left(\frac{n_{\text{O}} \times M_{\text{O}}}{M_i} \times w_i \right) \\ &= \frac{1 \times 16{,}000}{5 \times 12{,}011 + 12 \times 1{,}008 + 1 \times 16{,}000} \times w_i \\ &= 0{,}181\ 5 \times w_i \end{aligned}$$

9.4 Data report according to automotive motor gasoline specification

For reporting of conformity to current automotive motor gasoline specifications, specific rounding or summation of results can be necessary. The following results are reported.

- The total content of saturates is determined by summation of volume fractions of the paraffins, naphthenes and high-boiling polynaphthenes.
- The total olefin content is determined by summation of the volume fractions of the olefins and the cyclic olefins.
- The total aromatic content is reported unchanged.
- The benzene content is reported in percent volume fraction.
- The oxygenated compound contents are reported in percent volume fraction.
- The total oxygen content is calculated according to 9.3. It is reported in percent mass fraction.

10 Expression of results

The results are reported in percent volume fraction or percent mass fraction (see 9.4) according to the following requirements:

- saturates content, to the nearest 0,1 %;
- aromatics content, to the nearest 0,1 %;
- olefins content, to the nearest 0,1 %;
- benzene content, to the nearest 0,01 %;
- oxygenate content, to the nearest 0,01 %;
- total oxygen content, to the nearest 0,01 %.

11 Precision

11.1 General

The precision is given as determined by statistical examination of interlaboratory test results in accordance with ISO 4259 [8]. Precision values calculated from the equations given in Table 5 shall be rounded to the appropriate number of decimal places as specified in Clause 10.

STANDARDSISO.COM : Click to view the full PDF of ISO 22854:2008

11.2 Repeatability

The difference between two test results, obtained by the same operator with the same apparatus under constant operating conditions on identical test material, in the long run for the normal and correct operation of the test method, is expected to exceed the values given in Table 5 in only one case in twenty.

11.3 Reproducibility

The difference between two single and independent test results, obtained by different operators working in different laboratories on identical test material, in the long run for the normal and correct operation of the test method, is expected to exceed the values given in Table 5 in only one case in twenty.

NOTE 1 The reproducibility of *iso*-propanol can be higher than for the other components, particularly when it appears as a double peak; it is then necessary to identity both peaks properly (see warning notice in 4.2). The repeatability indicates that a better precision can be obtained when comparing the ratio of the reproducibility to the repeatability, R/r, with the ratio for *iso*-butanol. Reference can also be made to prEN/TR 15745 [9], which cites the research report on work done by CEN.

NOTE 2 The derived reproducibility data for methanol is much higher than can be expected from the repeatability. Due to the fact that methanol is an active component, it is necessary to take care during sampling and to ensure the proper operation of the pre-column. Reference can also be made to prEN/TR 15745 [9], which cites the research report on work done by CEN.

Table 5 — Repeatability and reproducibility

Component or group		**Repeatability** r % (V/V) [a]	**Reproducibility** R % (V/V) [a]
Saturates		0,5	1,6
Aromatics		$0{,}009\,5\,X + 0{,}195\,2$	$0{,}045\,0\,X + 0{,}138\,4$
Olefins		$0{,}018\,5\,X + 0{,}141\,5$	$0{,}117\,6\,X + 0{,}511\,8$
Benzene:	for $w_{\text{benzene}} \geqslant 0{,}8$	$0{,}014\,7\,X + 0{,}003\,1$	$0{,}077\,7\,X - 0{,}025\,0$
	for $w_{\text{benzene}} < 0{,}8$	0,02	0,04
Oxygenated compounds		$0{,}019\,3\,X + 0{,}002\,4$	$0{,}025\,1\,X + 0{,}351\,5$

[a] X is the mean of the two results being compared.

12 Test report

The test report shall contain at least the following information:

a) reference to this document, i.e. ISO 22854:2008;

b) type and complete identification of the product tested;

c) sampling method used (see Clause 7);

d) result of the test (see Clause 10);

e) if applicable, the external quantification (see 9.1);

f) any deviation, by agreement or otherwise, from the procedure specified;

g) date of the test.

STANDARDSISO.COM : Click to view the full PDF of ISO 22854:2008

© ISO 2008 – All rights reserved

Annex A
(informative)

Instrument specifications

A specific column specification is given in Table A.1. The test equipment should be set up to work according to the information in this annex and should have all the necessary items installed according to the requirements of the supplier's specifications.

