INTERNATIONAL STANDARD

ISO 16000-9

First edition
2006-02-01

Corrected version
2006-06-15

Indoor air —

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

Air intérieur —
Partie 9: Dosage de l'émission de composés organiques volatils de produits de construction et d'objets d'équipement — Méthode de la chambre d'essai d'émission

Reference number
ISO 16000-9:2006(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.

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 16000-9 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 16000-9:2006 incorporates the following corrections:

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

— in 3.11, on page 2, the symbols in Note 1 have been corrected;

— in Clause 10, on page 8, 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 chambers 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.

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

Indoor air —

Part 9: Determination of the emission of volatile organic compounds from building products and furnishing — Emission test chamber 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 also, in principle, be applied to aged products. The emission data obtained can be used to calculate concentrations in a model room.

This part of ISO 16000 applies to various emission test chambers used for determination of the emission of volatile organic compounds from building products or furnishing.

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 [11].

A general description of an emission test chamber is given 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 [12]. However, ISO 16000-9 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 [1].

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 16000-6:2004, *Indoor air — Part 6: Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA® sorbent, thermal desorption and gas chromatography using MS/FID*

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 chamber 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 chamber
enclosure with controlled operational parameters for the determination of volatile organic compounds emitted from building products

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

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

3.9
recovery
measured mass of a target volatile organic compound in the air leaving the emission test chamber during a given time period divided by the mass of target volatile organic compound added to the emission test chamber 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 chamber in order to simulate the emission behaviour of the material or product that is tested

3.14
total volatile organic compound
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 response is used. The areas of the unidentified peaks are converted on molecular mass basis to concentrations using the toluene response factor [2].

NOTE 2 Due to practical reasons to be taken into account for test chambers, this definition differs slightly from that defined 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 chamber outlet air

NOTE 1 Due to practical reasons to be taken into account for test chambers, this definition differs from that defined 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).

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.

4 Symbols and abbreviated terms

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

Symbol	Meaning	Unit
ρ_x	mass concentration of a VOC_x in the emission test chamber	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

5 Principle

The principle of the test is to determine the area specific emission rate of VOCs emitted from building products. The test is performed in an emission test chamber at constant temperature, relative air humidity, and area specific air flow rate. The air in the emission test chamber is fully mixed (see 9.7), and measurements of the VOC concentration in the air at the outlet are representative of the emission test chamber air concentrations.

Area specific emission rates at a given time, t, are calculated from the emission test chamber 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 chamber 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 chamber system

6.1 General

A facility designed and operated to determine area specific emission rates for VOCs emitted from building products shall contain the following: emission test chamber, clean air generation and humidification system, air mixing system, monitoring and control systems to ensure that the test is carried out according to specified conditions [3], [4].

General specifications and requirements that apply to all types of emission test chambers included in this part of the standard are given in 6.2 to 6.6 below.

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

A general description of an emission test chamber is given in Annex C.

6.2 Emission test chamber materials

The emission test chamber and the parts of the sampling system coming in contact with the emitted VOCs are normally made of surface-treated (polished) stainless steel or glass.

Other materials may be used for mixing devices, e.g. fans, and for sealing materials. These shall be low emitting and low adsorbing and shall be tested in the test chamber to confirm that they do not contribute to the emission test chamber background concentration.

6.3 Air supply and mixing facilities

The emission test chamber shall have facilities (e.g. electronic mass flow controller) capable of continuously controlling the air change rate at a fixed value with an accuracy of ± 5 %.

The emission test chamber shall be designed to ensure proper mixing of the emission test chamber air. The requirements are given in 9.6.

NOTE Fans, multi-port inlet and outlet diffusers, perforated floors and baffle plates are used to obtain adequate mixing.

6.4 Air tightness

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

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

The emission test chamber is considered sufficiently airtight if at least one of the following requirements is fulfilled:

— the air leakage is less than 0,5 % of the chamber volume per minute at an overpressure of 1 000 Pa;

— the air leakage is less than 5 % of the supply airflow rate.

6.5 Air sampling devices

The exhaust air (at the emission test chamber outlet) shall be used for sampling, although separate sampling ports in the emission test chamber can be used, provided that the air sampled is equivalent to the exhaust air.

The sampler manifold should 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 chamber.

The sum of sampling air flows should be smaller than 80 % of the inlet air flow to the emission test chamber to avoid underpressure.

A multiport sampling manifold can be used to provide flexibility for duplicate air sampling. A mixing chamber between the emission test chamber and the manifold or between the air inlet and the emission test chamber could be included to permit addition and mixing of internal standard gases with the emission test chamber air stream.

The exhaust from the emission test chamber 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 chamber. The concentrations generated shall be of similar magnitude to those expected during the emission tests of building products.