INTERNATIONAL STANDARD

ISO 16000-30

First edition
2014-09-01

Indoor air —

Part 30: Sensory testing of indoor air

Air intérieur —

Partie 30: Essai sensoriel de l'air intérieur

Reference number
ISO 16000-30:2014(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 146, *Air quality*, Subcommittee SC 6, *Indoor air*.

ISO 16000 consists of the following parts, under the general title *Indoor air*:

— *Part 1: General aspects of sampling strategy*

— *Part 2: Sampling strategy for formaldehyde*

— *Part 3: Determination of formaldehyde and other carbonyl compounds in indoor air and test chamber air — Active sampling method*

— *Part 4: Determination of formaldehyde — Diffusive sampling method*

— *Part 5: Sampling strategy for volatile organic compounds (VOCs)*

— *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*

— *Part 7: Sampling strategy for determination of airborne asbestos fibre concentrations*

— *Part 8: Determination of local mean ages of air in buildings for characterizing ventilation conditions*

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

— *Part 10: Determination of the emission of volatile organic compounds from building products and furnishing — Emission test cell method*

— *Part 11: Determination of the emission of volatile organic compounds from building products and furnishing — Sampling, storage of samples and preparation of test specimens*

— *Part 12: Sampling strategy for polychlorinated biphenyls (PCBs), polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) and polycyclic aromatic hydrocarbons (PAHs)*

— *Part 13: Determination of total (gas and particle-phase) polychlorinated dioxin-like biphenyls (PCBs) and polychlorinated dibenzo-*p*-dioxins/dibenzofurans (PCDDs/PCDFs) — Collection on sorbent-backed filters*

— *Part 14: Determination of total (gas and particle-phase) polychlorinated dioxin-like biphenyls (PCBs) and polychlorinated dibenzo-*p*-dioxins/dibenzofurans (PCDDs/PCDFs) — Extraction, clean-up and analysis by high-resolution gas chromatography and mass spectrometry*

— *Part 15: Sampling strategy for nitrogen dioxide (NO_2)*

— *Part 16: Detection and enumeration of moulds — Sampling by filtration*

— *Part 17: Detection and enumeration of moulds — Culture-based method*

— *Part 18: Detection and enumeration of moulds — Sampling by impaction*

— *Part 19: Sampling strategy for moulds*

— *Part 20: Detection and enumeration of moulds — Determination of total spore count*

— *Part 21: Detection and enumeration of moulds — Sampling from materials*

— *Part 23: Performance test for evaluating the reduction of formaldehyde concentrations by sorptive building materials*

— *Part 24: Performance test for evaluating the reduction of volatile organic compound (except formaldehyde) concentrations by sorptive building materials*

— *Part 25: Determination of the emission of semi-volatile organic compounds by building products — Micro-chamber method*

— *Part 26: Sampling strategy for carbon dioxide (CO_2)*

— *Part 28: Determination of odour emissions from building products using test chambers*

— *Part 27: Determination of settled fibrous dust on surfaces by SEM (scanning electron microscopy) (direct method)*

— *Part 29: Test methods for VOC detectors*

— *Part 30: Sensory testing of indoor air*

— *Part 31: Measurement of flame retardants and plasticizers based on organophosphorus compounds — Phosphoric acid ester*

— *Part 32: Investigation of buildings for pollutants and other injurious factors — Inspections*

The following parts are under preparation:

— *Part 33: Determination of phthalates with gas chromatography/mass spectrometry (GC/MS)*

— *Part 34: Strategies for the measurement of airborne particles (PM 2,5 fraction)*

— *Part 35: Measurement of polybrominated diphenylether, hexabromocyclododecane and hexabromobenzene*

— *Part 36: Test method for the reduction rate of airborne bacteria by air purifiers using a test chamber*

Introduction

Buildings are constructed airtight for reasons of energy saving and efficiency. The natural ventilation by infiltration and windows in airtight buildings does not ensure a sufficient air exchange for the well-being of the occupants and to remove moisture. Indoor odours are more frequently becoming a cause for user complaints. The sources of odours are mainly found inside, but odours also can be brought in from outside the building. These include construction products, materials for interior design, and furnishing including their emission and decomposition products, technical equipment, structural damage, animals, and the occupants themselves. In closed rooms, persistent odours, the existence of which occupants cannot control, are mostly considered objectionable. Exposure to such odours can lead to a decline in both the well-being and productivity of the occupants.