Table A.1 — Suggested column specification

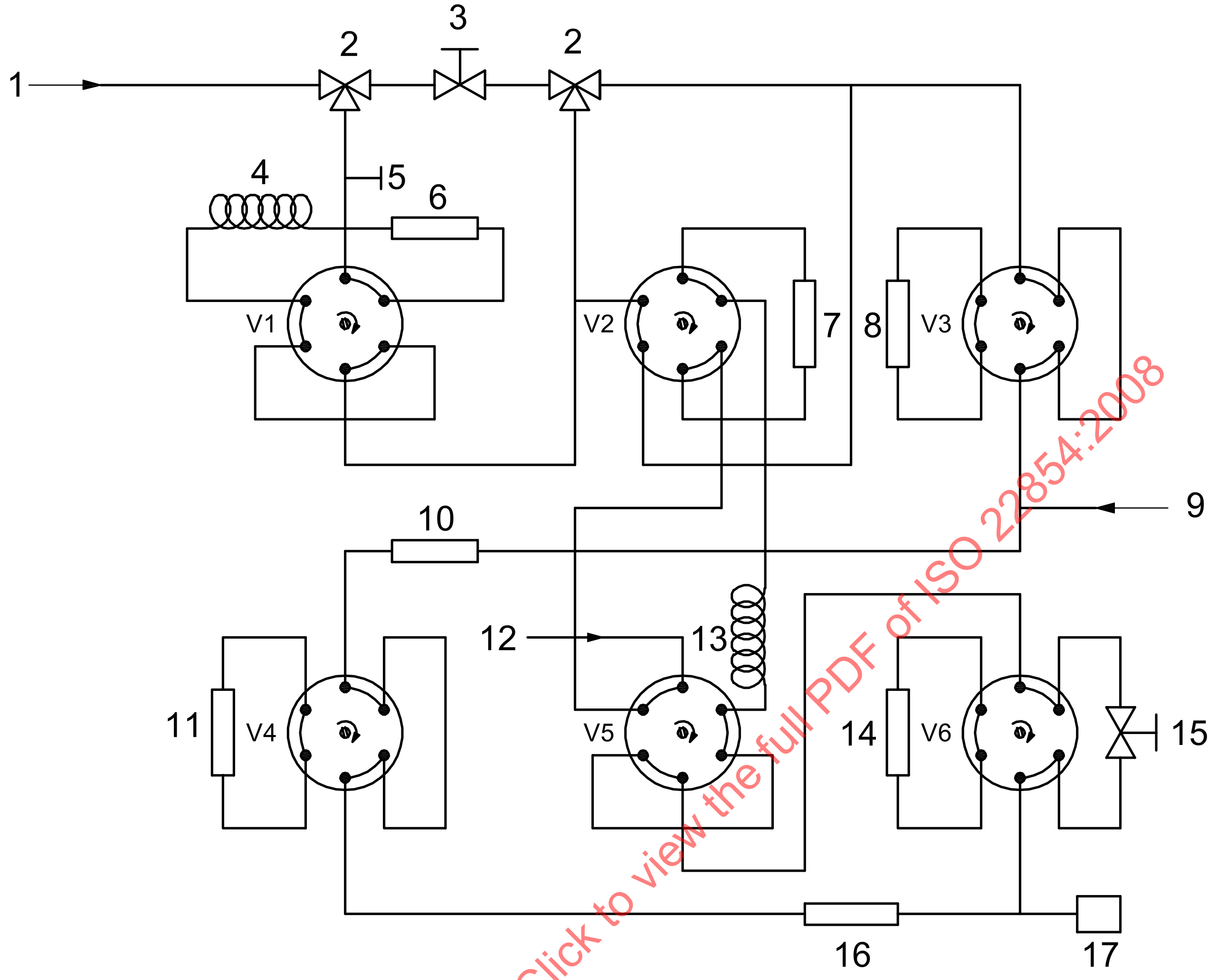
Name	**Length** cm	**I.D.** mm	**Phase**	**Description**
Sulfate column I	30	2	50 % sulfate on Chromosorb 750 [a], 80 to 100 mesh	Absorption of alcohols and higher-boiling aromatics
Polar column	270	2	30 % OV 275 on Chromosorb PAW, 60 to 80 mesh	Separation of aliphatic and aromatic compounds
Non-polar column	1 500	0,53	5 µm OV 101 methyl silicone	Elution of aromatics
Molecular sieve 13X	170	1,7	3 % molecular sieve 13X on Chromosorb 750, 80 to 100 mesh	Separation of paraffins and naphthenes
Sulfate column II	30	3	50 % sulfate on Chromosorb 750, 80 to 100 mesh	Adsorption of ethers
Olefin trap	30	3	8 % silver salt on silica gel, 80 to 120 mesh	Adsorption of olefins
Porapak [b] column	90	2	Porapak P [b], 80 to 100 mesh	Elution of aromatics, alcohols and ethers
Hydrogenation catalyst	5,5	1,7	2 % Pt on alumina	Hydrogenation of unsaturated compounds

[a] Chromosorb is the trade name of a product distributed by Johns-Manville Corp. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

[b] Porapak is the trade name of a product distributed by Waters Associates, Inc. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

A typical instrument configuration is shown in Figure A.1.

