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Interior air of road vehicles —

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

Air intérieur des véhicules routiers —

Partie 7: Détermination des odeurs dans l'air intérieur des véhicules routiers et dans les chambres d'essai d'air des composants de finition par des mesurages olfactifs

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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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 ISO/TC 146, *Air quality*, Subcommittee SC 6, *Indoor air*.

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

Introduction

Volatile and semi-volatile organic compounds (VOCs and SVOCs) are widely used in industry and may 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 indoor air of vehicles and their concentrations as well as an odour impression.

Since olfactory assessment is based on very subjective impressions, it is necessary to make this subjectivity comparable by means of a standardized procedure. This document describes a controlled olfactory examination of the interior air of road vehicles and the chamber air of trim components.

This document adopts the general requirements already specified in the International Standards of the ISO 16000 series which deal with the determination of odour emissions from building products using test chambers (see ISO 16000-28) and with sensory testing of indoor air (see ISO 16000-30), but uses different odour evaluation schemes developed for the automotive industry.

A risk assessment should be carried out to clarify that no harmful compounds are present in the room. In some countries, an ethics committee may require this.

Interior air of road vehicles —

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

1 Scope

This document specifies a standardized and objective process to analyse and determine the olfactory behaviour of components, semi-finished products and materials fitted in the interior of road vehicles. The odour determination is either performed by using samples from the interior air of road vehicles or from emission test chamber air. This document describes an olfactory screening method based on different scales for the olfactory assessment which are described in the annexes. Other olfactory assessments, e.g. according to ISO 16000-28, are also possible but are not the focus of this document.

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 8589, *Sensory analysis — General guidance for the design of test rooms*

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

ISO 12219-4:2013, *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 16000-28:2012, *Indoor air — Part 28: Determination of odour emissions from building products using test chambers*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12219-1, ISO 12219-4, ISO 16000-28 and the following apply.

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

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

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

3.1.1
odour
pleasant or unpleasant smell caused by chemical compounds emitting to indoor air from a building product or material, automotive part or whole vehicle interior

[SOURCE: ISO 16000-28:2012, 3.1.1, modified — The phrase "automotive part or whole vehicle interior" has been added.]

3.1.2
sensory odour panel
group of trained or untrained assessors performing the sensory assessment of the odour emission from building products or materials, automotive parts or whole vehicle interior

[SOURCE: ISO 16000-28:2012, 3.1.9, modified — The phrase "automotive parts or whole vehicle interior" has been added.]

3.1.3
panel member
<odour determination>person who is accepted to assess the *odours* (3.1.1)

[SOURCE: ISO 16000-28:2012, 3.1.11]

3.1.4
panel leader
person whose primary duties are to manage panel activities and recruit, train and monitor the assessors

[SOURCE: ISO 16000-28:2012, 3.1.10]

3.1.5
panel selection
procedure to determine which persons are qualified to serve as *panel members* (3.1.3)

[SOURCE: ISO 16000-28:2012, 3.1.5]

3.1.6
sensory adaptation
temporary modification of the sensitivity of a sense organ due to continued and/or repeated stimulation, which is reversible

[SOURCE: ISO 5492:2008, 2.6, modified — The phrase "which is reversible" has been added.]

3.1.7
sensory fatigue
form of *sensory adaptation* (3.1.6) in which a decrease in sensitivity occurs

[SOURCE: ISO 16000-28:2012, 3.1.6]

3.1.8
anosmia
lack of sensitivity to some olfactory stimulus due to physiological defects, which is not reversible

[SOURCE: ISO 5492:2008, 2.32, modified]

3.1.9
clean air
odourless air

[SOURCE: ISO 16000-28:2012, 3.1.23]

3.1.10
odourlessness
odour (3.1.1) assessed by the panel as being below the required value

[SOURCE: ISO 16000-28:2012, 3.1.29]

3.1.11
background concentration
concentration of a specific *volatile organic compound* (3.1.24) (or group of volatile organic compounds) measured in the small chamber outlet or the whole vehicle test chamber

[SOURCE: ISO 12219-4:2013, 3.6, modified — The phrase "or the whole vehicle test chamber" has been added.]

3.1.12
sampled air
air collected for subsequent measurement

3.1.13
air exchange rate
ratio of the volume of *clean air* (3.1.9) brought into the *test chamber* (3.1.20) hourly and the free test chamber volume measured in identical units

[SOURCE: ISO 16000-28:2012, 3.1.14]

3.1.14
outlet air flow rate
air volume per time at the chamber outlet

Note 1 to entry: The outlet air flow rate is expressed as volume per second.

