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Indoor air —

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

Air intérieur —

Partie 25: Dosage de l'émission de composés organiques semi-volatils des produits de construction — Méthode de la micro-chambre

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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 16000-25 was prepared by Technical Committee 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 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*

The following parts are under preparation:

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

— *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 constructions on pollutants and other injurious factors — Inspections*

Introduction

The determination of semi-volatile organic compounds (SVOCs) emitted from building products using micro-chambers in conjunction with standardized sampling, storage of samples and preparation of test specimens aims, for example, 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;

— promote the development of improved products.

The measurement method specified in this part of ISO 16000 is applicable to products used in construction such as board materials, wallpapers, flooring materials, insulation materials, adhesives, paints, and their combinations.

SVOCs such as phthalic esters are found in many construction materials. If emitted into the indoor environment they adhere to many surfaces and can become a persistent indoor air contaminant.

This part of ISO 16000 specifies a test procedure for measuring SVOC emissions from construction products and materials. This method can, in principle, be used for most building products used indoors.

ISO 16017[6][7] and ISO 12219[1]–[5] also focus on volatile organic compound (VOC) measurements.

Indoor air —

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

1 Scope

This part of ISO 16000 specifies a test method for determination of the area-specific emission rate of semi-volatile organic compounds (SVOCs) from newly produced building products or furnishings under defined climate conditions using a micro-chamber. The method can in principle also be applied to aged products. This measurement method is applicable to products and materials, such as board materials, wallpapers, flooring materials, insulation materials, adhesives, paints, and their combinations.

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

An example of a micro-chamber is described in Annex B.

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, *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® sorbent, thermal desorption and gas chromatography using MS or 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.

3.1
air change rate for micro-chamber
n
ratio of the volume of clean air brought into the micro-chamber per hour and the free micro-chamber volume measured in identical units

3.2
air flow rate for micro-chamber
$q_{V,\text{c}}$
air volume entering into the micro-chamber per time

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

[ISO 16000-9:2006, 3.3]

3.4
area specific air flow rate
q_{VA}
ratio between the supply air flow rate and the area of the test specimen

[ISO 16000-9:2006, 3.4]

3.5
area specific emission rate for SVOC
q_{mA}
building product specific rate describing the mass of a substance emitted from an exposed area per time at a given time from the start of the test

NOTE 1 For the purposes of this part of ISO 16000, the emission consists of SVOC.

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

3.6
building product
product produced for incorporation in a permanent manner in construction works

[ISO 16000-9:2006, 3.5]

3.7
field blank
m_{t0}
⟨SVOC emission from building products⟩ mass of SVOC in the sorbent tube when all operations except air sampling are performed

NOTE Used in order to consider contamination originating from the sorbent tube itself and contamination originating in opening, closing, and transportation.

3.8
inert gas
gas without active chemical or other properties

NOTE Normally, helium (He) gas or nitrogen (N_2) is used as the gas for thermal desorption (TD) of SVOC adsorbed in the micro-chamber (see Reference [8]).

3.9
mass collected in control test
m_0
sum of mass during first and second steps of test without introducing specimen

3.10
mass collected in first step
m_1
mass of SVOC sampled and measured at the micro-chamber outlet, which are emitted and not absorbed in the micro-chamber

3.11
mass collected in second step
m_2
mass of SVOC sampled and measured at the micro-chamber outlet when thermal desorption is performed

3.12
micro-chamber
container enabling control of conditions for measurement of SVOC emissions from building materials

NOTE Micro-chambers typically range in volume as described in B.1.

3.13
recovery
measured mass of a target semi-volatile organic compound in the air leaving the micro-chamber during thermal desorption (second step) divided by the mass of target semi-volatile organic compound added to the micro-chamber

NOTE 1 Recovery is expressed as a percentage.

NOTE 2 The recovery provides information about the performance of the entire method.

3.14
sample
part or piece of a building product that is representative of the production

[ISO 16000-9:2006, 3.10]

3.15
sampling period
duration over which a sample is taken

NOTE The sampling period is the time during which air is sampled from the outlet of the micro-chamber using sorbent tubes or other devices.

3.16
semi-volatile organic compound
SVOC
organic compound whose boiling point is in the range from (240 °C to 260 °C) to (380 °C to 400 °C)

NOTE 1 This classification has been defined by the World Health Organization (Reference [9]).

NOTE 2 Boiling points of some compounds are difficult or impossible to determine because they decompose before they boil at atmospheric pressure. Vapour pressure is another criterion for classification of compound volatility that can be used for classification of organic chemicals. SVOCs have vapour pressures between 10^{-2} mPa and 10 Pa.

