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**Interior air of road vehicles —**

Part 5:

**Screening method for the  
determination of the emissions of  
volatile organic compounds from  
vehicle interior parts and materials —  
Static chamber method**

*Air intérieure des véhicules routiers —*

*Partie 5: Méthode de criblage pour la détermination des émissions de  
composés organiques volatils des parties et matériaux intérieurs des  
véhicules — Méthode de la chambre statique*



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## 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 documents 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](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 146, *Air quality*, Subcommittee SC 6, *Indoor air*.

ISO 12219 consists of the following parts, under the general title *Interior air of road vehicles*:

- *Part 1: Whole vehicle test chamber — Specification and method for the determination of volatile organic compounds in cabin interiors*
- *Part 2: Screening method for the determination of the emissions of volatile organic compounds from vehicle interior parts and materials — Bag method*
- *Part 3: Screening method for the determination of the emissions of volatile organic compounds from vehicle interior parts and materials — Micro-scale chamber method*
- *Part 4: Method for the determination of the emissions of volatile organic compounds from vehicle interior parts and materials — Small chamber method*
- *Part 5: Screening method for the determination of the emissions of volatile organic compounds from vehicle interior parts and materials — Static chamber method*

## Introduction

Volatile organic compounds (VOCs) are widely used in industry and may be emitted by many everyday products and materials. They have attracted attention in recent years because of their impact on indoor air quality. After homes and workplaces, people spend a lot of time in their vehicles. Therefore there is a need for comprehensive and reliable information about the types of organic compounds in the interior air of vehicles and also their concentrations. As part of measures to achieve acceptable indoor air quality it is important to determine the material emissions of interior parts and to reduce them, if necessary, to an acceptable level.

Measuring VOCs from vehicle interior trim components can be performed in several ways and the approach selected depends upon the desired outcome and the material type. Complete assembly-based measurements<sup>[1,5]</sup> provide total emission results only, but cannot provide VOCs emission of each constituent component. Rapid screening methods obtain VOCs emission data for cut components.<sup>[2,3,6,7]</sup> Therefore, VOCs emission data for constituent unit component of car interior trim is required for reducing VOCs level in vehicles.

This part of ISO 12219 outlines a method of measuring the types and levels of chemicals emitted by unit component-based car interior trim using a static chamber method based on the principles of static headspace. Static chamber methods can provide diffusion data from unit components of vehicle interior trim without emission from cutting planes. It can be used to verify the correlation between a material-based method and an assembly-based method. Adjunctively, the static headspace chamber method is simply modified to the dynamic headspace mode to obtain complementary information by connecting of a supply of air for comparison.

Each measurement method such as bag<sup>[2]</sup> / micro-scale chamber<sup>[3]</sup> / small-chamber<sup>[1]</sup> sampling offers a complementary approach.

ISO 16000-3, ISO 16000-5, ISO 16000-6, ISO 16000-9, ISO 16000-10, ISO 16000-11, ISO 16000-24, and ISO 16000-25 also focus on VOC and formaldehyde measurements. ISO 16017-1 and ISO 16017-2 focus on VOC measurements.

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# Interior air of road vehicles —

## Part 5:

# Screening method for the determination of the emissions of volatile organic compounds from vehicle interior parts and materials — Static chamber method

## 1 Scope

This part of ISO 12219 specifies a chamber based, static headspace type method for measuring volatile organic compounds (VOCs), formaldehyde and other carbonyl compounds which may diffuse from vehicle interior unit components into the cabin air. The chamber emission test is intended to provide characteristic emission of unit component to car interior of assembly level emission. It also specifies the emission test chamber, preparation of the test specimen, connection of the vapour sampling devices and test conditions. This method is valid for new car interior unit components intended for vehicles, and can also be used for car interior unit components disassembled from assembly of car interior trim or used cars. A set of multi-unit components could be applicable according to the test purpose.

A dynamic mode operation of emission chamber could be applied if corroborative information of the unit component emission between this method and small chamber method (ISO 12219-4:2013) is desired.

The specified analytical procedure for VOCs (ISO 16000-6) is valid for the determination of VOCs ranging in concentration from sub- $\mu\text{g}/\text{m}^3$  to several  $\text{mg}/\text{m}^3$ . The method is applicable to the measurement of non-polar and slightly polar VOCs ranging in volatility from n-C<sub>6</sub> to n-C<sub>16</sub>. Some very volatile compounds (VVOC) and semi-volatile organic compounds (SVOC) can also be analysed (see informative Annex D of ISO 16000-6:2011).