[SOURCE: ISO 16000-28:2012, 3.1.15]

3.1.15
air velocity
air speed over the surface of the *test specimen* (3.1.23)

[SOURCE: ISO 16000-28:2012, 3.1.16]

3.1.16
supply air
sum of all gaseous volume flows conducted into the small chamber

[SOURCE: ISO 12219-4:2013, 3.12, modified — Note 1 to entry has been deleted.]

3.1.17
area specific air flow rate
ratio between the supply air flow rate and the area of the *test specimen* (3.1.23)

[SOURCE: ISO 16000-28:2012, 3.1.17]

3.1.18
air mixing
thorough intermingling of the air volume to be investigated

3.1.19
trim component
component produced for incorporation in a vehicle cabin

3.1.20
test chamber
enclosure with controlled operational parameters for the determination of *volatile organic compounds* (3.1.24) and *odours* (3.1.1) emitted from *test specimens* (3.1.23) prepared from building products, automotive parts or whole vehicle interior

[SOURCE: ISO 16000-28:2012, 3.1.21, modified — The phrase "automotive parts or whole vehicle interior" has been added.]

3.1.21
test room
room where the *odour* (3.1.1) test takes place

[SOURCE: ISO 16000-28:2012, 3.1.22]

3.1.22
product loading factor
ratio of exposed surface area of the *test specimen* (3.1.23) and the free test chamber volume

[SOURCE: ISO 16000-28:2012, 3.1.24]

3.1.23
test specimen
part of the sample specially prepared for emission testing in a *test chamber* (3.1.20) in order to simulate the odour emission behaviour of the material or product being tested

[SOURCE: ISO 16000-28:2012, 3.1.27]

3.1.24
odour sample
air sample collected from the test chamber outlet in containers and being tested for its *odour* (3.1.1)

Note 1 to entry: An example of a container is a flexible bag.

[SOURCE: ISO 16000-28:2012, 3.1.28]

3.1.25
volatile organic compound
VOC
organic compound that is emitted from the vehicle interior trim or from the *test specimen* (3.1.23) and all those detected in the interior air of road vehicles or in the chamber air of *trim components* (3.1.19)

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

3.1.26
olfactory reference material
homogeneous, stable and well-defined preparation of a chemical odorous compound (with unique CAS number) used for the training and calibration of the *panel members* (3.1.3)

Note 1 to entry: For example, different concentrations of butanol or acetone can be used to train the panel members or to assess odour intensity.

3.2 Abbreviated terms

FEP tetrafluoroethylene hexafluoropropylene copolymer

PVF polyvinyl fluoride

PET polyethyleneterephthalate

RH relative humidity

VOC volatile organic compound

4 Principle

The odour emission from road vehicle interior trim and trim components is measured using a sensory odour panel. The odour sampling from material parts or entire car cabin may be realized according to the sampling bag method described in this document. The odour determination may be carried out simultaneously with chemical emission measurements in accordance with ISO 12219-1 and ISO 12219-4. This document describes an olfactory screening method based on different scales for the olfactory assessment which are described in the annexes. These scales for olfactory analyses specified in this document deliberately differ from the scales specified in ISO 16000-28 to meet the specific needs of the automotive industry. In addition, the description of the odour character by olfactory notes using a set of chemical descriptors is informatively specified in Annex D.

5 Test facilities

5.1 General

Samples are either taken from the interior air of the road vehicles or from an emission test chamber atmosphere. The sample assessment is performed in a separate test room. The working environment of the test room for sensory odour panel members containing the odour test equipment shall be odourless and maintained under the conditions specified in ISO 8589. Any odour emissions from equipment, furnishings and materials (paints, wall and floor coverings and furniture, etc.) installed in the test room shall be avoided.

A facility designed and operated to determine the odour in the interior air of road vehicles consists of a whole vehicle test chamber meeting the requirements specified in ISO 12219-1. The whole vehicle test chamber is big enough to house the test vehicle completely and shall contain a clean air generation system. 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 ISO 12219-1).

A facility designed and operated to determine odours emitted from trim components consists of an emission test chamber containing the test specimen. The emission test chamber shall meet the requirements specified in ISO 12219-4. It shall contain a clean air generation and humidification system, an air mixing system, and monitoring and control systems to ensure that the test is carried out to specified conditions. The emission test chamber outlet shall be adapted to the sampling of chamber air in containers.

