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Interior air of road vehicles —

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

Air intérieur des véhicules routiers —

Partie 6: Méthode pour la détermination des émissions de composés organiques semi-volatils des parties et matériaux intérieurs des véhicules à des températures élevées — Méthode de la petit 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.

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).

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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 World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html .

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

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

Introduction

Volatile and semi-volatile organic compounds (VOCs and SVOCs) 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 emission chambers or bags that have sufficient volume to house the complete assembly (typically ≥ 1 m^3). The performance of such tests may take several hours or even days, depending on specified equilibration times and the requirements of the relevant test protocol.

This document outlines a screening method for measuring the types and levels of VOCs and SVOCs in vehicle trim components under controlled conditions using a small emission test chamber (small chamber). The described screening method can be used to investigate the emissions of car interior trim under conditions of real use where elevated temperatures are prevailing in the cabin of road vehicles. For this purpose, tests are performed at 65 °C and 100 °C. ISO 12219-6 describes requirements for a small chamber and a test protocol. Measurements are carried out according to ISO 16000-6 (VOCs).

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

This document is based on VDA 276[2] and correlates to ISO 16000-9.

Besides the ISO 12219-series, there are parts of ISO 16000 which deal with the measurements of vapour-phase organic chemicals and vapour-phase chemical emissions:

— *Part 3: Determination of formaldehyde and other carbonyl compounds in indoor air and test chamber air — Active sampling method*

— *Part 5: Sampling strategy for volatile organic compounds (VOCs)*

— *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*

— *Part 9: Determination of the emission of volatile organic compounds from building products and furnishing — Emission test chamber method*

— *Part 10: Determination of the emission of volatile organic compounds from building products and furnishing — Emission test cell metho*d

— *Part 11: Determination of the emission of volatile organic compounds from building products and furnishing — Sampling, storage of samples and preparation of test specimens*

— *Part 24: Performance test for evaluating the reduction of volatile organic compound (except formaldehyde) concentrations by sorptive building materials*

— *Part 25: Determination of the emission of semi-volatile organic compounds for building products — Micro chamber method*

Interior air of road vehicles —

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

WARNING — This method is unsuitable for materials that are not stable at 100 °C in air. Application of this document for thermally unstable materials could lead to irreversible contamination of the test equipment.

1 Scope

This document describes a qualitative and quantitative analytical method for vapour-phase organic compounds released from car trim materials under simulated real use conditions, i.e. a vehicle is parked for several hours in direct sunlight. Under these conditions, some interior parts and materials reach higher temperatures than 65 °C (ISO 12219-4), e.g. a dashboard can reach temperatures up to 120 °C. This document can be implemented as an optional addition to ISO 12219-4 so that VOC, volatile carbonyl and SVOC testing can all be completed within one day. This part has been added to gain insight into the emission behaviour and emission potential of selected vehicle interior parts and materials exposed to higher temperatures. (By convention, 100 °C is set as the higher temperature.)

The test is performed in small emission test chambers (small chambers). These small chambers are intended to provide a transfer function for vehicle level emissions. This method is intended for evaluating new car interior trim components but can, in principle, be applied to used car components.

The specified analytical procedure for SVOCs and semi-volatile carbonyls is ISO 16000-6.

This document is complementary to existing standards[1],[2] and provides third party test laboratories and manufacturing industry with an approach for

— identifying the effect of real use conditions on specific VOC and SVOC emissions data,

— comparing emissions from various assemblies with regards to specific VOC and SVOC emissions,

— evaluating and sorting specific assemblies regarding specific VOC and SVOC emissions data,

— providing specific VOC and SVOC emissions data to develop and verify a correlation between component level methods and in vehicle air quality and

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

The method described can be exclusively performed as a high temperature test or it can be performed in combination with the determination of VOCs at 65 °C in one run, which is described in ISO 12219-4.

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 12219-4, *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 16000-6:2011, *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 12219-4 and the following apply.

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

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
semi-volatile organic compound
SVOC
organic compound whose boiling point is in the range from (240 °C to 260 °C) to (380 °C to 400 °C)

Note 1 to entry: This classification has been defined by the World Health Organization[3].

