INTERNATIONAL STANDARD

ISO 12219-2

First edition
2012-06-15

Interior air of road vehicles —

Part 2:
Screening method for the determination of the emissions of volatile organic compounds from vehicle interior parts and materials — Bag method

Air intérieur des véhicules routiers —

Partie 2: Méthode de criblage pour la détermination des émissions de composés organiques volatils des parties et des matériaux intérieurs des véhicules — Méthode du sac

Reference number
ISO 12219-2:2012(E)

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Published in Switzerland

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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 12219-2 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*

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Introduction

Volatile organic compounds (VOCs) are widely used in industry and may be emitted by many everyday products and materials. They have attracted much 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 the sampling bag test method for the screening of VOCs, formaldehyde and other carbonyl compounds which diffuse from vehicle interior parts into the air inside road vehicles.

Measuring VOCs from vehicle interior parts can be performed in several ways and the approach selected depends upon the desired outcome and the material type. For example, to obtain diffusion data from complete assemblies (e.g. instrument panel, seat etc.) it is necessary to employ chambers / bags that have sufficient volume to house the complete assembly. Meanwhile, to obtain diffusion data from representative samples of homogeneous vehicle interior materials, the micro-scale chamber method can be chosen.

Each measurement method such as bag/micro-scale chamber/small-chamber sampling offers a complementary approach.

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

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Interior air of road vehicles —

Part 2:
Screening method for the determination of the emissions of volatile organic compounds from vehicle interior parts and materials — Bag method

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

1 Scope

This part of ISO 12219 specifies the sampling bag test method for measuring volatile organic compounds (VOCs), formaldehyde and other carbonyl compounds which may diffuse from vehicle interior parts into the air inside road vehicles. This method is intended for evaluating and screening new vehicle interior parts and materials such as seats, the instrument panel, ceiling materials and so on.

The test method specified in this part of ISO 12219 specifies a procedure for screening of VOCs, formaldehyde and other carbonyl compounds using sampling bags.

This part of ISO 12219 provides third party test laboratories and manufacturing industry with a cost-effective approach for:

a) evaluating and screening prototype, “low-diffusion” materials or products during development;

b) comparing diffusions from products within a range (e.g. different colours or patterns).

This part of ISO 12219 specifies the design, construction, performance, evaluation, and use of sampling bags for testing vapour-phase organic emissions diffused from vehicle interior parts.

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 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 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 purposes of this document, the following terms and definitions apply.

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3.1
vehicle interior part
part which is used in the interior of a vehicle including related materials such as adhesives and coating materials

3.2
sampling bag value
concentration increment of a subject gas component due to the diffusion of VOCs, formaldehyde and other carbonyl compounds from a test specimen, multiplied by the total amount of the gas filling the sampling bag

3.3
test specimen
component part or representative sample of material cut out from vehicle interior parts which are to be tested

3.4
volatile organic compound
VOC
organic compound whose boiling point is in the range from (50 °C to 100 °C) to (240 °C to 260 °C)

[ISO 16000-6:2011, 3.2]

3.5
total volatile organic compound
TVOC
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 by converting the total area of the chromatogram in that analytical window to toluene equivalents

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

4 Principle

The test method specified in this part of ISO 12219 is a procedure for calculating sampling bag values of VOCs, formaldehyde, and other carbonyl compounds which may diffuse from vehicle interior parts.

One or multiple test specimens put in a sampling bag are heated to a specified temperature, then a fraction of the gas in the sampling bag is collected to measure the test concentrations. By comparing the test concentrations with the corresponding blank concentrations, the sampling bag values of VOCs, formaldehyde, and other carbonyl compounds diffusing from one test specimen can be calculated (see Clause 10).

The analytical part of the overall measurement procedure is based on the use of sorbent tubes with subsequent thermal desorption and gas chromatographic analysis for VOCs (according to ISO 16000-6) and the use of 2,4-dinitrophenylhydrazine (DNPH) sorbent tubes, followed by high performance liquid chromatography (HPLC) analysis with ultraviolet absorption for the determination of formaldehyde and other carbonyl compounds (according to ISO 16000-3).

The specified analytical procedure is valid for the determination of VOCs ranging in concentration from sub-microgram per metre cubed to several milligrams per metre cubed. The method is applicable to the measurement of non-polar and slightly polar VOCs ranging in volatility from *n*-C_6 to *n*-C_{16}.