5.2 Odour test equipment

The following equipment is also necessary for the odour determination in interior air of road vehicles and in emission test chamber air of trim components by olfactory measurements.

5.2.1 Air sampling bag

The air sampling bag shall not induce any alteration of the odour being sampled. The bag with a volume of typically 5 l to 10 l shall, therefore, be airtight, odourless, non-permeable and non-adsorptive. So far, the following materials are considered appropriate for making air sampling bags:

— tetrafluoroethylene hexafluoropropylene copolymer (FEP);

— polyvinyl fluoride (PVF);

— polyethyleneterephthalate (PET).

A schematic representation of a possible sampling and presentation device for air samples collected from the interior air of road vehicles or from the emission test chamber is given in Annex A.

5.2.2 Odour sampling device

The sampling device for vehicle cabin air/emission test chamber consists of a container that can be evacuated using a pump according to the lung principle. The sampling location and the sampling device are connected by a probe. Upon evacuation of the sampling device, the sample bag, being mounted in the device, sucks in sample air via the probe. This procedure is used to avoid any contact between the sample air and the construction elements of the sampling device apart from the probe and the sample bag.

5.2.3 Odour presentation device

The odour presentation device consists of a cylinder to be filled with clean air. The sample container is inserted in the cylinder and connected to a sampling installation in the cylinder by means of a valve. By controlled injection of clean air into the cylinder, the interior pressure is raised and the sampling air is pressed in a controlled manner out of the sample container through the opened valve. This sampling air is transferred to the nose of the corresponding sensory odour panel member by means of a funnel. By this means, each sensory odour panel member receives an identical sample with a standardized volume flow and a constant provision time (see ISO 16000-28:2012, 5.6.2).

Air velocity is a critical parameter, it shall be above 0,35 m/s.

5.3 Olfactory panel

A qualified odour assessment requires at least five olfactory panel members. Moreover, the person in charge of the material testing and sampling of the odour shall never take part to the panel rating. All panel members shall succeed the selection phase previous to any sample assessment.

5.3.1 Panel selection

For any kind of sensory assessment specified in this document, the laboratory shall have a procedure for panel selection and follow-up in order to guarantee the level of performance (see Figure 1). More information about panel selection can be found in Annexes E to G.

The selection of the panel members is based on the following criteria:

— Performance on a sensitivity test; the candidate shall not have limitations of the sense of smell (e.g. anosmia) or hypersensitivity. Avoid heavy smokers, persons with chronic rhinitis or with allergies which affect the olfactory sense (e.g. including sneezing).

NOTE Butanol detection threshold is a good indication of sensitivity together with sensory stick method on the major odour descriptors.

— Performance over the training sessions on the reference materials; a candidate shall be able to rate with a given recognition level (e.g. 80 % for each of the references). Depending on the type of assessment performed by the panel, the reference materials can be qualitative descriptors or scale levels of intensity or both.

