
Indoor air —

Part 28:

**Determination of odour emissions
from building products using test
chambers**

iTeh **STANDARD PREVIEW**

Air intérieur —

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*Partie 28: Détermination des émissions d'odeurs des produits de
construction au moyen de chambres d'essai*

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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 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 (standards.iteh.ai)

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This second edition cancels and replaces the first edition (ISO 16000-28:2012), which has been technically revised. The main changes compared to the previous edition are as follows:

- besides acceptability and perceived intensity, the hedonic tone is described as odour characteristic;
- a more detailed description of the comparative scale, including information on set-up, check-up and calibration devices;
- recommendation on panel sizes for the different testing procedures (acceptability, perceived intensity and hedonic tone);
- procedure in case of failing the confidence interval.

A list of all parts in the ISO 16000 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.

Introduction

Odour evaluation is a complementary method to the chemical testing of emissions from building products and materials.

The determination of odour acceptability, intensity and hedonic tone of emissions from building products and materials using test chambers has objectives such as:

- to provide manufacturers, builders and end users with data useful for the evaluation of the odour impact of building products and materials on the indoor air quality;
- to promote the development of improved products.

The method can also be used for furnishings and consumer products. For this purpose, a suitable exposure scenario (according to the reference room defined in EN 16516) needs to be defined.

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Indoor air —

Part 28:

Determination of odour emissions from building products using test chambers

1 Scope

This document specifies a laboratory test method using test chambers defined in ISO 16000-9 and further specified in EN 16516 and evaluation procedures for the determination of odours emitted from building products and materials.

Sampling, transport and storage of materials under test, as well as preparation of test specimens are described in ISO 16000-11 and further specified in EN 16516.

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

EN 16516, *Construction products: Assessment of release of dangerous substances — Determination of emissions into indoor air*

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

acceptability

assessment of an odour emission into indoor air which can be ascertained according to a scale ranging from “clearly acceptable” to “clearly unacceptable” set by value on a defined evaluation scale

3.2

anosmia

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

3.3

building product

product for incorporation in a permanent manner in construction works

Note 1 to entry: A building product can be solid, liquid or combined (see ISO 16000-11).

3.4

hedonic tone

odour (3.5) quality, which can be ascertained on a scale ranging from “extremely pleasant” to “extremely unpleasant”

3.5

odour

sensory attribute perceptible by the olfactory organ on sniffing certain volatile substances

3.6

odour sample

air sample collected from the test chamber outlet in containers and being tested for its *odour* (3.5)

3.7

background odours

odours (3.5) released by equipment or location that might disturb the test procedure

3.8

panel leader

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

3.9

panel member

person who is accepted to assess odours according to a defined method

Note 1 to entry: Depending on the method panel members may need to be trained.

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3.10

perceived intensity

parameter to assess the strength of an odour based on a comparative scale

Note 1 to entry: See ISO 5492:2008, 2.8, 2.9 and 4.30.
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3.11

recovery room

room where the panel members can recover and acclimatize before and between *odour* (3.5) assessments

3.12

sample container

device for collection and transport of the *odour* (3.5) sample from the test chamber to the test room and for presentation of the sample to the *panel members* (3.9)

3.13

sensory adaption

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

[SOURCE: see ISO 5492:2008, 2.6]

3.14

sensory odour panel

group of trained or untrained *panel members* (3.9) performing the sensory assessment of the *odour* (3.5) emission from *building products* (3.3) or materials

[SOURCE: see ISO 5492:2008, 1.9]

3.15

test room

room where the *odour* (3.5) assessment takes place

3.16**test specimen**

part of a sample specially prepared for emission testing in a test chamber in order to simulate the *odour* (3.5) emission behaviour of the material or product being tested

4 Symbols and abbreviated terms

For the purposes of this document, the following symbols apply (see ISO 16000-9).

Symbol	Meaning	Unit
L	product loading factor	square metres per cubic metre
n	air change rate	changes per h
$q_{V,A}$	area specific air flow rate (n/L)	cubic metres per square metre and h
A	surface area	square metre
Π	perceived intensity	pi
$q_{V,c}$	volumetric supply air flow rate	cubic metres per h

For the purposes of this document, the following abbreviated terms apply.

