SLOVENSKI STANDARD
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Notranji zrak v cestnih vozilih - 1. del: Preskus celotnega vozila - Specifikacija in preskusna metoda za določevanje hlapnih organskih spojin v notranjosti vozila

Interior air of road vehicles - Part 1: Whole vehicle test chamber - Specification and method for the determination of volatile organic compounds in cabin interiors

Air intérieur des véhicules routiers - Partie 1: Enceinte d'essai pour un véhicule complet - Spécification et méthode de détermination des composés organiques volatils dans les habitacles d'automobiles

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INTERNATIONAL STANDARD

ISO 12219-1

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Interior air of road vehicles —

Part 1: Whole vehicle test chamber — Specification and method for the determination of volatile organic compounds in cabin interiors

Air intérieur des véhicules routiers —

Partie 1: Enceinte d'essai pour un véhicule complet — Spécification et méthode de détermination des composés organiques volatils dans les habitacles d'automobiles

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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 12219-1 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: Screening method for the determination of the emissions of volatile organic compounds from vehicle interior parts and materials — Small chamber method*

The following part is under preparation:

— *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 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.

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

There are several national test methods available for measuring in-vehicle air quality, e.g. References [2][3]. However, this part of ISO 12219 requires a fixed heating radiation system whereas the methods of References [2][3] define a fixed temperature programme.

Before setting a fixed radiation density for heating the test vehicle, several validation measurements were performed (Reference [1]).

ISO 16000-3, ISO 16000-5,[6] ISO 16000-6, ISO 16000-9,[7] ISO 16000-10,[8] ISO 16000-11,[9] ISO 16000-24,[10] ISO 16000-25,[11] as well as ISO 16017-1 and ISO 16017-2[12] also focus on volatile organic compound (VOC) measurements.

Interior air of road vehicles

Part 1:
Whole vehicle test chamber — Specification and method for the determination of volatile organic compounds in cabin interiors

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 describes and specifies the whole vehicle test chamber, the vapour sampling assembly and the operating conditions for the determination of volatile organic compounds (VOCs), and carbonyl compounds in vehicle cabin air. There are three measurements performed: one (for VOCs and carbonyl compounds) during the simulation of ambient conditions (ambient mode) at standard conditions of 23 °C with no air exchange; a second only for the measurement of formaldehyde at elevated temperatures (parking mode); and a third for VOCs and carbonyl compounds simulating driving after the vehicle has been parked in the sun starting at elevated temperatures (driving mode). For the simulation of the mean sun irradiation, a fixed irradiation in the whole vehicle test chamber is employed.

The VOC method is valid for measurement of non-polar and slightly polar VOCs in a concentration range of sub-micrograms per cubic metre up to several milligrams per cubic metre. Using the principles described in this method, some semi-volatile organic compounds (SVOC) can also be analysed. Compatible compounds are those which can be trapped and released from the Tenax TA®[1)] sorbent tubes described in ISO 16000-6, which includes VOCs ranging in volatility from *n*-C_6 to *n*-C_{16}.

The sampling and analysis procedure for formaldehyde and other carbonyl compounds is performed by collecting air on to cartridges coated with 2,4-dinitrophenylhydrazine (DNPH) and subsequent analysis by high performance liquid chromatography (HPLC) with detection by ultraviolet absorption. Formaldehyde and other carbonyl compounds can be determined in the approximate concentration range 1 µg/m^3 to 1 mg/m^3.

The method is valid for passenger cars, as defined in ISO 3833.

This part of ISO 12219 describes:

a) transport and storage of the test vehicles until the start of the test;

b) conditioning for the surroundings of the test vehicle and the test vehicle itself as well as the whole vehicle test chamber;

c) conditioning of the test vehicle prior to measurements;

d) simulation of ambient air conditions (ambient mode);

e) formaldehyde sampling at elevated temperatures (parking mode);

f) simulation of driving after the test vehicle has been parked in the sun (driving mode).

Buses, motor caravans, and trucks, in accordance with the descriptions given in ISO 3833, are excluded.

1) 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.