This part of ISO 12219 is complementary to existing standards and provides third party test laboratories and manufacturing industry with an approach for:

- comparing emissions from various unit components (sub-assemblies) with VOC emissions from related complete assemblies measured in other tests,
- evaluating and categorising specific unit components by their VOC emission data,
- comparing and correlating emission from unit components with VOC emission data obtained in other tests for the various materials used to make the unit component,
- evaluating prototype, “low-emission” unit components during development.

NOTE 1 All volatile carbonyls except formaldehyde can be analysed by ISO 16000-6:2011 incorporating informative [Annex D](#).

NOTE 2 The dynamic mode operation is described in the informative [Annex D](#) of this part of ISO 12219.

## 2 Normative references

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

ISO 12219-4:2013, *Interior air of road vehicles — Part 4: Method for the determination of the emissions of volatile organic compounds from vehicle interior parts and materials — Small chamber method*

ISO 16000-3:2011, *Indoor air — Part 3: Determination of formaldehyde and other carbonyl compounds in indoor air and test chamber air — Active sampling method*

ISO 16000-6:2011, *Indoor air — Part 6: Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA sorbent, 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.

**3.1 emission test chamber**  
enclosure ranging in size from 10 l to 500 l excluding buffer bag volume that permits the testing of vapour-phase organic emissions from various types of vehicle interior trim unit components under atmospheric pressure, and which is equipped with mixing fan for homogeneous mixing in the entire chamber and buffer bag

Note 1 to entry: Adapted from ISO 16000-9:2006, definition 3.6.

Note 2 to entry: See [Annex A](#) for a description of the test chamber.

Note 3 to entry: The size of the buffer bag connection port shall be large enough for homogeneous mixing between the bag and test chamber.

**3.2 buffer bag**  
low-emitting, impermeable and low-sorption plastic bag having a large enough mouth for proper connection to the test chamber and a capacity higher than the expansion volume that is due to heating of the emission test chamber

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**3.3 test concentration**  
concentration of a specific volatile organic compounds, VOC<sub>x</sub>, (or group of volatile organic compounds), formaldehyde and other carbonyl compounds collected from an emission test chamber outlet which has been heated for a specified period of time with unit component test sample in it

Note 1 to entry: Adapted from ISO 16000-9:2006, definition 3.7 emission test chamber concentration.

**3.4 background concentration**  
concentration of a specific volatile organic compounds, VOC<sub>x</sub>, (or group of volatile organic compounds), formaldehyde and other carbonyl compounds collected from an emission test chamber outlet which has been heated for a specified period of time without any test sample

Note 1 to entry: Adapted from ISO 12219-4:2013, definition 3.6.

**3.5 unit component value**  
total mass of each target compound, (VOC or carbonyl) or TVOC emitted from unit component under the prescribed test conditions

**3.6 recovery rate**  
ratio of the total amount of VOC, formaldehyde and other carbonyl compounds collected from an emission test chamber to the known total amount of VOC, formaldehyde and other carbonyl compounds supplied to the emission test chamber in the same time period<sup>[4]</sup>

Note 1 to entry: Adapted from ISO 16000-9:2006, definition 3.9, recovery.

Note 2 to entry: The recovery provides information about the performance of the entire method.



**3.7****unit component**

basic manufacturing unit of car trim interior part at the part manufacturing factory, and components before assembling the assembly of car interior trim or disassembled components in the assembly of car interior trim

**3.8****volatile organic compound****VOC**

organic compounds that are emitted from the unit components and all those detected in the chamber air

Note 1 to entry: For a detailed definition see ISO 16000-6.

**3.9****total volatile organic compound****TVOC**

sum of organic compounds eluting between and including *n*-hexane and *n*-hexadecane

Note 1 to entry: For a detailed definition see ISO 16000-6.

**4 Principle**

The principle of the test is to assess the emission rate of VOCs and carbonyls from unit components under conditions of fixed temperature and no external air flow. It is a static headspace type method. The sample is incubated in an emission test chamber containing clean air for a selected period at fixed temperature. During the incubation, the air between the chamber inside and buffer bag is mixed thoroughly with a mixing fan. The gas inside the test chamber is then sampled and analysed, after equilibrium has been reached or at time, *t*, to determine the vapour-phase masses/concentrations of VOCs and carbonyls. These data are used to characterize the car trim unit component in terms of their relative emission rates.