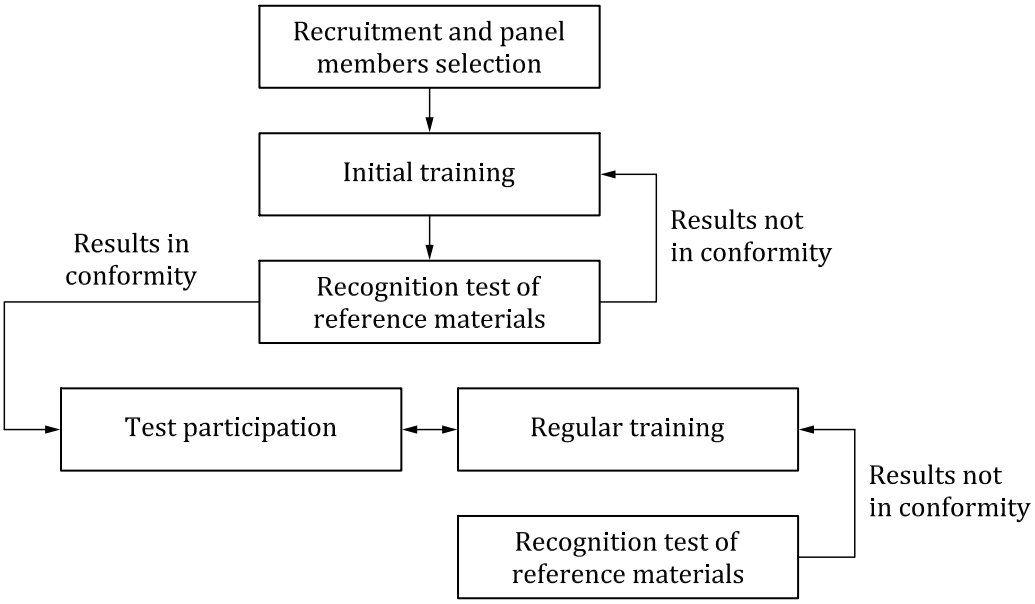


Figure 1 — Selection and training scheme for panel members

5.3.2 Behaviour of the panel members for olfactory training sessions and assessments

Before and after the olfactory assessment, the panel members shall follow some rules of conduct to increase the reproducibility and to reduce the mutual influencing.

— At least 30 min before the odour assessment, the panel member shall not smoke, eat or drink (exception: water) or chew chewing gum or the like. Avoid perfumed ambient atmosphere also. Drinking some sips of flat water can help to remove out persistent aroma.

— Impairment of olfaction by lack of body hygiene but also the use of odour-active body care products (scent, deodorant, aftershave or the like) shall not be allowed.

— The olfaction of the panel member is impaired by, e.g. illness at the day of the odour assessment. In the case of illness, the panel member shall inform the panel leader and will be excluded from the odour assessment.

— While the odour assessment is in progress, no information shall be exchanged among the panel members.

5.3.3 Panel members performance follow-up

All the panel members shall be trained on a regular basis. The training session shall be independent of the assessment session to avoid sensory fatigue or accommodation.

The training shall be done on the reference materials. The percentage of recognition shall be recorded and followed as far as the panel is active. A minimum performance is required throughout the year (e.g. 80 %).

6 Test conditions

6.1 General

General test conditions for the determination of odour emissions using test chambers are specified in ISO 12219-1 and ISO 12219-4 and shall be met. All control measures to verify the test conditions shall

be traceable to a reference standard according to the quality assurance and quality control schemes. The general requirements incorporate:

— temperature and relative humidity in the test chamber;

— supply air quality and VOC background concentration in the test chamber;

— air velocity in the test chamber;

— air exchange rate in the test chamber;

— test chamber airtightness;

— efficiency of the internal test chamber air mixing;

— ambient parameters (T, RH) of the sensory test.

6.2 Requirements related to the operation of the whole vehicle test chamber

6.2.1 General

Requirements concerning the whole vehicle test chamber, the test vehicle, the measurement procedures and the standard test procedures are given in ISO 12219-1 and shall be met. For the purposes of this document, the odour determination in the interior air of road vehicles is performed using the whole vehicle test chamber operated in the ambient mode and the parking mode. The whole vehicle test chamber shall be odourless.

6.2.2 Ambient air mode

The test conditions are specified in ISO 12219-1. The olfactory sample is taken after the optional sampling of VOCs and carbonyl compounds. The sampling positions are specified in ISO 12219-1.

6.2.3 Parking mode

The test conditions are specified in ISO 12219-1. The olfactory sample is taken after the optional sampling of VOCs and carbonyl compounds. The sampling positions are specified in ISO 12219-1.

6.3 Requirements related to the operation of the emission test chamber

Requirements concerning the emission test chamber, the test specimen, the measurement procedures and the standard test procedure are given in ISO 12219-4 and shall be met. The exhaust air at the chamber outlet shall be used for taking the olfactory sample directly prior to the optional sampling of VOCs and carbonyl compounds.

Pre-dilution of the stream of odorous gases shall be applied when there is a risk of condensation of the gas sample when stored at ambient conditions. Dynamic pre-dilution during sampling is done by mixing a flow of sample gas with a flow of neutral gas (e.g. nitrogen). The equipment for dynamic pre-dilution while sampling odours is described in Annex B. The dynamic pre-dilution device shall be regularly calibrated so that the pre-dilution factor is known. This procedure should take into account that the dilution factor shall remain stable during the sampling period.

A calibration procedure should be based on the measurement of oxygen or CO_2 at the inlet and outlet of the pre-dilution probe, if nitrogen is used as the dilution span gas. The dilution factor is then calculated from the following ratio of the tracer gas: C_{inlet}/C_{outlet} where C_{inlet} is concentration at the inlet and C_{outlet} is the concentration at the outlet.