The specified analytical procedure for formaldehyde and other carbonyl compounds is valid for the determination of carbonyl compounds within the concentration range of approximately 1 µg/m^3 to 1 mg/m^3.

5 Apparatus and materials

5.1 General. The test apparatus and materials necessary for determining the sampling bag values of VOCs, formaldehyde and other carbonyl compounds diffusing from vehicle interior parts are mainly as follows:

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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— sampling bag;

— nitrogen gas or air (filling gas);

— thermostatic oven;

— pumps;

— integrating flow meter;

— gas analyser;

— sorbent tube and DNPH cartridge.

5.2 Sampling bag.

5.2.1 General. Sampling bags used in this part of ISO 12219 shall be in accordance with 5.2.2, 5.2.3, 5.2.4 and 7.2.

5.2.2 Material and capacity. The sampling bag material shall be inert, impermeable, and non-sorbing [e.g. fluorinated resins, such as poly(vinyl fluoride) (PVF) or perfluoro(ethylene/propylene) plastic] and shall meet the performance characteristics specified in 7.2. The bag capacity shall be at least 10 l.

5.2.3 Airtightness. Sampling bags shall be sealed securely with low-emitting tape or heat bonded so as to be isolated from the uncontrolled ambient air.

5.2.4 Blank concentration. Blank concentrations (background artefacts) which are observed when a sampling bag is heated to test temperature (65 °C) without any sample present, shall be as low as possible (e.g. below 0,075 µg/bag for formaldehyde and other carbonyl compounds and below 0,05 µg/bag for VOCs) so that they do not interfere with the test results.

5.3 Purity of the gas. The nitrogen gas or air introduced to the sampling bag shall be pure and dry. The concentrations of VOCs, formaldehyde and other carbonyl compounds shall be as low as possible so that they do not adversely affect the test results.

The purity of the gas or air shall fulfil the requirements of ISO 16000-3 and ISO 16000-6.

5.4 Thermostatic oven. Temperature shall be controlled in an oven which is capable of maintaining a constant and homogeneous temperature.

The thermostatic oven where a sampling bag is heated shall be capable of uniformly controlling temperatures within ±1 °C.

5.5 Pumps. Vacuum pumps or other apparatus which can be used to evacuate sampling bags sufficiently quickly shall be used.

5.6 Integrating flow meter or gas meter. The volume of sampled gases or other gases shall be measured and adjusted to standard conditions (23 °C and 101,3 kPa) with an integrating flow meter or a gas meter ($V \pm$ 0,1 l, where V is volume).

5.7 Gas analyser. VOC analysis shall be performed according to ISO 16000-6 using thermal desorption (TD) and a gas chromatograph equipped with a mass spectrometer (GC–MS) and an optional flame ionization detector (FID). A high performance liquid chromatograph (HPLC) shall be used for the analysis of formaldehyde and other carbonyl compounds.

NOTE 1 Gas analysers are used according to ISO 16000-3, ISO 16017-1, and ISO 16000-6, but other equipment having equivalent or better performance can be used.

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NOTE 2 It is also possible that simpler analytical system configurations (e.g. TD-GC/FID) are preferable for routine application in industrial laboratories.

5.8 Vapour-sampling devices. Tubes packed with sorbents (such as Tenax TA[1)] or Tenax GR[2)]) are used for sampling vapour-phase organics ranging in volatility from *n*-hexane to *n*-hexadecane in accordance with ISO 16000-6. Note that alternative sorbents or sorbent combinations may be required for monitoring compounds over a wider volatility range. See ISO 16017-1 or ISO 16000-6:2011, Annex D for more details.

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

6 Test conditions

6.1 General

Test conditions shall be in accordance with 6.2 to 6.6. The test environment shall be sufficiently ventilated so as to minimize the background effect.

6.2 Test specimen size

A test specimen shall typically have an upper surface area of 100 cm^2 (e.g. 10 cm × 10 cm). The thickness of the test specimen is not specified, but shall be reported.

NOTE Cut edges are left as they are without being sealed.

6.3 Curing conditions (storage period and storage conditions)

Samples shall be tested within 4 weeks of production. Each test specimen shall be wrapped appropriately and stored so as not to be contaminated by chemical substances or affected by heat, humidity or other factors.

The storage period and storage conditions shall be reported. This requirement applies also to the case where such conditions are agreed upon between the parties concerned.