This part of ISO 16000 describes the procedure for the determination of indoor odours with trained or untrained panels. It describes assessment methods and planning, preparation, and execution of the olfactory tests. It also includes criteria and requirements for selection of panel members.

The methods can be applied to sensory evaluation with regard to acceptability, intensity, and hedonics. Olfactory tests of indoor air can either be conducted on site or in a laboratory. In the latter case, air is collected from the site and transported to the laboratory in sampling containers. It is necessary to record the physical conditions in the room during the testing or the sampling of the air, as they can influence the perception of the odours.

Odour testing can be required for hygiene evaluations of indoor air. The evaluation of the reasonability of an odour is an essential part of such an examination.

For the overall assessment of the indoor air, it is recommended that chemical tests be carried out in addition to the sensory tests. This is due to the fact that sensory tests do not provide information about possible health hazards. Chemical analyses are not discussed in this part of ISO 16000.

This part of ISO 16000 is based on VDI 4302-1[12] and VDI 4302-2.[13]

Indoor air —

Part 30: Sensory testing of indoor air

1 Scope

This part of ISO 16000 specifies sensory testing and the evaluation of indoor odours using human panels. Sensory testing can be performed on site or in laboratories; in the latter case, by means of air in sampling containers which were collected from the site.

The olfactory testing is appropriate for office and administration buildings, assembly halls, residential buildings, and other habitable rooms in which the comfort and health of the occupants is of interest. The test criteria in this part of ISO 16000 are not applicable to factory buildings and workshops or other rooms in which odours unavoidably stem from the production processes (kitchens, bakeries etc.). If an odour evaluation of such rooms is undertaken without the odour-producing processes, it is necessary to take into account that there is a possibility that the processes have influenced and changed the odour of the room through the adsorption of odorous compounds.

Sensory odour tests of indoor air can meet a variety of objectives. These include finding the cause(s) of unpleasant or objectionable odours, determining the reasonability of odours and the usability of affected rooms, and inspecting the results of renovation work. When seeking the cause of odours, it is wise to conduct additional laboratory tests on samples of the component materials according to ISO 16000-28. In the process of locating odour sources by means of olfactory tests, it is necessary to take into account the fact that the odour compounds can accumulate on other surfaces, which exacerbates the problem.

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

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 554, *Standard atmospheres for conditioning and/or testing — Specifications*

ISO 5496, *Sensory analysis — Methodology — Initiation and training of assessors in the detection and recognition of odours*

ISO 16000-8, *Indoor air — Part 8: Determination of local mean ages of air in buildings for characterizing ventilation conditions*

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

EN 13725, *Air quality — Determination of odour concentration by dynamic olfactometry*

3 Terms, definitions, symbols, units, and abbreviations

3.1 Terms and definitions

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

3.1.1
odour
pleasant or unpleasant smell caused by chemical compounds emitting to indoor air

[SOURCE: ISO 16000-28:2012, 3.1.1, modified]

3.1.2
acceptability
assessment of an odour immission into indoor air, which can be ascertained according to a scale ranging from “clearly acceptable” to “clearly unacceptable” set by values on a defined evaluation scale

[SOURCE: ISO 16000-28:2012, 3.1.2]

3.1.3
perceived intensity
parameter to assess odour intensity based on a comparative scale

[SOURCE: ISO 16000-28:2012, 3.1.3]

3.1.4
hedonic tone
odour effect which can be ascertained according to a scale ranging from “extremely pleasant” to “extremely unpleasant”

[SOURCE: ISO 16000-28:2012, 3.1.4]

3.1.5
panel selection
procedure to determine which persons are qualified as panel members

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

3.1.6
sensory fatigue
form of adaptation in which a decrease in sensitivity occurs

[SOURCE: ISO 16000-28:2012, 3.1.6; ISO 5492:2008, 2.7]

3.1.7
sensory adaptation
temporary modification of the sensitivity of a sense organ due to continued and/or repeated stimulation

Note 1 to entry: Sensory adaption is reversible.

[SOURCE: ISO 16000-28:2012, 3.1.7]

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

[SOURCE: ISO 16000-28:2012, 3.1.8]

3.1.9
sensory odour panel
group of trained or untrained assessors performing the sensory assessment of the odour emission

[SOURCE: ISO 16000-28:2012, 3.1.9]

3.1.10
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]

3.1.11
panel member
person who is accepted to assess the odours

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

3.1.12
untrained panel
panel consisting of members who assess the odour emission without any training on odorous references

[SOURCE: ISO 16000-28:2012, 3.1.12]

3.1.13
trained panel
panel consisting of members who are trained to judge the intensity of odour emission

[SOURCE: ISO 16000-28:2012, 3.1.13]

3.1.14
odour quality
comparative description of an odour with olfactory experience

EXAMPLE "There is a smell" or, "It smells burnt, rotten", etc.