7 Test procedure

7.1 Sampling

7.1.1 General

Sampling is performed using a sample container meeting the requirements outlined in 5.2.1. An example for an odour sampling and presentation device meeting the requirements of ISO 16000-28 is described in Annex A. The minimum sampling volume is 5 l to 10 l per bag. The panel leader should be aware that several bags may be necessary to make the different odour assessments according to Annex C or Annex D. The sample container exactly corresponds to the sampling volume to avoid any unaccounted dilution effects and shall be evacuated before sampling. Samples shall not be exposed to direct sunlight or strong daylight to minimize (photo)chemical reactions (see EN 13725). The closed container with the sampling air shall be transferred to a processing apparatus (example given in Annex A).

7.1.2 Sampling from the interior air of road vehicles

In the case of odour determination in interior air of road vehicles, the analysis comprises two samples. The odour samples are assessed without further dilution. One olfactory sample is taken just after the conditioning of the whole vehicle test chamber at (23 ± 2) °C and 50 % RH ± 10 % RH as specified by ISO 12219-1. Another sample is taken at the end of the parking mode, after sampling for carbonyls and before beginning of the driving-mode.

7.1.3 Sampling from emission test chamber air of trim components

Samples taken from the emission test chamber may be diluted before an odour assessment is performed, depending on the aim of the test (e.g. correlation with the testing of car cabin air).

If dilution is needed, a factor shall be determined (considering the exact volume of the vehicle cabin if this is known). If it is not known, an approximate factor shall be applied (an average cabin volume is between 1,5 m^3 and 3,5 m^3, depending of the size of the vehicle).

In order to perform a controlled pre-dilution of the sample, two different methods can be applied:

— Static pre-dilution during sampling is done by filling the sample bag with a known volume of dry odour-free air or nitrogen before the sampling of the odorous air. The bag should not be filled above 50 % of its maximal capacity with the clean gas. The bag is then filled with a known volume of the gas stream at the outlet of the emission chamber. The volume of gas sampled depends on the expected dilution factor to apply. This technique should not be used when a pre-dilution larger than a factor 3 is required. When using static pre-dilution, heated sample tubes shall be used to ensure that no condensation occurs before the sample enters the bag where the actual dilution takes place.

— Dynamic pre-dilution probe can be placed directly at the outlet of the emission chamber (see 6.3). It should be used even for larger pre-dilution factors.

The olfactory sample from the emission test chamber is taken directly prior to the optional sampling of VOCs and carbonyl compounds.

Dilution is required in case of high RH and/or high VOC concentrations. The dilution rate shall be recorded in the protocol.

8 Assessment

For the olfactory testing, an odourless room shall be used that exhibits constant temperature and ventilation conditions and does not impair the concentration of the sensory odour panel member by noise or the like. Prior to the odour assessment, the panel member should have stayed in the test room for approximately 5 min. Samples shall be analysed as soon as possible after sampling, at the latest 24 h after sampling. Odour assessment is carried out by at least five sensory odour panel members for each sample.

8.1 Presentation of odour samples

Two samples, stored at a controlled temperature of (23 ± 2) °C, are presented to the olfactory panel members. One bag contains the clean air, the other contains the air sample. The panel members approach the odour presentation device successively and at first sniff clean air and then the air sample. Per run, each panel member sniffs the air for 3 s to 5 s (clean air or the air sample).

8.2 Odour assessment

The odour assessment is performed according to one of Annexes C to D. Other odour assessments are also allowed, e.g. perceived intensity, hedonic tone and acceptability as described in ISO 16000-28. The assessment method finally chosen for the odour determination shall be defined by the client and consignee prior to the assessment.

For any rating of the odour sample, each panel member shall smell the odour twice, the first presentation to vote on the form and the second to confirm or adjust the vote. The panel member shall provide only one value for the characterization.

If different kinds of rating shall be performed on the same sample, it is better to organize the rating on each scale in separate sessions or to provide enough time to let the panel vote successively on the different scales (considered as different trials).

9 Test report

The test report shall contain the following data:

— chosen odour evaluation method;

— name and address of the test laboratory;

— name and address of the customer;

— unambiguous designation(s) for identification of the test specimen/component;

— testing and sampling conditions (testing period, temperature, dilution); ambient conditions of the testing room (temperature);

— time, type and duration of sampling;

— brief description of the analysis method and of the evaluation criteria;

— participating sensory odour panel members;

— types of submission sample volumes (sample containers);

— a reference to this document, i.e. ISO 12219-7;

— deviations from the standard and particularities occurring during the test;

— individual results of the participating sensory odour panel members;

— overall result of the olfactory test;

— date and signature.

