



BSI Standards Publication

Interior air of road vehicles

Part 11: Thermal desorption analysis of organic emissions for the characterization on non-metallic materials for vehicles

National foreword

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**International
Standard**

ISO 12219-11

**Interior air of road vehicles —
Part 11:
Thermal desorption analysis
of organic emissions for the
characterization on non-metallic
materials for vehicles**

Air intérieur des véhicules routiers —

*Partie 11: Analyse par désorption thermique des émissions
organiques pour la caractérisation des matériaux non
métalliques*

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Contents

Page

Foreword	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Abbreviated terms	2
5 Sampling and storage	3
6 Apparatus and performance characteristics	3
6.1 Apparatus	3
6.2 Performance characteristics	3
7 Analysis	4
7.1 General information on thermal desorption analysis	4
7.2 Cleaning of the desorption tubes	5
7.3 System checks	5
7.3.1 General	5
7.3.2 Check standard solution	6
7.4 Calibration	7
7.4.1 General	7
7.4.2 Calibration solutions	7
7.4.3 Injection of the calibration or check standard	7
7.4.4 Tenax TA® desorption tube	7
7.5 Sample analysis process	7
7.5.1 Photographic documentation of the samples	7
7.5.2 Trimming and weighing of the samples	7
7.5.3 Calibration run, determination of calibration factors (response factor)	8
7.6 Chromatographic evaluation	8
7.6.1 General	8
7.6.2 Integration limits relevant for quantification	9
7.6.3 Peak integration	9
7.6.4 Evaluation for rider peaks and “oil-hills”	9
7.6.5 Calculation of emissions	10
7.6.6 Qualitative analysis	10
7.6.7 Reporting of the analytical results	11
8 Validation parameters	12
8.1 Typical measured value variation for real samples	12
8.2 Quantification limit or linearity of toluene	13
8.3 Variation and recovery of toluene	14
9 Known problems and possible sources of errors	14
9.1 Sample preparation	14
9.2 Difficult samples with non-uniform surface	14
9.3 Samples with higher water content	14
9.4 Lower results when desorption stream is too low	15
9.4.1 General	15
9.4.2 Differences between sample tubes made of metal and glass	15
9.5 Over or under results due to deviations in the thermal desorption temperature	15
9.6 Danger of confusion during the identification of the substance	16
9.7 Exceeding the detector linearity in the case of high emission values	17
Annex A (informative) Material specific test portions	18
Annex B (informative) Production of paint films for thermal desorption	20
Annex C (informative) Examples for suitable test equipment, test parameters and possible errors	22

Annex D (informative) Preparation of standard solutions	32
Bibliography	33

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 146, *Air quality*, Subcommittee SC 6, *Indoor air*.

A list of all parts in the ISO 12219 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Interior air of road vehicles —

Part 11:

Thermal desorption analysis of organic emissions for the characterization on non-metallic materials for vehicles

1 Scope

This document describes an analytical method to determine the emissions from non-metallic materials used for moulded parts in motor vehicles, such as textiles, carpets, adhesives, sealing compounds, forms, leather, plastic parts, films and sheets, paints or material combinations.

The materials are characterized in terms of the type and quantity of organic substances that can be outgassed from them. For this purpose, two semiquantitative sum values are determined, which allow an estimation of the emissions of volatile organic compounds (VOC value) and the proportion of condensable substances [low volatile “fogging” compound (FOG) value]. Furthermore, individual substances of the emission are determined. During the analysis, the samples are thermally extracted, the emissions are separated by gas chromatography and detected by mass spectrometry. The test method presented in this document provides values that are valid only for conditions described in this document.

The results which can be achieved using this method are not appropriate for making further estimations of any kind of the health effects of emitted substances nor should they be used might that can be found in the interior of a complete vehicle in stationary condition, while driving or in conditions similar to driving.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 16000-6, *Indoor air — Part 6: Determination of organic compounds (VVOC, VOC, SVOC) in indoor and test chamber air by active sampling on sorbent tubes, thermal desorption and gas chromatography using MS or MS FID*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

volatile organic compound value

VOC value

total volatile organic compound value

total of the readily volatile to medium volatile substances

Note 1 to entry: The VOC value is calculated as a toluene equivalent. The method described in this document allows substances in the boiling/elution range from the beginning of the chromatogram up to n-Pentacosane (C₂₅) to be determined and analysed.

Note 2 to entry: It is known that the retention area between C1 and C6 cannot be completely quantified.

Note 3 to entry: It can be assumed that these substances can be detected when analysing the air of the vehicle interior. For the analysis, the *sample* (3.4) is heated at 90 °C for 30 min. The VOC value is determined by two measurements. The higher value of the measurements is indicated as the result.

