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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

Air intérieur des véhicules routiers —

Partie 4: Méthode pour la détermination des émissions de composés organiques volatils des parties et des matériaux intérieurs des véhicules — Méthode de la petite chambre

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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.

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 12219-4 was prepared by Technical Committee ISO/TC 146, *Air quality*, Subcommittee SC 6, *Indoor air*, in collaboration with Technical Committee ISO/TC 22, *Road vehicles*.

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*

The following parts are under preparation:

— *Part 6: Method for the determination of the emissions of semi-volatile organic compounds from vehicle interior parts and materials — Small chamber method*

— *Part 7: Odour determination in interior air of road vehicles and test chamber air of trim components by olfactory measurements*

Introduction

Volatile organic compounds (VOCs) are widely used in industry and can 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. It is important to determine the material emissions of interior parts and to reduce them to an acceptable level, if required. Therefore, it is necessary to obtain comprehensive and reliable information about the types of organic compounds in the interior air of vehicles and also their concentrations.

Monitoring emissions from vehicle trim components can be performed in several ways and the approach selected depends upon the desired outcome and the material type. For example, to obtain emissions data from complete assemblies (e.g. a dashboard or seat) it is necessary to employ emissions chambers or bags that have sufficient volume to house the complete assembly (typically ≥4 m^3). Such tests may take several hours or even days to perform, depending on specified equilibration times and the requirements of the relevant test protocol.

This part of ISO 12219 outlines a method of measuring the types and levels of VOCs in vehicle trim components under controlled conditions using a small emission test chamber (small chamber). It describes requirements for a small chamber and a test protocol. Measurements are carried out according to ISO 16000-6 (VOCs) and ISO 16000-3 (carbonyl compounds).

The capacity of a small chamber is not limited to small assemblies or representative samples of homogeneous car trim materials. Small chambers allow qualitative and quantitative VOC emission data to be measured and recorded. The subsequent VOC emission data can be used to develop a correlation between material level methods and the vehicle level method.

This part of ISO 12219 is based on VDA 276[2] and ASTM D5116,[1] and correlates to ISO 16000-9.[4]

ISO 16000-3, ISO 16000-5,[3] ISO 16000-6, ISO 16000-9,[4] ISO 16000-10,[5] ISO 16000-11,[6] ISO 16000-24,[7] ISO 16000-25,[8] as well as ISO 16017-1[9] and ISO 16017-2[10] also focus on VOC measurements.

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

WARNING — It is the responsibility of the user of this part of ISO 12219 to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use. National regulations for precautions shall be followed.

1 Scope

This part of ISO 12219 specifies a qualitative and quantitative analytical method for vapour-phase organic compounds (volatile and some semi-volatile) released from car trim materials under simulated real use conditions using small emission test chambers (small chamber). Small chambers are intended to provide a transfer function to vehicle level emissions. This method is intended for evaluating new car interior trim components but can, in principle, be applied to used car components.

Target compounds include VOCs (conventionally defined as organic compounds in the volatility range *n*-hexane to *n*-hexadecane) and volatile carbonyl compounds such as formaldehyde. The specified analytical procedure for VOCs is ISO 16000-6 and for formaldehyde and some other light carbonyl compounds is ISO 16000-3.

NOTE Compounds more volatile than *n*-hexane and less volatile than *n*-hexadecane can also be analysed (see ISO 16000-6:2011, Annex D, and ISO 16017-1[8] for more information).

This part of ISO 12219 is complementary to ASTM D5116[1] and VDA 276,[2] and provides third party test laboratories and manufacturing industry with an approach for:

a) identifying the effect of real use conditions on specific VOC emissions data;

b) comparing emissions from various assemblies with regards to specific VOC emissions;

c) evaluating and sorting specific assemblies regarding specific VOC emissions data;

d) providing specific VOC emissions data to develop and verify a correlation between material level methods and the vehicle level method;

e) evaluating prototype, “low-emission” assemblies during development.

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 3833, *Road vehicles — Types — Terms and definitions*

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 terms and definitions given in ISO 3833 and the following apply.

3.1
air change rate
volume ratio of clean air brought into the small chamber per hour and the free small chamber volume measured in identical units

[SOURCE: ISO 16000-9:2006,[4] definition 3.1, modified]

3.2
air circulation
ideal mixing of the small chamber

3.3
air flow rate
air volume entering into the small chamber per time

[SOURCE: ISO 16000-9:2006,[4] definition 3.2, modified]

3.4
air sample
representative quantitatively preset volume of the atmosphere in the small chamber

3.5
air speed
medium air speed over the surface of the test specimen

3.6
background concentration
concentration of a specific volatile organic compound, VOC_X, (or group of volatile organic compounds) measured in the small chamber outlet

3.7
clean air supply
pressurized purified air or synthetic air in gas cylinders

3.8
small chamber
enclosure with controlled operational parameters for the destination of volatile organic compounds emitted from products

3.9
small chamber concentration
concentration of a specific volatile organic compound, VOC_X, (or group of volatile organic compounds) measured in the small chamber outlet

3.10
emission
organic substances that escape from the component under the existing test conditions

3.11
ideal air mixing
substance diffusing in an ideally mixed chamber, without time delay, completely and homogeneously throughout the whole chamber

3.12
supply air
sum of all gaseous volume flows conducted into the small chamber

Note 1 to entry: The supply air is expressed as a volume flow per time.