PVF polyvinyl fluoride

PET polyethyleneterephthalate

rH relative humidity

VOC volatile organic compound

PAD photoacoustic detector [oSIST ISO 16000-28:2021](https://standards.iteh.ai/catalog/standards/sist/82960e17-966c-4a1d-842b-86cb91ef337d/osist-iso-16000-28-2021)
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PID photo ionization detector [86cb91ef337d/osist-iso-16000-28-2021](https://standards.iteh.ai/catalog/standards/sist/82960e17-966c-4a1d-842b-86cb91ef337d/osist-iso-16000-28-2021)

FID flame ionization detector

5 Principle

The odour emission from building products and materials is measured using a sensory odour panel. The odour determination may be performed in parallel to chemical emission measurements in accordance with ISO 16000-9 and further specified in EN 16516. The odour characteristics addressed in this part of ISO 16000 are the acceptability, the perceived intensity and the hedonic tone. Depending on the measurement task, these odour characteristics or a combination of those can be determined.

6 Test facilities**6.1 General**

A facility designed and operated to determine odours emitted from building products and materials consists of an emission test chamber containing the test specimen. The emission test chamber shall contain a clean air generation and humidification system, an air mixing system and monitoring and control systems to ensure that the test is performed to indicated conditions in accordance with ISO 16000-9 and further specified in EN 16516.

The standard procedure for odour assessment is carried out by using sample containers (see 6.3.3). Alternatively, direct assessment from the outlet of the emission test chamber is possible if sufficient air flow is assured (see 6.3.1). In this case the outlet shall be fitted with a funnel.

NOTE Due to the requirements of 6.3.1 sufficient air flow is only possible if the following requirements are met: test chambers with more than 4,3 m³ volume at 0,5 h⁻¹ air change rate.

If the odour assessment is carried out directly from the outlet of the chamber, the chamber material shall be non-transparent, or the chamber shall be covered in order to avoid the panel members being influenced by visual recognition of the material in test.

The test room in which the sensory assessment is performed shall conform with the general requirements described in 7.2. The panel members shall not be influenced by the working environment (light, acoustics, background odours).

6.2 Test room and recovery room

The test room and the recovery room shall be odour neutral, sufficiently large and unobtrusively designed. Contamination of the room air by any source, e.g. by coatings, wall and floor coverings, furniture, shall be prevented. In preparation for sensory testing, the air in the test room and the recovery room shall be assessed for acceptability or perceived intensity (7.2.1), and the requirements set out in 7.2.2–7.2.4 shall be complied with.

6.3 Odour sampling and assessment devices

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6.3.1 General

The odour sampling and assessment devices shall ensure that

- the air flow is sufficient to guarantee that the panel members inhale only sample air during the assessment, and
- significant adsorption on the surfaces is avoided and the interface has no emissions of its own to interfere with the sample air.

6.3.2 Funnel

The odour evaluation interface consists of a funnel, which is connected to the outlet of the sample presentation system or to the outlet of the emission test chamber. The funnel and the inner surfaces of the connection ducting shall be composed of glass or surface-treated (polished) stainless steel. The air flow at the outlet from the funnel to the panel member shall be between 0,6 l/s to 1 l/s and shall be constant for the duration of each test session. The design of the measurement funnel ensures that no ambient air is sucked in and mixed with the sample air. An opening angle (both sides) of up to 12° ensures a homogeneous outflow of sample air (see Figure 1). To prevent contamination of the test room air, the excess air flow shall be extracted above the funnel.