10 Quality control

An appropriate level of quality control shall be employed, including verification that:

— the room for the sensory test is compliant to the requirements in terms of background odour and ambient conditions [(23 ± 2) °C];

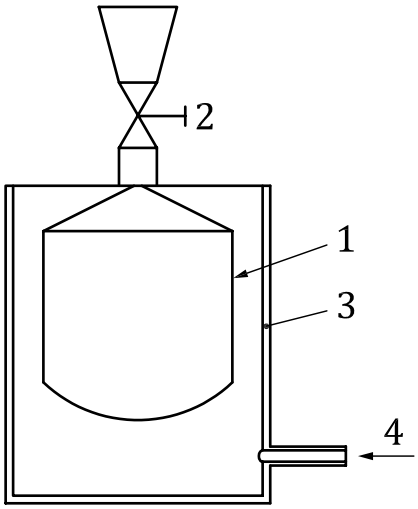
— the panel members know and approve the code of rules;

— the sensitivity test results are documented for all the panel members;

— the performance results of the panel member shall be recorded according to 5.3.3.

Annex A
(informative)

Description of a possible sampling and presentation device for air samples



Key

1 sampling bag
2 funnel with on/off valve
3 cylinder
4 clean air inlet

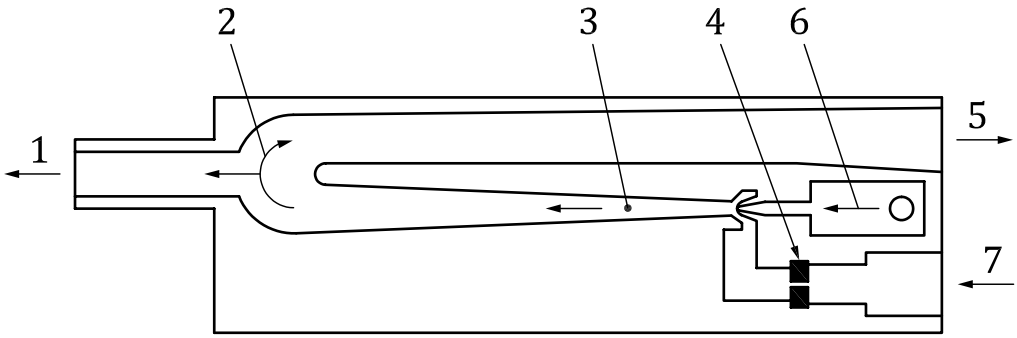
Figure A.1 — Schematic illustration of an odour sampling and presentation device

NOTE In ISO 16000-28:2012, D.2, an example of a cleaning procedure is provided, using a specific polyvinyl fluoride, i.e. Tedlar®[1]. For further information on this procedure, see ISO 16000-28.

1) Tedlar® is an example of a suitable product available commercially. This information is given for the convenience of the users of this document and does not constitute an endorsement by ISO of this product. Equivalent products may be used if they can be shown to lead to the same results.

Annex B
(informative)

Dilution device



Key

1 outlet for diluted air to the air sampler
2 pressure compensation to sampling point
3 gas jet pump
4 measurement point for sample volume flow
5 outlet for excess air
6 inlet for nitrogen or neutral gas
7 inlet for sample air

Figure B.1 — Example of a dilution device used to make an online-controlled dilution during sampling

Annex C
(informative)

Intensity assessment

C.1 Preparation of the odour intensity scale

The range consists in a six-level scale from 1 (no odour) to 6 (unbearable odour). The description of each level is behavioural to determine an acceptability limit. To avoid a natural discrepancy between panel members and/or panels, cultures, etc., a set of aqueous 1-butanol solutions correspond to the different odorous grades. See Table C.1.

Table C.1 — Odour intensity scale

Grades	Solution	Concentration of aqueous 1-butanol solution ml/l
1	S1[a]	0
2	S2	0,01
3	S3	0,05
4	S4	0,5
5	S5	2,5
6	S6	10

[a] Instead of S1, 10 ml of demineralized and odourless water is directly used to spike the 10 l bag for grade 1.

The different solutions are prepared in flasks with the appropriate volume of (1-butanol) completed with demineralized and odourless water.

Inject 10 ml of a solution (e.g. S3) into a clean 10 l bag, with a syringe for example, for the corresponding grade (e.g. grade 3). The bag is filled with additional inert gas (nitrogen or clean air). The equilibrium between the liquid and gas phase is reached by keeping the bag at the control room temperature for a minimum of 4 h.

