INTERNATIONAL STANDARD

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Indoor air —

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

Air intérieur —
Partie 10: Dosage de l'émission de composés organiques volatils de produits de construction et d'objets d'équipement — Méthode de la cellule d'essai d'émission

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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 16000-10 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 264, *Air quality*, in collaboration with Technical Committee ISO/TC 146, *Air quality*, Subcommittee SC 6, *Indoor air*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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 — Active sampling method*

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

— *Part 5: Measurement 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/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*

The following parts are under preparation:

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

— *Part 13: Determination of total (gas and particle-phase) polychlorinated dioxin-like biphenyls and polychlorinated dibenzo-p-dioxins/dibenzofurans — Collection on sorbent-backed filters with high-resolution gas chromatographic/mass spectrometric analysis*

— *Part 14: Sampling strategy for nitrogen dioxide (NO_2)*

— *Part 15: Measurement of nitrogen dioxide (NO_2)*

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

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

This corrected version of ISO 16000-10:2006 incorporates the following corrections:

— in Clause 2, on page 1, 2006 has been added after ISO 16000-11;

— in 3.11, on page 2, Note 1 has been revised to align it with the corrected version of ISO 16000-9:2006;

— in Clause 10, on page 7, ISO 16000-11:2005 has been replaced by ISO 16000-11:2006.

Introduction

The determination of volatile organic compounds (VOCs) emitted from building products using emission test cells in conjunction with the standardised sampling, storage of samples and preparation of test specimens has objectives such as:

— to provide manufacturers, builders, and end users with emission data useful for the evaluation of the impact of building products on the indoor air quality;

— to promote the development of improved products;

— on-site investigation of building product surfaces.

The method can in principle be used for most building products used indoors.

Indoor air —

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

1 Scope

This part of ISO 16000 specifies a general laboratory test method for determination of the area specific emission rate of volatile organic compounds (VOCs) from newly produced building products or furnishing under defined climate conditions. The method can in principle also be applied to aged products. The emission data obtained can be used to calculate concentrations in a model room.

According to the definition of an emission test cell, it is also possible to perform non-destructive emission measurements on building products on-site in buildings. However, the procedure for such measurements is not described in this part of ISO 16000.

Sampling, transport and storage of materials to be tested, and preparation of test specimens are described in ISO 16000-11. Air sampling and analytical methods for the determination of VOCs are described in ISO 16000-6 and ISO 16017-1[20].

An example of an emission test cell is described in Annex C of this part of ISO 16000.

For the determination of formaldehyde emissions from wood-based panels, refer to EN 717-1:2004 [21] and ISO 12460-1 [1]. However, this part of ISO 16000 is also applicable to wood-based panels and other building products in order to determine the emission rate of formaldehyde. The measurement procedure for formaldehyde is described in ISO 16000-3 [2].

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 554:1976, *Standard atmospheres for conditioning and/or testing — Specifications*

ISO 16000-11:2006, *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*

3 Terms and definitions

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

3.1
air change rate
ratio of the volume of clean air brought into the emission test chamber per hour and the free emission test chamber volume measured in identical units

3.2
air flow rate
air volume entering into the emission test cell per time

3.3
air velocity
air speed over the surface of the test specimen

3.4
area specific air flow rate
ratio between the supply air flow rate and the area of the test specimen

3.5
building product
product produced for incorporation in a permanent manner in construction works

3.6
emission test cell
a small chamber for the determination of volatile organic compounds emitted from indoor materials/products that is placed on the surface of the test specimen and is designed so that the surface of the test specimen becomes a part of the emission cell

3.7
emission test cell concentration
concentration of a specific volatile organic compound, VOC_x, (or groups of volatile organic compounds) measured in the emission test cell outlet

3.8
product loading factor
ratio of exposed surface area of the test specimen and the free emission test cell volume

3.9
recovery
measured mass of a target volatile organic compound in the air leaving the emission test cell during a given time period divided by the mass of target volatile organic compound added to the emission test cell in the same time period, expressed in percent

NOTE The recovery provides information about the performance of the entire method.

3.10
sample
part or piece of a building product that is representative of the production

3.11
specific emission rate
q_m
product specific rate describing the mass of a volatile organic compound emitted from a product per time at a given time from the start of the test

NOTE 1 Area specific emission rate, q_A, is used in this part of ISO 16000. Several other specific emission rates can be defined according to different requirements, e.g. length specific emission rate, q_l, volume specific emission rate, q_V, and unit specific emission rate, q_u

NOTE 2 The term “area specific emission rate” is sometimes used in parallel with the term “emission factor”.

3.12
target volatile organic compound
product specific volatile organic compound

3.13
test specimen
part of the sample specially prepared for emission testing in an emission test cell in order to simulate the emission behaviour of the material or product that is tested

3.14
total volatile organic compounds
TVOC
sum of the concentrations of identified and unidentified volatile organic compounds eluting between and including *n*-hexane and *n*-hexadecane

NOTE 1 For quantification of the identified compounds, their individual responses are used. The areas of the unidentified peaks are converted on molecular mass basis to concentrations using the toluene response factor [3].

NOTE 2 Due to practical reasons to taken into account for emission test chambers, this definition differs slightly from that in ISO 16000-6:2004. In ISO 16000-6, TVOC are related to the sampling medium Tenax TA®1) on which the TVOC are adsorbed.

3.15
volatile organic compound
VOC
organic compound that is emitted from the test specimen and all those detected in the test cell outlet air

NOTE 1 Due to practical reasons to be taken into account for emission test chambers, this definition differs from that in ISO 16000-6:2004. In ISO 16000-6, the definition is based on the boiling point range (50 °C to 100 °C) to (240 °C to 260 °C).