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 3833:1977, *Road vehicles — Types — Terms and definitions*

ISO 9060, *Solar energy — Specification and classification of instruments for measuring hemispherical solar and direct solar radiation*

ISO 16000-3, *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*

ISO 16017-1, *Indoor, ambient and workplace air — Sampling and analysis of volatile organic compounds by sorbent tube/thermal desorption/capillary gas chromatography — Part 1: Pumped sampling*

3 Terms and definitions

For the purpose of this document, the terms and definitions of ISO 16000-3, ISO 16000-6 and the following apply.

3.1
background concentration
analyte concentration in the whole-vehicle test chamber when the test vehicle is inside

3.2
test vehicle
new or used vehicle to be tested

NOTE 1 The test vehicle can be of any type specified in ISO 3833:1977, 3.1.1, only.

NOTE 2 See also 4.5.

3.3
total volatile organic compounds
TVOCs
sum of volatile organic compounds sampled on Tenax TA®[1)] and eluting between and including *n*-hexane and *n*-hexadecane, detected with a flame ionization detector ($TVOC_{FID}$) or mass spectrometric detector ($TVOC_{MS}$) and quantified converting the total area of the chromatogram in that analytical window to toluene equivalents

NOTE Adapted from ISO 16000-6:2011, 3.4.

3.4
carbonyl compound
compound containing the functional group –C(=O)– determined according to a specified procedure

NOTE For the purposes of this part of ISO 12219, the procedure is that specified in ISO 16000-3.

3.5
ambient mode
mode in which sampling of VOCs and carbonyl compounds in the cabin of a test vehicle under standardized ambient temperature conditions is performed, defined by 23 °C

NOTE Engine off, radiators off, sampling time 30 min.

3.6
parking mode
mode in which sampling of formaldehyde in the cabin of a test vehicle under standardized elevated temperatures is performed

NOTE Sampling time 30 min.

3.7
driving mode
mode in which sampling of VOCs and carbonyl compounds in the cabin of a test vehicle under standardized conditions starting at elevated temperatures is performed, simulating a vehicle driven after being parked in the sun

NOTE Sampling time 30 min.

3.8
sampling train
apparatus to collect the sample gas inside the test vehicle cabin (indoor) and in the whole vehicle test chamber, trapping the VOCs and carbonyl compounds in sorbent tubes under standardized conditions

NOTE See ISO 16000-3 for formaldehyde and ISO 16000-6 for VOCs.

4 Apparatus and materials

4.1 General. The whole vehicle test chamber is big enough to house the test vehicle completely. An air-conditioning system is installed to allow standardized air conditions for a temperature of 23 °C ± 2 °C, humidity of 50 % RH ± 10 % RH. A solar radiator system is installed to heat the test vehicle cabin with a fixed irradiation. The resulting temperature inside the cabin depends on the insulation and the window glass material (the minimum requirements are specified in 6.1) (see also Figure 1).

4.2 Heating radiator. Infrared radiator, halogen radiator or other radiators (simulating sunlight) (wavelengths <300 nm shall be filtered out). The heating radiators used shall be powered to create a radiation density at the reference measurement point in the middle of the roof surface of the test vehicle of 350 W/m^2 to 450 W/m^2 (400 W/m^2 ± 50 W/m^2).

The heating area shall cover at least the area of the test vehicle cabin and an additional 0,5 m more to each side of the lower part of the glazing (footprint) (see Figure 1). Position the heating radiators on the roof with a shining angle of 90° to the heating area. There shall be no heating radiators shining from the side. The heating area shall be calibrated in squares of 25 cm × 25 cm with a radiation density of 400 W/m^2 ± 50 W/m^2. The required radiation density shall be available directly after the lamps are switched on (within a few minutes).

The irradiation shall be measured in accordance with ISO 9060.

Take care not to have too short a distance between radiator and surface in order to avoid hot spots.