3.13
product loading factor
ratio of exposed surface area (or mass or volume) of the test specimen and the free small chamber volume

3.14
recovery rate
measured mass of a target volatile organic compound in the air leaving the small chamber during a given time period divided by the mass of target volatile organic compound added to the small chamber in the same time period

Note 1 to entry: The recovery provides information about the performance of the entire method.

Note 2 to entry: The recovery rate is expressed in per cent.

3.15
sample
part of piece of a product that is representative of the production

[SOURCE: ISO 16000-9:2006,[4] definition 3.10]

3.16
specific emission rate
q_X
product-specific rate describing the mass of a volatile organic compound emitted from a product per time at a given time from the start of the test

Note 1 to entry: Area-specific emission rate, q_A, is used in this part of ISO 12219. Several other specific emission rates can be defined according to different requirements, e.g. length-specific emission rate, q_l, volume-specific emission rate, q_V, and unit-specific emission rate, q_u.

Note 2 to entry: The term "area-specific emission rate" is sometimes used in parallel with the term "emission factor".

[SOURCE: ISO 16000-9:2006,[4] definition 3.11, modified]

Note 3 to entry: The specific emission rate is expressed in units of mass per time.

3.17
surface of the component
surface of the automotive interior product
surface that is formed by the outline of the component or automotive interior product and penetrable by organic substances

3.18
target volatile organic compound
product-specific volatile organic compound

3.19
test specimen
part of the sample specifically prepared for emission testing in the small chamber in order to simulate the emission behaviour of the material or product that is tested

[SOURCE: ISO 16000-9:2006,[4] definition 3.13, modified]

3.20
total volatile organic compounds
TVOCs
sum of volatile organic compounds, sampled on Tenax TA®,[1)] which elute between and including *n*-hexane and *n*-hexadecane on a non-polar capillary column, detected with a flame ionization detector (TVOC-FID) or mass spectrometric detector (TVOC-MS), and quantified by converting the total area of the chromatogram in that analytical window to a nominal mass using the chromatographic response factor for toluene (toluene equivalents)

[SOURCE: ISO 16000-6:2011, definition 3.4, modified]

Note 1 to entry: While this part of ISO 12219 specifies the determination of individual VOCs, it is common in practice to generate a single concentration value to characterize the total amount of VOCs present in the air. This value is called the TVOC value. It should be emphasized that the TVOC value so obtained depends on the sampling and analytical methods used, and therefore should be interpreted taking into account the full description of these methods.

3.21
outlet air
air leaving the small chamber through a fixed opening

3.22
volatile organic compound
VOC
organic compound that is emitted from the test specimen and all those detected in the small chamber outlet air

[SOURCE: ISO 16000-9:2006,[4] definition 3.15, modified]

Note 1 to entry: Due to practical reasons to be taken into account for test chambers, this definition differs slightly from that defined in ISO 16000-6:2011. In ISO 16000-6, the definition is based on the boiling point range (50 °C to 100 °C) to (240 °C to 260 °C).

Note 2 to entry: The emission test method described in this part of ISO 12219 is optimum for the range of compounds specified by the definition of total volatile organic compounds (TVOCs).

3.23
volume of the small chamber
chamber volume minus the technical fittings and devices in the small chamber that take up volume

4 Symbols

Symbol	Meaning	Unit
t	time	hours or days
γ_X	mass concentration of substance X	micrograms per cubic metre
q	area specific air flow rate (= n/L_A)	cubic metres per square metre hour
q_u	unit specific emission rate	micrograms per hour
q_l	emission rate per length	micrograms per metre hour
q_A	emission rate per area	micrograms per square metre hour
q_V	emission rate per volume	micrograms per cubic metre hour

1) Tenax is the trademark 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.

q_m	emission rate per mass	micrograms per kilogram hour
n	air change rate	per hour
L_A	surface loading of chamber	square metres per cubic metre

5 Principle

A component or automotive interior product is inserted into an almost ideally mixed small chamber (0,5 m^3 to 4,0 m^3) and stored under conditions of preset temperature, humidity and air change or air renewal. Organic substances that escape the component accumulate in the small chamber and are conveyed through an airstream.

Air samples are taken at selected times. The concentration of gaseous air substances in the small chamber can be determined qualitatively and quantitatively using chemical analysis procedures and from that the rate of emission of target compounds from the test material can be determined.

6 Emission test bed preparation

6.1 Components

A test bed to determine gaseous emissions consists of the following functional components or operational elements:

— small chamber;

— air circulation;

— clean air supply;

— temperature, humidity, and flow control and regulation;

— sample line.

There are no mandatory guidelines for construction, arrangement, combination, and technical finish of these individual functional components. Hints for continual measurers for quality assurance are given in Clause 7.

6.2 Small chamber

6.2.1 General

The small chamber is an airtight container with the volume of 0,5 m^3 to 4,0 m^3. A typical standard small chamber size has a volume of 1 m^3 ± 0,05 m^3. The chamber volume shall be specified in the test report. Inside there is a device for mixing the air and a stand to guarantee the storage of the component without touching the walls. An inflow pipe and an outlet air pipe shall be provided to adjust the air change (air renewal) or to test the air. An example of a small chamber is shown diagramatically in Figure 1.

6.2.2 Materials

General specifications and requirements, which apply to all types of small chambers, are provided in the following.

The small chamber method requires the following key components.

— Airtight small chamber apparatus.