3.2

low volatile “fogging” compound value

FOG value

total of substances with low volatility which elute from the retention time of n-tetradecane (inclusive)

Note 1 to entry: It is calculated as hexadecane equivalent. Substances in the boiling range of n-alkanes C14 to C32 are determined and analysed.

3.3

retention index

index calculated with a series of n-alkanes

[SOURCE: Reference [6]]

3.4

sample

part or piece of a product that is representative of the production

[SOURCE: ISO 12219-4:2013, 3.15]

3.5

specimen

article prepared from a *sample* (3.4)

[SOURCE: ISO 15906:2007, 3.2]

4 Abbreviated terms

CI	confidence interval
EI	electron impact
FID	flame ionization detector
FOG	low volatile “fogging” compounds ¹⁾
GC	gas chromatograph
MSD	mass-selective detector
PES	polyester film
TD	thermal desorption
TIC	total ion chromatogram
TPO	thermoplastic polyolefin foil
VOC	volatile organic compound

1) Semi-volatile organic compounds prone to condensation on vehicle interior surfaces causing ‘fogging’ of the windscreen and other windows.’

5 Sampling and storage

For sampling and storage of the samples, the conditions of ISO 12219-8:2018, Clauses 8 and 10 should be met.

6 Apparatus and performance characteristics

6.1 Apparatus

The following laboratory equipment is needed:

- directly coupled thermal desorption / gas chromatography system;
- GC (electronic control of pneumatics is recommended; suitable instruments are listed in [Annex C](#));
- a focusing device comprising a cryofocusing or cold-trapping mechanism, which can be heated sufficiently quickly to release compounds of interest and inject them into the capillary GC column without dispersion;
- MSD;
- empty desorption tubes with inert surface, internal diameter 4 mm to 5 mm;
- a fused silica GC capillary column of 5% phenyl-methyl-siloxane is selected; bonded columns of 30 m to 60 m, internal diameter 0,25 mm to 0,32 mm and phase thickness 0,25 µm to 0,52 µm are examples of columns proven to be suitable for VOC and FOG analyses;
- software for equipment control;
- software for analysis of chromatograms.

6.2 Performance characteristics

The following recommendations regarding the performance shall be considered:

- The recovery rates of the single substances (calculated as toluene equivalent) of the check standard solution describe in [7.3.1](#) should be between 60 % and 140 % under VOC conditions, whereby the recovery of the toluene should be at least 80 % and no more than 120 %.
- It should be possible to fall below the following detection limits (see DIN 32645, 95 % confidence interval):
 - In the VOC run toluene < 0,04 µg, and icosane (C20) < 0,06 µg.
 - In the FOG run n-alkane C32 < 0,2 µg.
 - Tenax TA®²⁾ desorption tubes:
 - With regard to the density and amount on the packing, refer to the recommendation of the equipment manufacturers. In particular, care should be taken to ensure that the Tenax TA® packing fills the tube so that it can be covered completely by the heated zone of the TD instrument's tube heater.
 - The tubes should be filled with a sufficient amount of Tenax TA® so that no substance breakthrough can occur during sample feed. Further manufacturer-specific information is described informatively in the [Clause C.3](#).
 - This document only uses sorbent tubes for introducing standards to the analytical system.
 - For the determination of the detection limits, different amounts of the test substances dissolved in methanol (for VOC run) and n-pentane (for FOG) should be injected into desorption tubes

2) Tenax TA® is the trade name of a product supplied by Buchem. 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.

filled with Tenax TA® and desorbed at 280 °C. The split characteristics and GC conditions should conform to the VOC/FOG method parameters.

- Parameters for gas chromatography for calibration and control analysis (examples are given in [Table C.1](#)):
 - For toluene calibration and the analysis of the control mix, the same parameters should be set as for the VOC sample run (for retention times of the control mix, see [Table B.1](#)). The only difference is a later start of the data logging to mask out the methanol peak.
 - Hexadecane calibration is carried out under the GC conditions of the FOG analysis. The only difference is a later start of the data logging to mask out the pentane peak.
 - Compared to the sample runs, the GC runs can be shortened by abandoning the oven temperature program after elution of the calibration substances.