STANDARDSISO.COM : Click to view the full PDF of ISO 22854:2008



Key

V1 to V6 column switching/bypass valves

1 front inlet
2 3-way valve
3 needle valve
4 OV 275 column
5 injection port
6 pre-column
7 alc/ether trap
8 olefin trap
9 Pt hydrogen
10 Pt column
11 molecular sieve 5A
12 back inlet
13 non-polar column
14 Porapak column
15 bypass valve
16 molecular sieve 13X
17 flame ionization detector

Figure A.1 — Typical instrument configuration

STANDARDSISO.COM : Click to view the full PDF of ISO 22854:2008

© ISO 2008 – All rights reserved

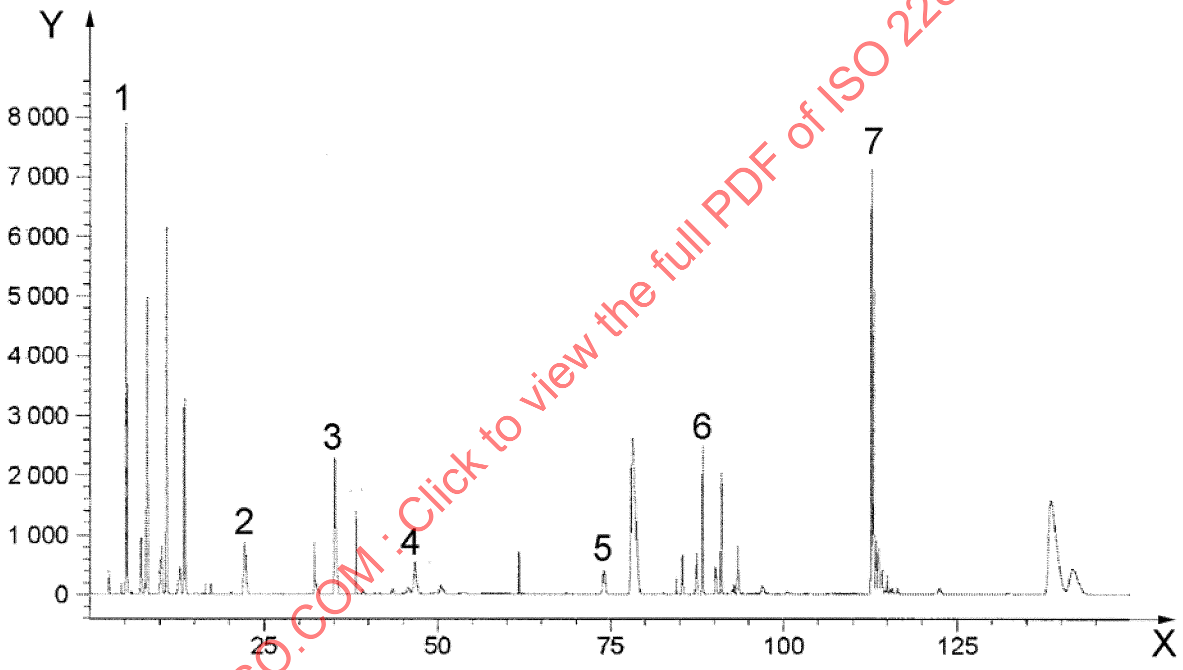
Annex B
(informative)

Examples of typical chromatograms

Figures B.1 and B.2 show example chromatograms with a typical elution order of the hydrocarbon fractions as mentioned in 4.3. Figure B.3 is a more detailed presentation of the elution of ethanol, showing that ethanol elutes just before the C9 aromatics (indicated as A9 in the chromatograms).

Reference can also be made to prEN/TR 15745 [9], which cites the research report on work done by CEN. or the manufacturer's manual for additional detailed chromatograms.

STANDARDSISO.COM : Click to view the full PDF of ISO 22854:2008



Key

X	time, expressed in minutes
Y	instrument response, expressed in picoamperes
1	light saturates: C3 to C8
2	MTBE
3	C4 to C6 olefins
4	heavy saturates: C7 to C10
5	benzene
6	olefins
7	aromatics

Figure B.1 — Typical chromatogram of an automotive motor gasoline containing MTBE