If not used directly, store all standard solutions in tightly capped containers in a refrigerator and protected from light. Allow them to equilibrate to room temperature before use. They should be replaced after 2 weeks.

C.2 Panel selection and training

The use of reference materials with known intensity values allows panel members to be selected objectively based on performance criteria. A new candidate shall be able to assess the right intensity level with 80 % success (i.e. they assign the correct intensity level four times out of five).

During the initial training, the different intensity levels are presented to the candidate with the corresponding value (supervised). In a second step, six different bags of the intensity standards (one at each level) are presented to the candidate. Then the candidate shall order them from the weakest to the strongest. At the end of the initial training and during the regular training sessions, each panel member should be asked to assess at least two different scale levels blindly (unsupervised).

The presentation of the intensity grades to the panel shall be performed according to the same procedure used for samples and by using the same presentation device (see 5.2.3).

C.3 Rating on the odour intensity scale

The odour characteristic addressed in this document is based on a scale of increasing grades of intensity (mainly based on VDA 270). This scale consists of six grades, half grades are permitted. See Table C.2.

Table C.2 — Scale of grades for olfactory assessment of air samples

Assessment grade	Odour intensity	Criterion half grades
1	No perceptible odour	
1,5		More odorous than 1
2	Slightly perceptible odour	
2,5		More odorous than 2
3	Clearly perceptible odour	
3,5		More odorous than 3
4	Intensive odour, sensed even when the person's attention is drawn to something else	
4,5		More odorous than 4
5	Very intensive odour which occupies the person's attention and interferes with its other activities	
5,5		More odorous than 5
6	Intensive and unbearable odour that puts people off	

NOTE The olfactory assessment is presented as arithmetic mean of the single grades. The arithmetic mean is rounded up using half grades.

EXAMPLE $\frac{1}{4}\left(2{,}5 + 3{,}5 + 3{,}0 + 4{,}0\right) = 3{,}25$; the final result of the assessment is rounded up to 3,5. Comments on the air quality and/or the olfactive character are welcome and will also be documented.

If the individual odour assessment of a panel member differs more than ±1 to the average, the value of the corresponding panel member is excluded and the average is recalculated. If more than one member shall be excluded, the test shall be repeated with other panel members.

Annex D
(informative)

Further odour evaluation assessments

NOTE For perceived intensity, hedonic tone and acceptability evaluation, see respective sections of ISO 16000-28.

D.1 Olfactory notes and chemical descriptors for characterization

It can be interesting to describe odours further than only the intensity level. Odours are characterized by poles and one or several olfactory reference molecules corresponds to each pole. A set of olfactory notes and chemical descriptors typical of automotive products are proposed in Table D.1[6].

Table D.1 — Olfactory reference molecules adapted for automotive products

Pole	Molecule	CAS number	Dilution in pure ethanol mass %
Amine-like	Trimethylamine	75–50–3	0,1
Sulfur-like	Dimethylsulfide	75–18–3	0,01
Rancid	Butanoic acid	107–92–6	0,01
Fat	Decadienal	25152–84–5	0,01
	Undecanal	112–44–7	0,1
Vinegar	Acetic acid	64–19–7	1
Solvent	Ethyl acetate	141–78–6	5
	Styrene	100–42–5	0,05
Fruity	Ethyl isobutyrate	97–62–1	5
Sweet	Benzaldehyde	100–52–7	0,9
	Delta-decalactone	705–86–2	1
	Ethyl maltol	4940–11–8	0,5
Woody	Cedryl acetate	77–54–3	5
Humus-like	Geosmin	16423–19–1	0,001
	Isobutylquinolein (IBQ)	65442–31–1	0,1
Fecal	Scatol	83–34–1	0,001
Pyro-burned	Methylcyclopentenolone (MCP)	80–71–7	0,05
	Acetyl pyrazine	22047–25–2	0,05
Phenolic	Guajacol	90–05–01	1
Chlorated	Sodium hypochlororite	7681–52–9	0,01
Rubber	Benzothiazole	95–16–9	0,1

Odour reference solution should be prepared in a glass bottle which has been beforehand cleaned (with demineralized water and ethanol). The concentration of each reference is given in Table D.1 (mass % in ethanol).

For the training of the panel members to recognize references, the panel leader soaks enough paper strips for each panel members in the same time in the bottle. Then he presents the paper strips to the panel members who smell it and write the name of the referent on the training sheet. Repeat this procedure for each reference molecule.

