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Interior air of road vehicles —

Part 10: Whole vehicle test chamber — Specification and methods for the determination of volatile organic compounds in cabin interiors — Trucks and buses

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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).

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).

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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.

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Introduction

Volatile organic compounds (VOCs) are widely used in industry and can be emitted by many every-day products and materials. They have attracted much attention in recent years because of their impact on cabin 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. Therefore, it is important to get comprehensive and reliable information about the types of organic compounds in the interior air of vehicles and also their concentrations.

This document 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.

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Interior air of road vehicles —

Part 10: Whole vehicle test chamber — Specification and methods for the determination of volatile organic compounds in cabin interiors — Trucks and buses

1 Scope

This document describes and specifies the whole vehicle test chamber, the vapour sampling assembly and the operating conditions for the determination of volatile organic compounds (VOCs; for more information see Annex E), 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, 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*-C6 to *n*-C16.

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.

This method applicable to trucks and buses, as defined in ISO 3833:1977 3.1.1 to 3.1.6.

This document describes:

a) Transport and storage of the test vehicle until the start of the test.

b) Conditioning of 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).

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.

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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 12219-1, *Interior air of road vehicles — Part 1: Whole vehicle test chamber — Specification and method for the determination of volatile organic compounds*

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, *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.

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

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

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

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

3.2
test vehicle
new vehicle to be tested

Note 1 to entry: The test vehicle used can be of any type specified in ISO 3833:1977, 3.1.2 to 3.1.6.

Note 2 to entry: See also 3.5

3.3
total volatile organic compounds (TVOC)
sum of volatile organic compounds sampled on Tenax TA® 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

3.4
carbonyl compound
compound containing the functional group -C(=O)- determined according to 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 as 23 °C

Note 1 to entry: Engine off, radiators off, trucks and buses sampling time 30 min.

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

Note 1 to entry: Engine off, radiators on, trucks and buses sampling time 30 min.

3.7
driving mode
mode in which sampling of VOCs and carbonyl compounds in the cabin of a *test vehicle* (3.2) under standardized conditions starting at elevated temperatures is performed, simulating a vehicle driven after being parked in the sun

Note 1 to entry: Engine on, radiators on, air conditioning on, trucks sampling time 30 min, buses sampling time 120 min.

3.8
sampling train
apparatus to collect the sample gas inside the *test vehicle* (3.2) cabin (indoor) and the whole vehicle test chamber, trapping the VOCs and carbonyl compounds on sorbent tubes under standardized conditions

Note 1 to entry: See ISO 16000-3 for formaldehyde and ISO 16000-6 the VOCs.

3.9
field blank
air quality sample taken in an identical manner as the real sample, but without sucking air through the sampling apparatus

[SOURCE: ISO 16000-16; 3.7, modified — Note to entry has been deleted since it does not apply to this document.]

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 to a defined temperature (see also Figure 1).

4.2 Heating radiator

Infrared radiator, halogen radiator or other radiators (simulating sunlight). The heating radiators used shall be powered to maintain a temperature of 40°C ± 2 °C for trucks and 35°C ± 2 °C for buses.

Position the heating radiators on the roof. There shall be no heating radiators shining from the side.

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).

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