See Annex A for details of test specimen preparation and storage.

6.4 Heating temperature

Sampling bags shall be uniformly heated to 65 °C ± 1°C.

Alternative heating temperatures may be agreed between the parties concerned.

6.5 Heating time

Sampling bags shall be heated for 2 h ± 5 min.

6.6 Gas amount to be filled in a sampling bag

After the test specimen is introduced and the bag is evacuated, the sampling bag shall be filled with 5 l of pure and dry gas.

Filling with a pump directly is inappropriate because of the potential risk of contamination.

2) Tenax GR® 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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7 Verification of test conditions

7.1 Monitoring of test conditions

Heating temperatures shall be monitored and recorded.

Temperature accuracy of measuring instruments shall be within ±0,5 °C.

7.2 Recovery rate

The recovery rate is defined as the ratio of the total amount of VOCs, formaldehyde, and other carbonyl compounds collected from a sampling bag to the known total amount of VOCs, formaldehyde and other carbonyl compounds supplied to the sampling bag.

Recovery rates of the VOCs under investigation, formaldehyde, and other carbonyl compounds shall be measured using corresponding standard gases. Sampling bags shall provide average recovery rates better than 60 % for formaldehyde and 70 % for toluene.

NOTE It is difficult to satisfy the minimum accuracy requirements for the test, if there is a sink effect or leakage and if the calibration accuracy is insufficient. Sink effect and absorption characteristics are closely related with the kinds of diffused VOCs, formaldehyde and other carbonyl compounds. In order to identify their effects, VOCs, formaldehyde and other carbonyl compounds with a different molecular mass or polarity may be introduced to the sample bags for additional recovery tests (see B.3).

8 Test method

8.1 Test equipment

The test equipment set-up is illustrated in Figure 1.

8.2 Preparation for testing

8.2.1 Cleaning of sampling bags

Sampling bags shall be cleaned prior to testing as follows:

— connect a polytetrafluoroethylene (PTFE) tube to the sampling bag sleeve;

— fill the bag with dry nitrogen gas or air, then empty the bag using a pump;

— repeat the filling and emptying operation three times.

Sampling bags may be heated (e.g. up to 80 °C) beforehand in order to lower the blank concentrations.

Used bags shall not be used for other measurements due to memory effects.

8.2.2 Preparation of sampling bags

Cut an end of a sampling bag after cleaning, and put one or multiple test specimens in it. Fold the cut end of the sampling bag and securely seal it using a sealing material (e.g. tape) or by heat bonding. Fill the sampling bag with dry nitrogen gas or air, and then empty the bag. Fill the bag again with 5 l of dry nitrogen gas or air. The same sequence of operation shall be applied to an empty sampling bag to use as a blank.

8.3 Emission test

Put the sampling bag containing one or multiple test specimens and the blank bag in a thermostatic oven kept at a specified temperature (see 6.4). Thread the PTFE tubes connected to each bag out through suitable openings in the oven. Both sampling bags shall be heated for a specified period of time (see 6.5).

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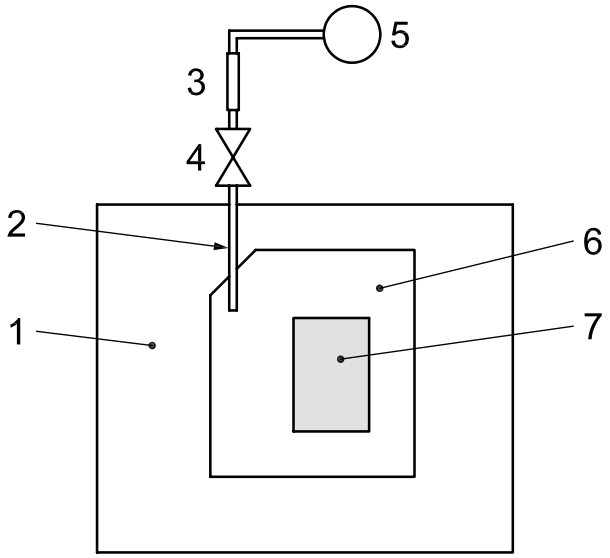
Test onset is the time point when a sampling bag is placed in a thermostatic oven.