7 Analysis

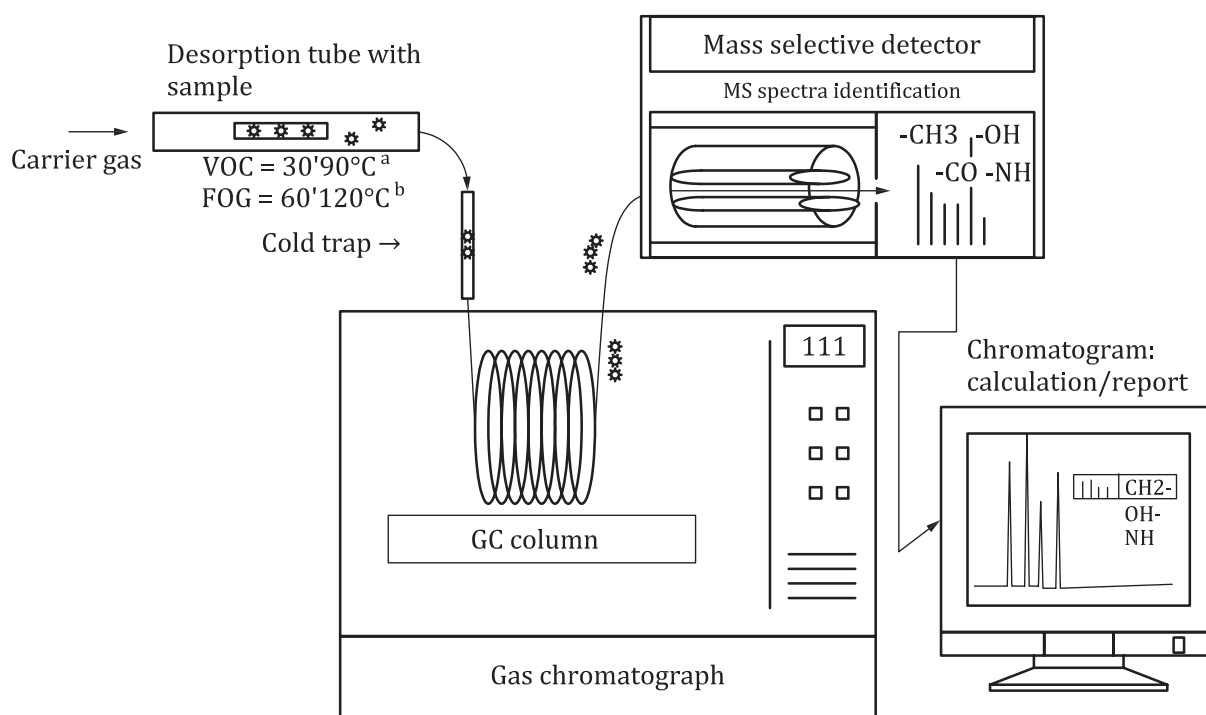
7.1 General information on thermal desorption analysis

In a TD analysis, small amounts of the material are heated in an empty thermal desorption tube in a defined process. The volatile substances emitted during this process are carried by means of a GC carrier gas to the focusing trap with programmable temperature. A scheme of the process is given in [Figure 1](#).

Following the heating phase, the focusing trap is heated up quickly to 280 °C. The focused substances are desorbed during this process. They are split during transfer to the gas-chromatographic separation column and are detected by mass spectrometry.

Calibration with reference substances allows for a semiquantitative estimation to be carried out, expressed as µg/g.

Toluene for the VOC analysis and n-hexadecane for the FOG value are used as quantitative reference substances. Using mass spectra and retention indices, the substances can be identified.



- a VOC: 30 min at 90 °C.
b FOG: 60 min at 120 °C.

Figure 1 — Principle of thermal desorption

7.2 Cleaning of the desorption tubes

All desorption tubes used should be completely free of contamination. New tubes should also be cleaned carefully before initial use by means of an appropriate method. The following procedure is recommended for glass tubes.

- Clean the glass tubes by storing them in an alkaline cleaning solution for several hours, preferably overnight. Then, rinse thoroughly, first under running hot water for at least one minute and subsequently with deionized water.
- Dry the tubes in a drying oven for approximately 45 min at 105 °C and store in a manner that is free from contamination (e.g. wrapped airtight in aluminium foil) until used.

7.3 System checks

7.3.1 General

The performance of the equipment system should be checked during the sample series by analysing a performance check standard solution (see 7.3.1).

The check standard solution should contain non-polar, polar alkaline and acidic components which would demonstrate a noticeable peak tailing in the event of undesired adsorption effects. Peaks in close succession such as o-xylene and n-nonane are used for checking the separation performance of the chromatography column. Under the chromatographic conditions chosen, these two substance peaks shall be almost baseline separated. Check standards are also useful to monitor the drift in the instrument response over time. All substances contained in this check standard should be uniquely identified during the search in the mass spectral database.