3.17
sorbent tube blank
value of SVOC in the sorbent tube itself before air sampling

3.18
target semi-volatile organic compound
product specific semi-volatile organic compound

3.19
test specimen
⟨SVOC emission from building products⟩ part of the sample specially prepared for emission testing in a micro-chamber cell in order to simulate the emission behaviour of the material or product that is tested

3.20
test start
time of placing the test specimen in the micro-chamber

3.21
total mass collected in first and second step
sum of mass collected during first and second steps of test

4 Symbols

Symbol	Meaning	Unit
A	surface area of test specimen	square metres
A_c	inner surface area of the micro-chamber	square metres
S_L	surface area ratio (equal to A_c/A)	square metres per square metre
m_0	mass collected in control test	micrograms
m_1	mass collected in first step	micrograms
m_2	mass collected in second step	micrograms
m_{1+2}	mass collected in first and second steps	micrograms
m_{t0}	field blank	micrograms
n	air change rate for micro-chamber	changes per hour
q_{mA}	area specific emission rate	micrograms per square metre hour
q_{VA}	area specific air flow rate (equal to $q_{V,c}/A$)	cubic metres per square metre hour
$q_{V,c}$	air flow rate for micro-chamber	cubic metres per hour
t	duration of first phase	hours
V	air volume of micro-chamber	cubic metres

5 Principle

The principle of the test is to determine the area specific emission rates of SVOCs emitted from the surface of a product test specimen. Although SVOCs are emitted in the micro-chamber, the greater part of these emissions are adsorbed in the chamber at temperatures of 40 °C or below. Therefore, in this test, the area specific emission rate of SVOC for a building material which is the object of a test is determined from the mass collected in the first and second steps. The outcome of the test is the mean rate of emission of SVOCs from the product over a 24 h period. For specific purposes, the emission rate over a different period of time could be determined using the same procedure, but varying the duration of the first step.

6 Micro-chamber system

6.1 General

A micro-chamber system designed and operated to determine area specific emission rates of SVOCs from building products shall contain the following: micro-chamber, clean air generation and humidification system, and monitoring and control systems to ensure that the test is carried out according to specified conditions.

The design of the micro-chamber may allow solid products with a smooth surface to be placed in or on (or under) the micro-chamber such that the sample itself forms a wall of the micro-chamber. This is analogous to the approach used in ISO 16000-9 and ISO 16000-10. In this case, it is important that the sample surface be sealed against the micro-chamber so that emissions from the edges and rear of the test specimen are excluded. To secure airtightness, other products shall be placed in specially constructed test specimen holders.

General specifications and requirements that apply to all types of micro-chambers in this part of ISO 16000 are given in 6.2 to 6.7.

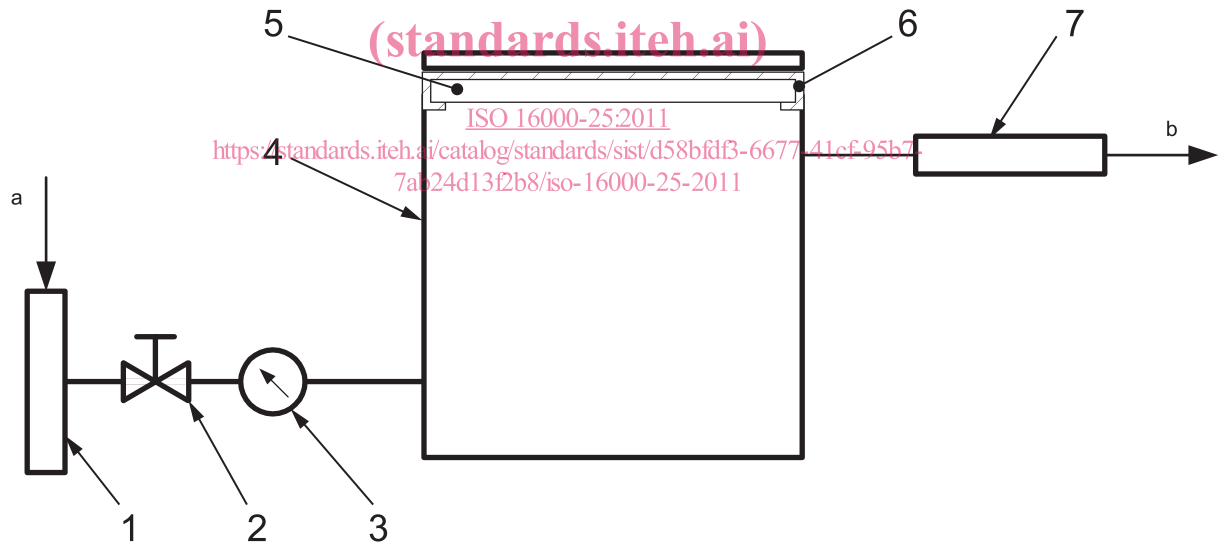
Quality assurance and quality control activities shall be carried out as specified in Annex A.