8.4 Gas collection

Confirm that the temperature in the oven is in a steady-state condition after heating for a specified period of time (see 6.5), and then connect vapour-sampling devices (see 5.8) to the PTFE tubes connected to each bag at the same time. An appropriate union shall be used to ensure a leak-free connection between the vapour-sampling device and the PTFE tubing. Suitable connectors include stainless steel compression fittings incorporating PTFE ferrules.

The collected gas volumes shall be 1 l for VOCs and 3 l for formaldehyde and other carbonyl compounds sequentially, after temperature calibration. Additional collection of VOCs may be performed as required.

The limited 3 l sampling volume may compromise the detection limits for formaldehyde as reported in ISO 16000-3.



Key

1	thermostatic oven	5	pump
2	PTFE tube	6	sampling bag
3	sorbent tube	7	test specimen
4	valve		

Figure 1 — Outline of test equipment set-up (sampling line instead of PTFE tube)

Sampling line shall be as short as possible. Outside the oven the sampling line should be, for example, 10 cm, and it may be heated to ensure against condensation.

9 Analytical procedures

9.1 Analysis of VOCs

Analyse VOCs in accordance with ISO 16000-6. Determine the test concentration and the blank concentration of VOCs.

9.2 Analysis of formaldehyde and other carbonyl compounds

Analyse formaldehyde and other carbonyl compounds in accordance with ISO 16000-3. Determine the test concentrations and the blank concentrations of formaldehyde and other carbonyl compounds.

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10 Calculation of sampling bag values

Determine the sampling bag value, m, in micrograms, of a gas component diffused from a test specimen as follows:

$$m = (\gamma_S - \gamma_b)V \quad (1)$$

where

γ_S is the test concentration, in micrograms per metre cubed, of a specific VOC, formaldehyde or other carbonyl compound collected from a sampling bag which has been heated for a specified period of time with one or more test specimens in it;

γ_b is the blank concentration, in micrograms per metre cubed, of a specific VOC, formaldehyde or other carbonyl compound collected from a sampling bag which has been heated for a specified period of time without any test specimen;

V is the volume, in metres cubed, of gas introduced to the sampling bag.

11 Test report

The test report shall contain the following items, in general

a) testing organization:

- name and address,
- name of the person responsible for the test;

b) test specimen:

- kind or type (construction material, part name, if possible),
- selection process of parts to be tested (e.g. sampling method),
- other information on the vehicle interior part (production date, batch number, arrival date at the testing organization, date of unpacking, storage conditions, date and time when the test specimens were prepared for testing, etc.);

c) test results — sampling bag values of:

- the VOC(s) under investigation,
- formaldehyde,
- other carbonyl compounds,
- TVOC;

d) test conditions:

- sampling bag conditions (temperature, batch and type, time, gas volume),
- upper surface area of the test specimen,
- information regarding collection of the VOC under investigation, formaldehyde, and other carbonyl compounds (sorbent tubes used, collected gas volumes, etc.);

e) measuring instrument — information regarding the instruments used and their handling in terms of, for example:

- sampling bags,
- sealing materials,

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- thermostatic ovens,
- pumps,
- gas analysers;

f) quality control/quality assurance (QA/QC):

- blank concentrations of the VOC under investigation, formaldehyde, and other carbonyl compounds,
- recovery rates used for evaluating the sink effect of the VOC of interest, formaldehyde, and other carbonyl compounds,
- number of measurements,
- accuracy of temperature measurement,
- DNPH cartridge blank value.

An example of the test report format is shown in Table 1.

12 Quality assurance/quality control

If this bag method is to be used for quick screening of product emissions as part of routine quality control or for in-house intercomparison of products by the manufacturer, the performance guidelines given in this part of ISO 12219 are sufficient.

However, if this bag method is to be used for estimating the contribution of a product to atmospheric concentrations of organic vapours in vehicle cabin air experimentally, follow the analytical QA plans given in relevant standards (e.g. ISO 16000-9).

An appropriate level of quality control shall be employed following ISO 16000-3 and ISO 16000-6 including:

- bag blanks are prepared according to Clause 8;
- the blank concentration level is acceptable if artefact peaks are no greater than 10 % of the typical areas of the analytes of interest;
- desorption efficiency of VOCs/carbonyl compounds should be checked according to ISO 16000-3 and ISO 16000-6;
- the collection efficiency can be controlled by using back-up tubes or taking samples of different sampling volumes less than the safe sampling volume;
- repeatability of the air sampling and analytical method shall be determined — a coefficient of variation ≤15 % (ISO 16000-3 and ISO 16000-6) from the duplicate measurements should be reached;

NOTE The repeatability of the emission test is influenced by any inhomogenity of the material under test.