D.2 Odour pleasantness

The fact that the odour is pleasant or not can be considered as informative for certain users of this document. The following range of verbatim can be used to complete the intensity of the odour:

— very pleasant;

— pleasant;

— slightly pleasant;

— neutral;

— slightly unpleasant;

— unpleasant;

— very unpleasant

NOTE Notice that this notion is subjective and dependant on the respective panel member.

Annex E
(informative)

Panel selection using sniffing sticks

E.1 General

A panel member is to be tested for normal olfactory functioning before the first odour test. Panel members who did not pass the test are allowed to repeat it, for example following an illness. Only panel members with normal olfactory function should be used for odour measurements.

E.2 Screening of olfactory function with sniffing sticks

To test the olfactory function of the panel members, the "Sniffin' Sticks[2)]" test can be used. The test relies on pen-like odour dispensing devices[7][8].

2) Sniffin' Sticks test is an example of a suitable product available commercially. This information is given for the convenience of the users of this document and does not constitute an endorsement by ISO of this product. Equivalent products may be used if they can be shown to lead to the same results.

Annex F
(informative)

Panel selection using olfactometry

F.1 General

A panel member is to be tested for normal olfactory functioning before the first odour test. Panel members who did not pass the test are allowed to repeat it, for example following an illness. Only panel members with normal olfactory function should be used for odour measurements.

F.2 Testing olfactory function with olfactometry in accordance with EN 13725

Measurements at the olfactometer may be carried out in accordance with EN 13725. In order to select panel members with average odour sensitivity, it is intended that results be obtained from at least 10 dilution series with test gas *n*-butanol (of spectroscopic grade) in nitrogen (CAS No. 71-36-3). The data for each individual panel member is to be collected on three different, non-consecutive days. The panel member is expected to satisfy the following eligibility requirements (see EN 13725). The measurement performance of each panel member is to be recorded and kept. To this end, at least three dilution series with this reference substance is to be measured with each panel member about every 6 months. The results of this reference measurement are used to supplement and evaluate the measurement performance of the panel member in question. Evaluation is carried out by calculating the above-mentioned selection parameters from at least the 10, and at most the 20, most recent dilution series (see EN 13725). After this, the results are to be compared with the selection criteria. If the panel member fails to satisfy the conditions, he/she is excluded from all future measurements until he/she again satisfies the conditions.

F.3 Supplementary tests

To test and train the powers of discrimination of panel members, it is advisable to apply additional test methods[7][9][10][11][12][13][14].

a) The quality test checks whether or not the panel member is capable of correctly assigning given terms to the odour quality of certain common odorants[13].

b) For the odour intensity test, the panel member is expected to correctly rank, in ascending order of intensity, odour samples whose odorant concentration differs by a factor of 10 in each case (smelling bottles)[12][14].

Annex G
(informative)

Panel selection using five standard odorants

G.1 General

In order to select a panel member having normal olfactory function, panel members are to be screened using five standard dilution liquids. These standard odorants are called the “T&T olfactometer”.

G.2 Five standard odorants

The five standard odorants are: β-phenyl ethyl alcohol, methyl cyclopentenolone, isovaleic acid, γ-undecalactone and skatole. Table G.1 shows the concentration (the dilution liquid is odour-free liquid paraffin) and odour quality of these five standard odorants.

Table G.1 — Mass fraction and odour quality of the five standard odorants

Name of odorant	CAS number	Mass fraction %	Qualities of the odour
β-phenyl ethyl alcohol	60–12–8	10 to 4,0	Odour of rose; light, sweet odour
Methyl cyclopentenolone	8–71–7	10 to 4,5	Burnt odour, caramel odour
Isovaleric acid	503–74–2	10 to 5,0	Putrid odour, odour of long-worn socks, odour of sweat, odour of fermented soybeans
γ-undecalactone	104–67–6	10 to 4,5	Odour of canned peaches; heavy, sweet odour
Skatole	83–34–1	10 to 5,0	Odour of vegetable garbage, oral odour, repulsive odour

G.3 Procedure of test

a) The method is used as the procedure for the panel screening test.

b) Five odour-free papers (size: 14 cm × 7 mm) are prepared. The panel leader soaks the top 1 cm of two papers in a standard odorant liquid. The other three papers are soaked in the odour-free liquid paraffin using the same method. The five papers are presented to each panel member. After sniffing each paper, the panel member identifies the two papers which contain the odour.

c) Each panel member is to be tested for the five standard odorants using this same test method.

d) The panel member who answers all five standard odorants completely correctly is to be deemed to have passed the panel screening test.

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