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**5 Instrument and reagent****5.1 General**

A test bed to determine VOCs and carbonyls emissions consists of the following required elements:

- a suitable emission test chamber to contain the test specimen of unit component;
- a regulated, pressurized supply of clean air for cleaning and checking airtightness;
- a non-emitting, temperature-controlled incubation chamber;
- low-emitting, low-sorptive plastic buffer bag with large diameter connection port;
- a non-emitting cover of buffer bag connection port;
- flow controlled pumps, to draw the air from the test chamber through the sampling devices;
- an inert, non-emitting flow meter to control the flow of air supplied to the test chamber;
- vapour sampling trains incorporating the sampling devices specified in ISO 16000-6 and ISO 16000-3 and associated analytical apparatus;
- pressure and humidity control and regulation apparatus.

An example of a static test chamber is shown schematically in [Annex A](#).

## 5.2 Test chamber

The test chamber is an airtight container with the volume of 10 l to 500 l, excluding the volume of the buffer bag. A typical standard test chamber size has a volume of  $125 \text{ l} \pm 5 \text{ l}$ . It shall be equipped with a connection port for air supply for cleaning and airtightness checking, connection port for sampling and large diameter port for buffer bag, and stir fan for mixing inside chamber and buffer bag. A stand is installed inside to set off the unit component without touching the test chamber walls. The buffer bag port should be blocked by non-emitting cover when the incubation chamber is cleaned at a high temperature.

### 5.2.1 Materials

The chamber material shall be an inert, non-emitting and non-adsorbing material, such as surface treated (polished) or inert coated stainless steel or deactivated glass. The sealing materials used for sealing the lid of test chamber, shall be low emitting and low sorption and shall not contribute significantly to the background concentration.

### 5.2.2 Airtightness

The test chamber, equipped with the buffer bag, shall be sealed securely so that the air leakage is less than 0,5 % of the test chamber volume per minute during a period of 30 min or less than 5 % of air supply flow rate at 1 000 Pa of excess pressure.

### 5.2.3 Cleaning

The test chamber should be freed of all particles or similar remains of the components with mechanical purification methods. Remove any o-rings or gaskets and clean the test chamber components using an alkaline detergent, followed by two separate rinses with distilled water or by using an appropriate solvent and thoroughly dried.

Alternatively, the emission test chamber can be heated for cleaning. At this moment, the buffer bag is removed and the buffer connection port should be blocked by a non-emitting cover. The empty emission test chamber should be baked at a temperature of 180 °C up to 230 °C in an incubation chamber or appropriate heating oven.

If the test chamber has an inert coating, care shall be taken not to damage the coating during cleaning (e.g. by using abrasive cleaners and/or high pH).

## 5.3 Clean air

Clean air is used for maintaining excess pressure when checking airtightness of the test chamber, and exchanging the test chamber air during cleaning. VOC, formaldehyde and other carbonyl compound concentrations in the clean air shall be as low as possible so that they do not adversely affect the test results.

## 5.4 Buffer bag

The bag has a large mouth for connection with the chamber. The capacity is large enough to contain the desired sampling volume and expansion volume of the emission test chamber when it is heated in the test procedure. The buffer bag is low emitting, impermeable, flexible and low-sorptive plastic. It shall not contribute significantly to background VOC concentration. A new plastic bag should be used in each emission test.

## 5.5 Non-emitting cover

A buffer connection port shall be covered with a non-emitting cover when the test chamber is cleaned by heat and is operated by a dynamic mode described in [Annex D](#). The material of the cover is generally identical to that of the buffer bag connection port.

## 5.6 Vapour sampling devices

Tubes packed with sorbents (such as Tenax<sup>1)</sup> TA®) are used for sampling vapour-phase organics ranging in volatility from *n*-hexane to *n*-hexadecane in ISO 16000-6:2011. Note that alternative sorbents or sorbent combinations may be required for monitoring compounds over a wider volatility range. See ISO 16017-1 or informative Annex D of ISO 16000-6:2011 for more details.

DNPH cartridges as described in ISO 16000-3 are used for the collecting and analysis of formaldehyde and other carbonyl compounds.

## 6 Unit component sample preparation

### 6.1 General

When determining volatile organic emissions, the conditions the unit component was exposed to before the test can have a considerable effect on the results, especially in quantitative tests. Therefore, it is necessary to standardize the history and preparation procedure for the unit component.