Note 2 to entry: Boiling points of some compounds are difficult or impossible to determine because they decompose before they boil at atmospheric pressure. Vapour pressure is another criterion for classification of compound volatility that can be used for classification of organic chemicals. SVOCs have vapour pressures between 10^{-2} mPa and 10 Pa.

[SOURCE: ISO 16000-25:2011, 3.16]

3.2
target semi-volatile organic compound
product-specific semi-volatile organic compound

4 Symbols

Symbol	Meaning	Unit
t	time	[h]
q	area specific air flow rate $q = n/L_A$	[$m^3 \cdot m^{-2} \cdot h^{-1}$]
q_A	emission rate per unit area	[$\mu g \cdot m^{-2} \cdot h^{-1}$]
q_m	emission rate per unit mass	[$\mu g \cdot kg^{-1} \cdot h^{-1}$]
n	air change rate	[h^{-1}]
n_L	specific leak rate	[h^{-1}]
L_A	surface loading of chamber	[$m^2 \cdot m^{-3}$]
V	air flow rate entering the small chamber	[$m^3 \cdot h^{-1}$]

5 Principle

A vehicle interior trim component or material sample, referred to as a test specimen, is inserted into a small chamber (0,5 m^3 to 4,0 m^3) and kept under controlled conditions of temperature, humidity and air change rate (air flow rate). The air inside the chamber is thoroughly mixed at all times so that the concentration of any organic substances emitted by the test specimen is uniform – both within the chamber and in the flow of air exhausting from the chamber.

The air exhausting from the chamber is sampled for semi-volatile organic compounds at selected times. Chemical analysis of these samples allows the chamber air concentration and specific emission rates from the test specimen to be determined.

6 Emission test bed preparation

6.1 General

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

— small chamber;

— air circulation;

— clean air supply;

— temperature, humidity, and flow control and regulation;

— sample line.

General guidelines regarding suitable construction materials and configurations of test apparatus are given below. Recommendations for continuous monitoring of the chamber air for quality assurance purposes are also 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 has a volume of 1 m^3 ± 0,05 m^3. The chamber volume shall be specified in the test report. Inside the chamber, there is a device for mixing the air and a stand to guarantee positioning of the component (see 6.2.2) 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 in the form of a flow chart is shown in Figure 1.

6.2.2 Materials

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

The small chamber method requires the following key components.

6.2.2.1 Airtight small chamber apparatus.

6.2.2.2 Appropriate wall surfaces and rack. The wall surfaces of the small chamber and the rack for supporting the test specimen should be made of electropolished high-quality steel. When testing materials or components that are not compatible with hot stainless steel (e.g. test specimens which emit odorous reactive substances such as some sulfur-containing compounds), the chamber shall be constructed of inert materials that don't emit or absorb organic vapours.

6.2.2.3 Heating mechanism and temperature control system.

6.2.2.4 Sampling line, constructed of an inert, non-emitting and non-adsorbing material which is heated, if necessary, to prevent condensation/deposition on the inner walls. The length of the sampling line shall be as short as possible and is restricted to about 3 m. It is strongly recommended to heat up the sampling line to 120 °C to prevent condensation.

6.2.2.5 Clean air supply and humidification system.

6.2.2.6 Appropriate monitoring and control systems (to ensure that the test is carried out according to specified conditions).

6.2.2.7 Appropriate vapour sampling tubes are also required.

6.2.2.8 Appropriate sealing materials (e.g. gaskets or O-rings). Any sealing materials used for sealing the doors or lids of the small chambers, shall be compatible with high temperatures and exhibit low emission and low absorption properties even at elevated temperatures. They shall not contribute significantly to the background vapour concentration. The O-rings or gaskets should be easily removed to facilitate cleaning or replacement (see 6.2.5). Surfaces of these parts that are in contact with the small chamber atmosphere shall not exceed in their sum 5 % of the small chamber walls.

