



International  
Standard

**ISO 16000-9**

**Indoor air —**

Part 9:

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

*Air intérieur —*

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

**Second edition  
2024-03**

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[ISO 16000-9:2024](https://standards.iteh.ai/catalog/standards/iso/af31a771-2164-408f-be86-dd38a9c300b6/iso-16000-9-2024)

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Published in Switzerland

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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 document 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](http://www.iso.org/directives)).

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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](http://www.iso.org/iso/foreword.html).

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

This second edition cancels and replaces the first edition (ISO 16000-9:2006), which has been technically revised.

The main change is as follows: detailed information about cut edge has been added.

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](http://www.iso.org/members.html).

## Introduction

The objectives of 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 are:

- 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.

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 specified in ISO 16000-6 and ISO 16017-1.

A general description of an emission test chamber is given in [Annex C](#).

For the determination of formaldehyde emissions from wood-based panels, refer to EN 717-1<sup>[1]</sup>. The measurement procedure for formaldehyde is described in ISO 16000-3<sup>[2]</sup>.

The determination of the emission rates of cut edges is described in [Annex D](#).

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## Indoor air —

### Part 9:

# Determination of the emission of volatile organic compounds from samples of building products and furnishing — Emission test chamber method

## 1 Scope

This document specifies a general laboratory test method for the determination of the area specific emission rate of volatile organic compounds (VOCs) from samples of newly produced building products or furnishing under defined climate conditions. The method can also, in principle, be applied to samples of aged products. The emission data obtained can be used to calculate concentrations in a model room (see [Table B.1](#)).

This document is applicable to various emission test chambers used for the determination of the emission of VOCs from building products or furnishing.

This document is also applicable to samples of wood-based panels and other building products, in order to determine the emission rate of formaldehyde.

NOTE In principle, this document can be applied to the study of any gas phase emissions from samples of building products and furnishing.

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

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

ISO 16000-11, *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*

ISO 16017-1, *Indoor, ambient and workplace air — Sampling and analysis of volatile organic compounds by sorbent tube/thermal desorption/capillary gas chromatography — Part 1: Pumped sampling*

## 3 Terms and definitions

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

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

**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* (3.13)

**3.4  
area specific air flow rate**

ratio between the supply *air flow rate* (3.2) and the area of the *test specimen* (3.13)

**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 *VOCs* (3.15) emitted from *samples* (3.10) of *building products* (3.2)

Note 1 to entry: The chamber size depends upon the required application but should at minimum be 20 l.

**3.7  
emission test chamber concentration**

concentration of a specific *volatile organic compound* (3.15),  $VOC_x$ , (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* (3.13) and the free emission test chamber volume

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**3.9  
recovery**

measured mass of a *target volatile organic compound* (3.12) 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

Note 1 to entry: Recovery is expressed as a percentage.

Note 2 to entry: The recovery provides information about the performance of the entire method.

**3.10  
sample**

part or piece of a *building product* (3.5) or furnishing product that is representative of the production

**3.11  
specific emission rate**

$E_A$   
product specific rate describing the mass of a *volatile organic compound* (3.15) emitted from a unit area of a *test specimen* (3.13) per time at a given time from the start of the test

Note 1 to entry: Several other specific emission rates can be defined according to different requirements, e.g. length specific emission rate,  $E_l$ , mass specific emission rate,  $E_m$ , volume specific emission rate,  $E_v$ , and unit specific emission rate,  $E_u$ .

Note 2 to entry: The term "area specific emission rate" is sometimes used in parallel with the term "emission factor".



**3.12**

**target volatile organic compound**

specific *VOC* (3.15) identified as a target chemical in a standard or specification

**3.13**

**test specimen**

part of the *sample* (3.10) 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 *VOCs* (3.15) eluting between and including *n*-hexane and *n*-hexadecane

Note 1 to entry: 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<sup>[3]</sup>.

Note 2 to entry: Due to practical reasons to be taken into account for test chambers, this definition differs slightly from that defined in ISO 16000-6:2021, where TVOC are related to the sampling medium Tenax TA<sup>®1)</sup> on which the TVOC are adsorbed.

**3.15**

**volatile organic compound**

**VOC**

organic compound that is emitted from the *test specimen* (3.13) and all those detected in the chamber outlet air

Note 1 to entry: Due to practical reasons to be taken into account for test chambers, this definition differs from that defined in ISO 16000-6:2021.

Note 2 to entry: The emission test method described in this document is optimum for the range of compounds specified by the definition of *total volatile organic compounds (TVOC)* (3.14).

**4 Symbols and abbreviated terms**

**4.1 Symbols**

$\rho_x$	mass concentration of a $VOC_x$ in the emission test chamber	$\mu\text{g}/\text{m}^3$
$L$	product loading factor	$\text{m}^2/\text{m}^3$
$n$	air change rate	$\text{h}^{-1}$
$q$	area specific air flow rate ( $= n/L$ )	$\text{m}^3/(\text{m}^2 \cdot \text{h})$
$E_A$	area specific emission rate	$\mu\text{g}/(\text{m}^2 \cdot \text{h})$
$t$	time after start of the test	h or d

1) Tenax TA<sup>®</sup> 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.

## 4.2 Abbreviated terms

RH	relative humidity
QAPP	quality assurance project plan
QA/QC	quality assurance and quality control
TVOC	total volatile organic compound
VOC	volatile organic compound
VOC <sub>x</sub>	individual VOC

## 5 Principle

The principle of the test is to determine the area specific emission rate of VOCs emitted from samples of 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 9.6), 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 test specimen 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 samples of 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<sup>[4],[5]</sup>.

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

Quality assurance and 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 and Figure C.1.

### 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 as part of the overall background test to confirm that they do not contribute to the emission test chamber background concentration or low VOC recoveries (see 6.6).

### 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 flow rate at a fixed value with an accuracy of  $\pm 5\%$ .