- the recovery of *n*-C_6 to *n*-C_{16} hydrocarbons shall be at least 95 % (ISO 16000-6);
- documentation illustrating traceable calibrations for temperature, humidity, and flow measurements.

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Table 1 — Example of test report format

a) Testing organization	
Name:	XXXXX Corporation
Address:	A-B, CC, DD-ku, Tokyo
Responsible person:	Ichiro Kikaku
b) Test specimen	
Kind or type (part name):	Seat
Product number:	AB1234
Sampling method:	Test specimen of 10 cm × 10 cm cut from the part
Shape of the test specimen:	Thickness: 3 mm; mass: 12 g
Production date:	2007-03-13
Arrival date:	2007-03-15
Date of unpacking:	2007-03-16
Date and time test specimens prepared for testing:	2007-03-16 15:00
Test date:	2007-03-16
Remarks:	
c) Test results	
Gas component	Sampling bag values, µg
Formaldehyde	not detected (n.d.) (≤0,xyz)
Acetaldehyde	1,0
Toluene	2,0
o-, *m*-, *p*-Xylene	3,0
Ethyl benzene	4,0
Styrene	5,0
TVOC	100
d) Test conditions	
Heating temperature:	65 °C
Heating period:	2 h
Volume of gas introduced:	5 l
Upper surface area of the test specimen:	100 cm^2
Collecting conditions for VOCs	
Sorbent tube:	Tenax TA[1)]
Collected gas volume:	1,0 l x 2
Collecting conditions of formaldehyde and other carbonyl compounds	

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Cartridge:	DNPH
Collected gas volume:	3,0 l
Ambient air temperature:	23 °C
Ambient air humidity	55 % (RH)
Remarks:	Polyester batch 1234

e) Test equipment

Thermostatic oven:	Type AAA manufactured by BBB Corp.
Sealing material:	PTFE sealing tape
Heat bond:	Not used
Air collecting equipment:	Sampling pump manufactured by CCC Corp.
Gas analysers	
Formaldehyde and other carbonyl compounds	
High-speed liquid chromatograph:	DDDD
Detector:	EEEE
VOC (toluene, xylene, other VOC, TVOC)	
Thermal desorption system:	FFFF
Gas chromatograph – Mass analyser:	GGGG

f) Quality control/assurance

Test item	Test concentration, μg/m^3	Blank concentration, μg/m^3
Formaldehyde	n.d. (≤000)	n.d. (≤000)
Acetaldehyde	X	n.d. (≤000)
Toluene	XX	n.d. (≤000)
o-, *m*-, *p*-Xylene	XXX	n.d. (≤000)
Ethyl benzene	YYY	n.d. (≤000)
Styrene	ZZZ	n.d. (≤000)
TVOC	●●●●	●●●
Number of measurements:	1	
Recovery rate:	85 % (Toluene)	
Temperature accuracy:	±0,5 °C	
DNPH cartridge blank concentration	n.d. (≤000)	n.d. (≤000)

g) Data analysis

Sampling bag values, m, of the test specimen are calculated by Equation (1).

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Annex A
(informative)

General procedures for preparation and storage of test specimens

A.1 Introduction

These general procedures are subject to review and revision, if necessary, in the light of any new information obtained in the future.

A.2 Sampling of products and transportation and storage of test specimens

A.2.1 General

In order to determine sampling bag values of VOCs and aldehydes diffusing from vehicle interior parts using sampling bags, the subject products shall be handled properly before and during the test. This procedure applies only to vehicle interior parts which are new and to be used in the vehicle assembly.

A.2.2 Sampling method of products

Products to be subjected to testing shall be manufactured, wrapped and handled in the normal way. The test specimens cut from the products which have been randomly selected from the products of interest should be wrapped immediately and transported to the testing organization as soon as possible.

A.2.3 Wrapping and transportation of test specimens

Test specimens should be protected from chemical contamination or effects by heat or humidity. Each test specimen should be wrapped in aluminium foil (with the glossy surface outside) or aluminium processed wrapping material and encapsulated in a polyethylene bag or in a sheet lined with transparent PVF film. To avoid light-induced ageing of the test specimens, storage and transportation should occur, for example, in a cardboard box.