3.1.15
comparative scale
reference substance/air-mixtures with increasing concentration of the reference substance

Note 1 to entry: The mixtures are assigned to a defined scale by olfactory assessment.

Note 2 to entry: The mixtures are labelled according to the olfactory assessment by the sensory odour panel member to enable a comparative odour assessment of the sample air.

3.2 Symbols, units, and abbreviations

Symbol	Name	Unit
Π	perceived intensity	odour intensity unit pi
n	total number of members of the sensory odour panel	–
n_d	number of dissatisfied people	–
PD	percentage of dissatisfied people	%

4 Objectives of odour evaluations and boundary conditions

4.1 General

Before indoor air measurements are carried out, the objective of such measurements shall be clearly defined and a list of possible objectives is given in the following:

— elucidating the reasons for complaints, optionally with special regard to guide values for indoor air;

— determination of the odour intensity occurring under special conditions;

— identification of odour sources;

— inspection of the success of restoration measures.

Depending on the objective, different environmental conditions shall be maintained or recorded before and during measurements. These environmental conditions principally relate to the ventilation condition, the room temperature, and the relative humidity.

4.2 Clarification of the reasons for complaints from room occupants

In many cases, indoor air analyses are initiated by various types of complaints expressed by the room occupants. Complaints of this type can range, e.g. from the perception of unknown and frequently unpleasant odours, to headaches, nausea; or irritation of the nose, throat, or eyes.

For odour evaluations in naturally ventilated rooms, an intensive ventilation for 15 min is performed. Afterwards, doors and windows are kept closed for about 8 h (optimally overnight) prior to measurement, without additional sealing measures such as taping over window and door gaps. Measurements are then performed (see ISO 16000-6) with the room still closed off. To obtain information on the effectiveness of hourly intensive ventilation, the room is ventilated intensively after measuring by opening doors and windows for 5 min. Doors and windows are reclosed, and after a waiting time of 1 h, further measurement is performed.

When rooms which are ventilated by mechanical ventilation or air conditioning (VAC) systems are investigated, the system shall be operated according to the building codes or other normative guidelines; and the required ventilation shall be in operation at least for 3 h before the sampling is started. The functioning of the ventilation system should be recorded or measured (see ISO 16000-8). For rooms operated according to specified ventilation instructions (for example, schools and kindergartens where windows have to be opened after specified time periods), one complete and typical operating cycle has to be carried out prior to measurement. If room occupants make complaints during unusual conditions, for clarification, measurements should also be performed under these conditions. The functioning of the ventilation system shall be recorded or measured (see ISO 16000-8). The investigated spaces should preferably be operated according to the building codes or design guidelines, and, especially in complaint cases, any deviation shall be the reported. To obtain representative indoor air measurements, it is essential to perform the measurement under the climate conditions under which the room being investigated is usually used.

4.3 Determination of odour intensity occurring under special conditions

In some cases, it can also be of interest to obtain information on the odour intensity under special conditions. Such special conditions can occur, firstly, if a room is used under unfavourable climatic conditions, for example, at temperatures or relative humidity outside the comfort region without the room occupants being able to alter this.

NOTE The conditions for thermal comfort of temperate climate are described in ISO 7730. In the case of extreme climatic conditions, ISO 7243 or ISO 7933 are available.

Secondly, the emission of odours from sources which emit temporarily, for example, when a solvent is used, can also be an unusual situation of this type.

4.4 Identification of sources

If unusual odour intensities occur, it is of interest to identify the source. The potential sources, such as building materials, interior furnishings, office materials, or cleaning agents often have typical emissions reflected in the indoor air. Therefore, it is important to know the emission characteristics of materials and products.

4.5 Checking the success of remedial activities

Measurements are made before and after completion of remedial activities. The indoor air conditions shall be selected here to ensure comparability with the initial measurements. Attention shall be paid as to whether new substances have been introduced into the interior as a result of the remediation measures chosen.