6.2.3 Tightness

In order to avoid uncontrolled sample loss, any leakage shall be either

— less than 0,1 % of the volume of the small chamber per minute or

— less than 5 % of the incoming air (delivery air/supply air) in tests with air change (air renewal) at 1 000 Pa excess pressure.

In order to avoid air inflow from outside, a small excess pressure with regard to the atmospheric pressure in the laboratory or a volume over-current shall be used.

6.2.4 Air mixing

This method relies on the air inside the chamber being thoroughly mixed. A suitable device for mixing the air is required, that can also fulfil this prerequisite when testing large-volume, bulky material.

The flow rate (flow velocity) in the middle of the empty small chamber shall exceed 0,1 m/s.

NOTE Suitable equipment for measuring air velocity includes hot wire or film anemometers calibrated in the range 0,1 m/s to 0,5 m/s.

6.2.5 Cleaning

The chamber shall be easy to clean – mechanically and thermally, including ready access to seals and gaskets. See 7.3 for performance criteria relating to background levels and see 9.2 and 9.3.4 for information on cleaning procedures.

6.3 Small chamber temperature control

The chamber temperature shall be precisely controlled because there is a strong link between temperature and the chemical emission rate. The chamber shall be able to maintain a given temperature within ± 1 °C. Emission rates are specific to a particular temperature; therefore, it is essential to maintain a constant temperature within the small chamber throughout the emission test/ comparative analyses.

6.4 Air humidification

The humidification of the supply air in the small chamber shall be carried out in such a way that the formation of steam, vapour, and aerosols is ruled out. Maintain a relative humidity of 5 % at 65 °C in the supply air using the humidification unit. This corresponds to a relative humidity of 50 % at 21 °C or a dew point of 10,4 °C. It is typical to maintain a targeted dew point temperature and then to reheat to a specified air temperature by the feedback from a RH sensor in the chamber. Maintaining a constant dew point and air temperature produces a very constant relative humidity.

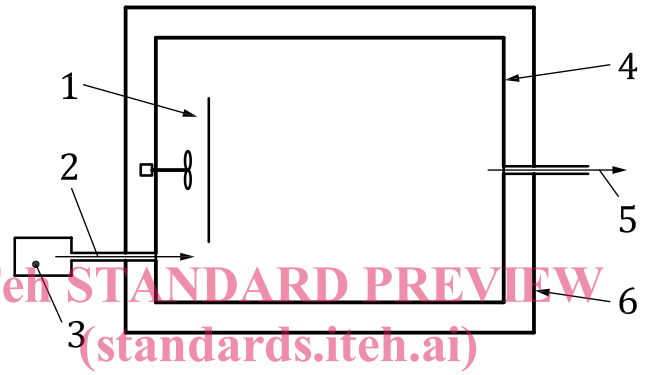
6.5 Clean air supply

Tests with air change or air renewal and air sampling require a flow of clean air. An air change or air renewal of 0,4 h^{-1}, under the test conditions (65 °C, ambient pressure), shall be set with an accuracy of ± 5 %. When regulating the supply air flow, the temperature and pressure conditions at which the mass flow controller was calibrated shall be taken into account.

To prevent localized cooling of the chamber and material/component near the air inlet, the inlet air supply is normally heated up in the heating jacket between the small chamber and the outer test cabinet.

Before the start of a test, the sum of the concentrations of volatile and semi-volatile organic hydrocarbon combinations in the supply air shall not be more than 50 µg m^{-3}; for individual substances, the concentration shall not be more than 5 µg m^{-3}.

Particulate matter in the clean air supply shall be reduced through a particle filter in order to avoid the adsorption of compounds.



Key

1	air circulation	4	small chamber
2	controlled humidified flow	5	heated sample line
3	clean air supply	6	temperature controlled test cabinet

Figure 1 — Emission test bed of the small chamber

7 Quality control

7.1 General

The minimum requirements for small chamber emissions are listed below.

Errors can occur through the integration of numerous technical functions within a small chamber; therefore, regular and thorough inspections of the whole system are required. Since these errors can affect a test result, the inspection of the small chamber shall be integrated into a creditable quality assurance system or a comparable continual observation method.

Several important test methods for measuring test parameters are described below.