NOTE 2 The emission test method described in this part of ISO 16000 is optimum for the range of compounds specified by the definition of total volatile organic compounds (TVOC).

4 Symbols and abbreviated terms

The symbols and abbreviated terms used in this part of ISO 16000 are given below.

Symbol	Name	Unit
ρ_x	mass concentration of a VOC_x in the emission test cell	micrograms per cubic metre
L	product loading factor	square metres per cubic metre
n	air change rate	changes per hour
q	area specific air flow rate (= n/L)	cubic metres per square metre and hour
q_A	area specific emission rate	micrograms per square metre and hour
q_l	length specific emission rate	micrograms per metre and hour
q_m	mass specific emission rate	micrograms per gram and hour
q_V	volume specific emission rate	micrograms per cubic metre and hour
q_u	unit specific emission rate	micrograms per unit and hour
t	time after start of the test	hours or days

1) Tenax TA® is the trade name of a product manufactured by Supelco, Inc. This information is given for the convenience of users of this part of ISO 16000 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.

5 Principle

The principle of the test is to determine the area specific emission rates of VOCs emitted from the surface of a product test specimen. The test is performed in an emission test cell at constant temperature, relative air humidity, and area specific air flow rate. Measurements of the VOC concentration in the air at the outlet are representative of the air in the emission test cell.

Area specific emission rates at a given time, t, are calculated from the emission test cell air concentrations and the area specific air flow rate, q (see Clause 13).

With knowledge of the concentration in the air, the air flow through the emission test cell, and the surface area of the test specimen, the area specific emission rates of VOCs from the product under test can be determined.

6 Emission test cell system

6.1 General

An emission test cell system designed and operated to determine area specific emission rates of VOCs from building products shall contain the following: emission test cell, clean air generation and humidification system, monitoring and control systems, to ensure that the test is carried out according to specified conditions [4], [5], [6], [7].

For solid products with smooth surface, the emission test cell is placed directly against the surface of the product test specimen. To secure air tightness, other products shall be placed in specially constructed test specimen holders.

General specifications and requirements that apply to all types of emission test cells in this part of ISO 16000 are given in 6.2 to 6.6 below.

Quality assurance / quality control activities shall be carried out as in Annex A.

6.2 Emission test cell materials

The emission test cell and the parts of the sampling system coming in contact with the emitted VOCs (all tubings and couplings) are normally made of surface treated (polished) stainless steel or glass. However, in all cases the requirements in 6.3 and 6.5 shall be fulfilled.

The sealing material that links together the emission test cell and the test specimen shall be low emitting and low adsorbing and shall not contribute to the emission test cell background concentration.

6.3 Air supply

The emission test cell shall be supplied with pure and humidified air and have a device for controlling the air flow rate with an accuracy of ± 5 %.

6.4 Air tightness

The emission test cell shall be airtight in order to avoid uncontrolled air exchange with external air.

The emission test cell shall be operated slightly above atmospheric pressure to avoid any influence from the laboratory atmosphere.

The emission test cell is considered sufficiently tight if the inlet and outlet air flows differ by less than 5 %.

Products with a large air permeability or irregular surface may cause leakage. According to the demand for air tightness given above they shall therefore be placed in airtight test specimen holders.

6.5 Air sampling devices

The exhaust air (at the emission test cell outlet) shall be used for sampling. Sampling of the outlet air (e.g. with a sampling pump) is achieved by connecting adsorbent tubes to the outlet couplings.

The sum of sampling air flows shall be smaller than 90 % of the inlet air flow to the emission test cell.

A multiport sampling manifold can provide the flexibility for duplicate air sampling. The sampling manifold shall enter directly to the outlet air stream If a duct shall be used, it shall be as short as possible and maintained at the same temperature as the emission test cell.

NOTE The exhaust from the emission test cell should be ducted into a fume hood, ensuring that any chemicals emitted from the test material are isolated from the laboratory environment.

6.6 Recovery and sink effects

The recovery of a target VOC can be determined using a VOC source of known specific emission rate in the emission test cell. The concentrations generated shall be of similar magnitude as those expected during the emission tests of building products.

Recovery tests shall be performed in the test cell on an inert surface (glass or stainless steel), using toluene and *n*-dodecane. Test cell air concentrations shall be determined at 24 h after start of the test. The mean recovery shall be greater than 80 % for toluene and *n*-dodecane. The results of this recovery test shall be reported in the test report as concentration expected versus concentration measured.

NOTE 1 Low recovery of hygroscopic VOCs may occur in humidified air.

NOTE 2 Sink effects, leaks or poor calibration can cause difficulties to meet the minimum requirements. Sink and adsorption characteristics are very much dependent on the type of compound emitted. Additional recovery tests using target VOCs with different molecular weight and polarity can be used to increase understanding of these effects.

7 Apparatus

The equipment necessary for carrying out an emission test are listed below.

7.1 Clean air supply, e.g. pressurised purified air or synthetic air in gas cylinders.

7.2 Emission test cell system.

7.3 Humidification system.

7.4 Air humidity and temperature monitoring systems.

7.5 Air flow meters.

7.6 Facilities for recovery testing.

7.7 Either cleaning agent for the emission test cell, or oven for heating and cleaning the emission test cell.

8 Test conditions

8.1 Temperature and relative air humidity

Products for use in Europe shall be tested at temperature and relative air humidity 23 °C, 50 % RH during the emission test (ISO 554). The tolerances are ± 2 °C and ± 5 % RH.