The diffusion characteristic of the test specimens can be affected by the transportation conditions. Special attention needs to be paid to the effect of temperature.

A.2.4 Storage of test specimens until testing

Emission tests should usually be initiated as soon as the test specimens arrive at the testing organization. If the test specimens are stored by the testing organization before testing, they should remain securely sealed inside the packaging described in A.2.3 in order to avoid any degradation or contamination during the storage period (generally, 2 weeks).

A.3 Miscellaneous

Preparation and storage of test specimens should be in accordance with the procedures specified in A.2; however, the parties concerned may establish other procedures taking the test specimen material or manufacturing process into consideration.

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Annex B
(informative)

Additional information on test report and recovery rate

B.1 Introduction

This additional information is subject to review and revision, if necessary, in the light any new information obtained in the future.

B.2 Test report and recovery rate

The test report and recovery rate should be in accordance with the normative requirements of this part of ISO 12219; however, this part of ISO 12219 does not prevent other processes or procedures being agreed between the parties concerned.

B.3 Procedure for recovery rate testing

B.3.1 Recovery rate of bag method

B.3.1.1 Prepare three bags and purge them three times using pure and dry nitrogen gas.

B.3.1.2 Evacuate the sampling bag and, using a micro-syringe, inject 1 µl of the compound of interest into standard solution (e.g. 1 000 µg/ml VOC mixed standard liquid).

B.3.1.3 Introduce 5 l of pure and dry nitrogen or air into the sampling bag and seal it immediately.

B.3.1.4 Leave the sampling bag for 2 h in an oven fitted with a thermostat and maintained at 65 °C ± 1 °C.

B.3.1.5 Collect gases from the sampling bag. Collection conditions are listed in the following.

Tenax TA®:[1)] Collect duplicate 1 l gas samples using a flow rate below 250 ml/min.

DNPH: Collect a 3 l gas sample using a flow rate below 800 ml/min.

Gases should be collected from the heated sampling bag.

NOTE Also standard gas of the compound of interest can be used.

B.3.2 Blank test of bag method

Repeat the procedure specified in B.3.1 using an empty bag to get a blank measurement.

B.3.3 Calculation of recovery rate

Calculate the recovery rate, w, expressed as a percentage mass fraction of each compound to be measured from the resulting analytical data (HPLC for aldehydes and TD–GC–MS for VOCs) using Equation (B.1):

$$w = \frac{\gamma_{\mathrm{i,means}}}{\gamma_{\mathrm{i,std}}} \times 100 \qquad \text{(B.1)}$$

where

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$\gamma_{i,means}$ is the concentration of the test concentration of compound i (VOC, formaldehyde or other carbonyl compound), in micrograms per sampling bag;

$\gamma_{i,std}$ is the concentration of compound i of the standard gas (VOC, formaldehyde or other carbonyl compound), in micrograms per sampling bag (see 7.2).

The blank test value should be subtracted from the concentration value of each substance. The recovery rate shall be calculated as the mean of three individual bag experiments.

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[1] JASO M902:2011, *Material and surface treatment — Road vehicles — Interior parts and materials — Measurement methods of diffused volatile organic compounds (VOC)*

Documents on VOCs cited informatively

[2] ISO 16000-5, *Indoor air — Part 5: Sampling strategy for volatile organic compounds (VOCs)*

[3] ISO 16000-9, *Indoor air — Part 9: Determination of the emission of volatile organic compounds from building products and furnishing — Emission test chamber method*

[4] ISO 16000-10, *Indoor air — Part 10: Determination of the emission of volatile organic compounds from building products and furnishing — Emission test cell method*

[5] ISO 16000-11, *Indoor air — Part 11: Determination of the emission of volatile organic compounds from building products and furnishing — Sampling, storage of samples and preparation of test specimens*

[6] ISO 16000-24, *Indoor air — Part 24: Performance test for evaluating the reduction of volatile organic compound (except formaldehyde) concentrations by sorptive building materials*

[7] ISO 16000-25, *Indoor air — Part 25: Determination of the emission of semi-volatile organic compounds by building products — Micro-chamber method*

[8] ISO 16017-2, *Indoor, ambient and workplace air — Sampling and analysis of volatile organic compounds by sorbent tube/thermal desorption/capillary gas chromatography — Part 2: Diffusive sampling*

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ICS 13.040.20; 43.020

Price based on 14 pages

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