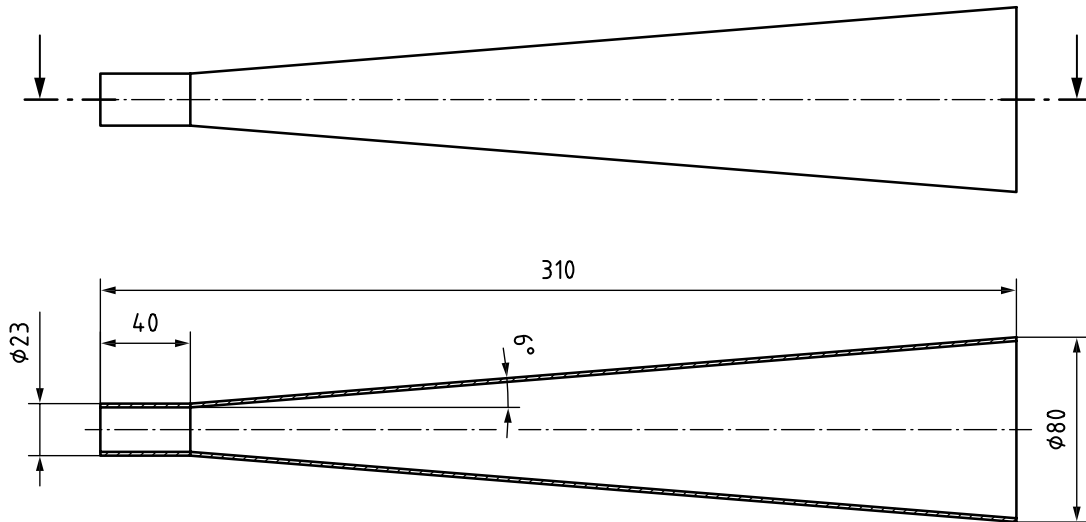


Figure 1 — Schematic of a standard funnel

6.3.3 Sample containers

The following materials are suitable to be used as a sample container:

- polyethylene terephthalate (PET, Nalophan®¹⁾;
- polyvinyl fluoride (PVF, Tedlar®²⁾).

All batches of container material shall be evaluated for unusual emissions/background odours before first use. PVF/Tedlar® containers need to be conditioned before first use, see 8.4 and Annex C.

Sample containers made of PET shall not be reused.

Other container materials may be used if the performance is tested according to Annex C.

6.3.4 Sample presentation system

A sample presentation system is a device designed for providing odour samples from the sample containers to the interface (funnel) for odour testing. The size of the sample presentation system is based on the size of the sample containers. The system shall be designed to minimise influence on the odour samples and test room conditions. Any parts in direct contact with the odour sample shall be made from glass, polished stainless steel or polytetrafluoroethylene (PTFE).

NOTE For an example of a suitable sample presentation system see Annex C.

6.4 Comparative scale

6.4.1 General

A comparative scale offers at least six different reference stimuli by means of presentation funnels. The reference odorant is acetone (quality grade $\geq 99,8\%$). The comparative scale is made up of three basic parts: clean air ducts, acetone source and dosing device. Only materials of very low odour emission and

1) Nalophan® is the trade name of a product of Kalle Nalo GmbH. 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) Tedlar® is the trade name of a product. 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.

absorption, such as glass, polished stainless steel or polytetrafluoroethylene (PTFE) shall be employed for the parts that come in contact with sample air to avoid influencing the stimuli. The background odour of the comparative scale, (i.e. the comparative scale is operated with supply air), must not exceed the requirements in [Table 1](#) (see [7.2.1](#)).

The flow rate and the concentration of the reference odourant shall be constant both over time as well as locally within the funnel outlet and independent of the ambient conditions. The flow rate at the outlet of the funnel shall be between 0,6 l/s and 1,0 l/s and shall be constant for the duration of each test session. The funnels shall meet the requirements of [6.3.2](#). The relative humidity and the temperature of the mixture of air and reference odourant shall be kept constant and shall meet the requirements for the test chamber 23 °C and 50 % RH (± 3 K and ± 10 % rH). A schematic of a possible comparative scale is given in [Figure 2](#).