6.2 Micro-chamber

An appropriate volume size and an appropriate size ratio of the dimension has been tested and is given in Table B.1. The micro-chamber and the parts of the sampling system coming into contact with the emitted SVOCs (all tubings and couplings) are normally made of glass or inert non-outgassing materials, such as inert-coated stainless steel and polished stainless steel. However, in all cases, the requirements specified in 6.3 and 6.7 shall be fulfilled. Depending on the material of micro-chamber construction (e.g. some types of glass), surface treatment may be required to aid thermal desorption.

NOTE Polished stainless steel can catalyse degradation of some SVOCs.

The sealing material housing the test specimen shall be low emitting and low adsorbing, and shall not contribute to the micro-chamber background concentration. Schematic diagrams of the micro-chamber apparatus are shown in Figure 1 and Figure 2.

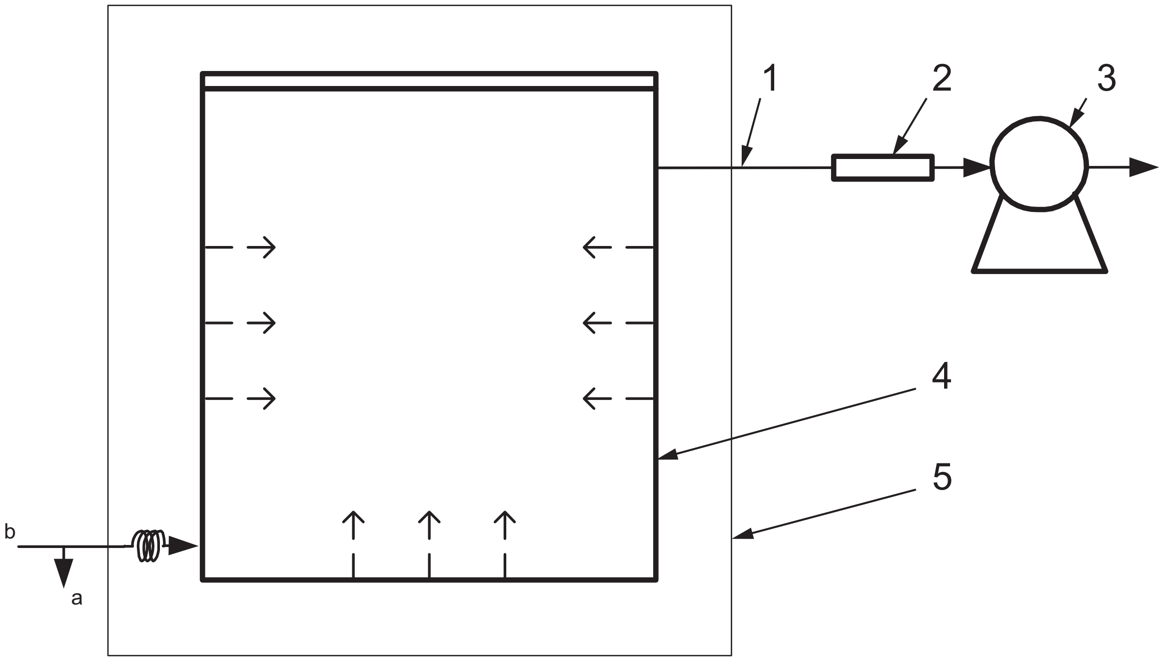


Key

1 clean air supply
2 air flow regulator
3 air flow meter
4 micro-chamber
5 test specimen
6 sealing material
7 manifold air sampling (sorbent tube)

[a] Air inlet.
[b] Exhaust outlet.

Figure 1 — Schematic diagram of a type of micro-chamber apparatus as used in step 1 of the test



Key

1 transfer line
2 sorbent tube
3 sampling pump
4 micro-chamber
5 chamber heating device

a Vent line.
b Inert gas inlet.

Figure 2 — Schematic diagram of a type of micro-chamber apparatus as used in step 2 of the test

6.3 Surface area ratio

The ratio of the surface area of the test specimen to the inner surface area of the micro-chamber shall be 0,15 ± 0,007 5.

NOTE A surface area ratio outside this range can give different measurement results.

6.4 Airtightness

The micro-chamber shall have an airtight condition, in which exchange of air with uncontrolled external air is minimal.

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

NOTE One method of minimizing ingress of laboratory air during the test is to ensure a slightly positive pressure within the micro-chamber. One way this can be achieved is to supply air to the micro-chamber at a rate that is ~50 % faster than the pumped sampling rate leaving the micro-chamber. If this approach is followed, a vent line can be conveniently installed immediately before the air inlet to the micro-chamber, allowing excess air to be discharged away from the immediate testing location.