5 Principle

The principle of this part of ISO 16000 is to measure the odour in buildings using a sensory panel. Different test methods or combinations of test methods are described which differ in the questions presented to the sensory odour panel. The main odour test methods are the acceptability and the perceived intensity. It depends on the measurement task whether the acceptability, perceived intensity, or both characteristics can be determined.

Depending on the measurement task, the determination of the hedonic tone can be used as a complementary method of these assessments.

6 Basic principle of the evaluation of indoor air

6.1 Evaluation method selection

The purpose of odour evaluation of indoor air determines the selection among the methods described in Clause 7. A sensory olfactory examination should be carried out either on the basis of acceptability or intensity.

It is recommended to conduct an evaluation of the acceptability, if

— it is to be determined, whether an odour meets the "requirements" in terms of a building code,

— the influence of the odour on comfort is to be determined,

— the quality of the air is to be determined,

— a prediction of the percentage of dissatisfied users is to be made,

— an examination for the certification of the building is to be carried out, and

— an examination is required due to complaints.

It is recommended to conduct an evaluation of the intensity, if

— it is to be determined, whether an odour is "reasonable" in terms of the building code (in combination with hedonics),

— the strength of the odour is to be determined,

— the quality of the air is to be determined, and

— an examination for the certification of the building is to be carried out.

The intensity evaluation should be carried out preferably by the intensity method with a comparative scale (perceived intensity). If the intensity is determined according to the categorising method, then a calibration of the panel's sense of smell should be carried out to establish a uniform odour reference.

The evaluation of the hedonics indicates whether the odour is considered pleasant or unpleasant. It is wise to combine this assessment with an intensity evaluation (see 6.2).

6.2 Combination of evaluation methods

Evaluation methods with trained and untrained panel members are not combinable due to knowledge obtained from psychology of perception. A small group of trained panel members is possible for acceptance determination (use of the same group as for intensity evaluation) if, in addition to the intensity evaluation, the acceptance of the air to be evaluated shall also be evaluated in order to obtain further information. The acceptance determination and the determination of perceived intensity have to be carried out independent from each other.

The acceptance method can be combined with an intensity assessment according to the category method if untrained panel members are used. In this case, it has to be considered that this intensity assessment is dependent on the context and subject to high uncertainties in case of comparisons between different examinations.

The intensity determination with trained panellists should be supplemented by a hedonic evaluation if the reasonableness shall be determined. Further combinations are possible.

The use of different test methods is affected by separate test cycles, i.e. for example the intensity evaluation is not started until the acceptance evaluation has been carried out by all panellists.

NOTE Indoor air can be modified by frequent entering of the room and the air change caused thereby. Where appropriate, a room air sampling and an odour measurement in a laboratory can be considered.

6.3 Ways of testing

Odour testing can be performed by means of two ways of testing, which includes

— direct odour testing on site, and

— air sampling and odour tests in a laboratory.

The odour examination is carried out in terms of an individual evaluation of the room by a single panel member who carries out the evaluation immediately after reaching the measurement position by inhaling the room air.

During sampling of indoor air, samples are taken at the measurement positions by means of a suitable appliance. The samples are stored in sampling containers. Subsequently, the sampling containers are transported to the odour laboratory where the odour measurement itself in terms of evaluation by the panel members is carried out later. In order to clarify the possibility of adaptation, the odour measurement can be repeated after an appropriate stay (e.g. after 5 min to 10 min) in the room to be examined. An examination of the adaptation can be necessary to discover possible masking effects.

6.4 Selection of the way of testing

Direct, on-site odour testing involves less technological complexity than sampling. If difficulties arise in the evaluation, the test can simply be repeated. On-site odour testing means an evaluation under a context.

In the case of sampling, there is a risk of alterations to the sample through transport and storage, especially in the case of high temperatures during transport due to exposure to direct sunlight, or through insufficient preparation of the sampling containers or storage over longer periods (see Reference [6] for specifications).

Air sampling and laboratory testing are preferable, if

— there is a risk of an influence regarding on-site evaluations through disruptive ambient conditions (e.g. noise, garish light),

— the odour of the air could be influenced by the panel members themselves (e.g. small room volume),

— visual recognition of possible sources is not desired,

— no space is available on site for the regeneration of panel's sense of smell,

— getting the panel to the place of inspection is logistically complex, and

— the use of the comparative scale can influence the odour of the air in the room (e.g. air flow from the installation site of the comparative scale to the room in question).

In preliminary testing, a small panel can be selected for orientational testing of the odour situation on-site. For testing very small rooms, the number of panel members shall also be limited, as the panel