4.3 Sampling trains.

4.3.1 Sampling in the test vehicle. Four sampling trains are employed: two for the VOC measurements in parallel and two for the carbonyl compound measurements in parallel in the test vehicle (to check the repeatability) (see ISO 16000-3 for carbonyl compounds and ISO 16000-6 or ISO 16017-1 for VOCs). There is one sampling line with a manifold for the division of the sampling flow outside the test vehicle (see 4.3.3). It consists of the probe, the sampling line (heated, if necessary), the sorbent tube for VOC or the DNPH cartridge for carbonyl compound sampling respectively, the gas meters and the pumps (see 4.5).

All sampling trains shall be checked for leaks and shall have a maximum vacuum decay rate of 30 kPa for an average time of 10 s. For the leak check, the nozzle shall be plugged. Other equivalent leak checks can be employed.

4.3.2 Sampling in the whole vehicle test chamber. Four sampling trains are used to determine the background concentration in the whole vehicle test chamber. The sampling trains are identical to those of 4.3.1, apart from the sampling line, which is much shorter and not heated.

All sampling trains shall have a maximum vacuum decay rate of 30 kPa for an average of 10 s. The nozzle is plugged for the leak check. Other equivalent leak checks can be employed.

4.3.3 Sampling line. Tubing, between the sampling point (probe) inside the test vehicle, via the manifold outside the test vehicle to the VOC sorbent tubes or DNPH cartridges respectively (see Figure 1).

The sampling line shall be constructed so as to be

a) as short as possible (maximum 5 m) with an internal diameter of 4 mm or more;

b) of inert, non-emitting and non-absorbing/non-adsorbing material [e.g. stainless steel or polytetrafluoroethylene (PTFE) or glass/quartz (deactivated)];

c) proven that there are no contaminations or sink effects in the sampling line;

d) with heating device, if necessary, to prevent condensation/deposition on the inner walls (best practice: temperature controlled to about 20 °C above air temperature inside the test vehicle).

The tubing should be inserted between the door and the door frame or between the door frame and the glazing and should be sufficiently non-compressible to ensure an unimpeded flow of air.

The second sampling line [tubing, between the sampling point (probe) in the whole vehicle test chamber in the vicinity of the test vehicle [see 6.1 b)] and the manifold and to the VOC sorbent tubes or DNPH cartridges, respectively] is identical to that described in the preceding, but no heating is necessary. This second sampling line is needed to monitor the background analyte concentration of the whole vehicle test chamber.

4.4 Analytical equipment and materials. The analytical equipment used for the determination of VOCs and carbonyl compounds or formaldeyde alone shall be in accordance with ISO 16000-6 (VOCs) or ISO 16000-3 (carbonyl compounds), respectively.

It shall be proven for the VOC sorbent tubes and the DNPH cartridges that there is no breakthrough. This can be identified by a back-up sorbent tube which is analysed separately (see ISO 16017-1).

4.5 Test vehicle. A new vehicle (i.e. one not driven more than 50 km and within 28 d ± 5 d after the completion of manufacture) to be tested shall have been manufactured by the normal production process. The test data are dependent on the trim level and exterior colour of the selected test vehicle. The colour of the test vehicles for the determination of the official VOC and carbonyl compound emissions is black. If there is no black test vehicle available, take the darkest colour.

All manual glazing shades shall remain open.

The test vehicle shall be stored and transported under conditions preventing direct solar heating, otherwise the vehicle shall be conditioned after arrival overnight with open doors and windows before it is transferred into the whole vehicle test chamber. This conditioning shall be undertaken if used vehicles are tested. No transport waxes for protection should be used. All transport foils or transit lacquers shall be removed carefully before the test. The test vehicle shall not be cleaned (inside) for at least 24 h before starting the measurements.

The method specified in this part of ISO 12219 can also be employed for used vehicles. In this case, it is possible that the measurement results are not identical to those obtained on a new test vehicle due to different usage.

5 Principle

A whole vehicle test chamber (see Annex A) reserved for this purpose is assembled. The air in the test vehicle cabin is measured according to a uniform standardized programme (see Figure 1). Sampling of VOCs and carbonyl compounds is performed for the ambient mode at 23 °C. Subsequently, formaldehyde is determined alone under elevated temperature conditions in the parking mode (see Figure 3). Sunshine is simulated by the