6.4.2 Set up of the comparative scale

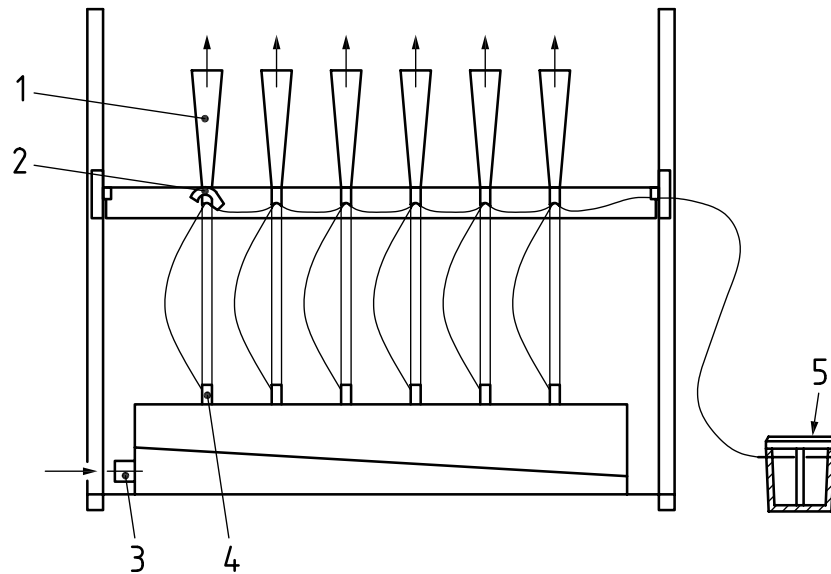
The comparative scale is connected to a supply of odour-neutral air. To cover the whole intensity perception range of indoor odour samples the comparative scale shall be made of at least the six fixed levels 0 pi, 3 pi, 6 pi, 9 pi, 12 pi, 15 pi. The test setup shall also provide neutral air to the panel members. The presented concentrations shall be kept constant over the total measurement period. Between 0 and 10 pi, a maximum deviation of ± 10 mg/m³ ($\pm 0,5$ pi) is acceptable. From 10 pi on, a maximum deviation of ± 20 mg/m³ (± 1 pi) is acceptable.

The scale levels of the comparative scale are defined by the following frame conditions:

- 0 pi is assigned to an acetone concentration of 20 mg/m³;
- the concentrations for 1 pi to 20 pi can be derived by means of a linear graduation of the acetone concentrations, i.e. an increase of 20 mg/m³ corresponds to an increase of 1 pi;
- 15 pi correspond to an acetone concentration of 320 mg/m³. If necessary, the scale can be extended upward. Linearity is shown up to 380 mg/m³ by [\[37\]](#), [\[38\]](#). National occupational exposure limits shall be considered.

NOTE 2 All concentrations refer to a temperature of 23 °C and 50 % RH (± 3 K and ± 10 % rH and atmospheric pressure).

If a reference odour other than acetone is chosen it shall be proven that the odours' pi levels match the pi levels of acetone. As concentration for the 0 pi level the odour threshold of the reference odour is recommended. With reference odours other than acetone, it cannot be assumed that there is a linear relationship between the magnitude of chemical stimulus (odour concentration) and the associated magnitude of the odour intensity.

**Key**

- 1 funnel
- 2 dosing valve
- 3 air inlet
- 4 acetone injection
- 5 acetone source (in cool box with $10^{\circ}\text{C} \pm 2^{\circ}\text{C}$)

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Figure 2 — Schematic of a possible comparative scale

[osIST ISO 16000-28:2021](https://standards.iteh.ai/catalog/standards/sist/82960e17-966c-4a1d-842b-06eb91e1537c/osist-iso-16000-28-2021)

6.4.3 Check-up of the comparative scale

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The concentration at the funnel outlet of the comparative scale shall be checked every work day and whenever settings are adjusted. When using needle valves to adjust the acetone gas flow, additional checking of the acetone concentration during or between the assessments is recommended.

The concentration at the funnel shall be measured in the middle of the funnel opening and 1 cm to 3 cm deep from the upper rim of the funnel. For this purpose, an adaptor fixing the position of the end of the sampling line is helpful.

6.4.4 Measurement of acetone concentration and calibration of the measurement device

The comparative scale provides acetone concentrations over a large range. Therefore, a suitable detector covering the entire range (e.g. 0 mg/m^3 to 320 mg/m^3 for 0 pi to 15 pi) is needed for the calibration of each individual concentration. PAD, PID and FID are possible devices for the quick determination of the acetone concentrations. The used detector/analyzer needs to be calibrated using acetone before use.

FID often feature an inbuilt oxygen compensation which can cause offsets with test gases supplied in pure nitrogen — synthetic air is often better suited for such instruments. PID are sensitive to water content; a calibration with humidified test gas is therefore required. Substantial deviations between different detectors calibrated with the same calibration gas were observed. Sufficient cross-checks with other analytical methods are recommended. PAD are sensitive towards the water content. The water content of the analyzed air has to be measured simultaneously and used for an automatic correction of the measured values.