NOTE If the emission results of the unit component attempt to be harmonized with the small chamber method (ISO 12219-4:2013), the sample preparation for the unit component could follow the sample preparation procedure (ISO 12219-4:2013, Clause 8 and 9.3.1).

### 6.2 History of the unit component

The components need to be checked at their delivery condition when used for tests in which the emissions from a new part are to be measured.

Possibly, the adsorption of substances from the environment not in the original component also should be expected. Therefore, the history of the component before conducting the test should be documented as completely as possible.

If it is prepared by dismantling the assembly to a unit component, then the original assembly and this procedure should be documented.

### 6.3 Packaging, transport and storage of the unit component

The unit component shall be thoroughly protected from chemical contamination or any physical exposure, e.g. heat, light and humidity, until the start of the test.

During temporary storage and transport the component shall be kept in its packaging and a temperature of 23 °C should not be exceeded during any period.

For a unit component of car interior trim, this can usually be achieved by wrapping each unit component separately in aluminium foil and in a polyethylene bag or alternatively, in aluminised packaging lined with polyethylene or clear polyvinyl fluoride film.

The component shall be labelled with the details of the type of product, date of manufacture (if known) and/or any identification numbers or batch numbers.

Storage may affect the emission properties due to aging of the component. It is recommended to minimize the storage time of the sample prior to testing.

1) Tenax TA® is the trade name of a product manufactured by Supelco, Inc. This information is given for the convenience of users of this International Standard 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

## 6.4 Preparation of unit component specimens

Car interior components selected for emissions testing shall be manufactured, packaged and handled in the usual way for component used in manufacture. They shall not be stored for more than two weeks before the start of emissions testing, and shall be tested within three months after manufacture. The test specimen of unit components shall not be modified by extra treatment such as cutting. The test specimen is prepared using the unit component before assembling but can, in principle, be prepared as a unit component by dismantling the assembled car interior trim.

## 7 Verification of test conditions

### 7.1 Test temperature

Heating temperatures shall be monitored and recorded. The emission test chamber shall be uniformly heated in the incubation chamber at  $65\text{ °C} \pm 2\text{ °C}$ .

The accuracy of the instrument used to measure the temperature throughout the test period shall be  $\pm 0,5\text{ °C}$ .

### 7.2 Recovery

The recovery of organic vapours can be determined by introducing a known mass of one or more specific target volatile organic compounds into the chamber on a suitable substrate and by sampling the total mass of vapour recovered from the small chamber exhaust. Examples of compounds commonly used for recovery tests include: toluene, *n*-dodecane and surrogate polar compounds such as ethyl hexanol. The addition of a known mass of a compound into the small chamber can be performed via a syringe injected on a substrate or with a known mass of the compound in the supply air. The substrate has to be put in the middle of the small chamber. Contact with the walls of the chamber should be avoided. A set of several substrates shall be arranged in such a way that an air flow through the circulation is achieved from all sides in the best way possible. Attention should be paid to a reasonable product loading factor. The small chamber has to be closed/locked immediately after inserting the compound on the substrate.

The tests of analytic recovery with dynamic mode shall be carried out under normal test conditions, e.g. normal time,  $65\text{ °C}$ , and an exchange rate of 0,4 times per hour.

If a standard solution is used to check recovery, it is recommended, where practicable, to use a very volatile solvent that will not be retained by the sorbent sampling device. Methanol is a good example of a solvent that is not quantitatively retained by many common sorbents including Tenax TA®. This will minimize subsequent analytical interference.

NOTE 1 Low recovery of hygroscopic VOCs may occur in humidified air.

NOTE 2 Sink effects, leaks or poor calibration can cause difficulties with achieving the desired recovery. Sink and adsorption characteristics are very much dependent on the type of compound emitted. Additional recovery tests using target VOCs with different molecular weight and polarity can be used to increase understanding of these effects.

### 7.3 Clean air

Clean air supplied to the test chamber for excess pressure and for cleaning shall be pure and dry, and at satisfactory background levels (see 7.4).

### 7.4 Background concentration levels

Clean air shall not contain VOCs and carbonyls at levels greater than  $50\text{ }\mu\text{g}/\text{m}^3$  as TVOC, and  $5\text{ }\mu\text{g}/\text{m}^3$  as any single target VOC and target carbonyl.