



# SLOVENSKI STANDARD SIST ISO 16000-6:2004

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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

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Air intérieur -- Partie 6: Dosage des composés organiques volatils dans l'air intérieur des locaux et enceintes d'essai par échantillonnage actif sur le sorbant Tenax TA, désorption thermique et chromatographie en phase gazeuse utilisant MS/FID

Ta slovenski standard je istoveten z: **ISO 16000-6:2004**

**ICS:**

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**en**

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**Indoor air —**

Part 6:

**Determination of volatile organic  
compounds in indoor and test chamber  
air by active sampling on Tenax TA<sup>®</sup>  
sorber, thermal desorption and gas  
chromatography using MS/FID****(standards.iteh.ai)***Air intérieur —*

*Partie 6 Dosage des composés organiques volatils dans l'air intérieur  
des locaux et enceintes d'essai par échantillonnage actif sur le sorbant  
Tenax TA<sup>®</sup>, désorption thermique et chromatographie en phase  
gazeuse utilisant MS/FID*

Reference number  
ISO 16000-6:2004(E)

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## ISO 16000-6:2004(E)

## 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 16000-6 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 — Active sampling method*
- *Part 4: Determination of formaldehyde – Diffusive sampling method*
- *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*

The following parts are under preparation:

- *Part 5: Measurement strategy for volatile organic compounds (VOCs)*
- *Part 7: Sampling strategy for determination of airborne asbestos fibre concentrations*
- *Part 8: Ventilation rate measurement*
- *Part 9: Determination of the emission of volatile organic compounds — Emission test chamber method*
- *Part 10: Determination of the emission of volatile organic compounds — Emission test cell method*
- *Part 11: Determination of the emission of volatile organic compounds — Sampling, storage of samples and preparation of test specimens*

## Introduction

ISO 16000-1 describes general requirements relating to the measurement of indoor air pollutants and the important conditions to be observed before or during the sampling of individual pollutants or groups of pollutants. Aspects of the determination (sampling and analysis) and the sampling strategy of specific pollutants or groups of pollutants are described in the subsequent parts of ISO 16000 (see Foreword).

ISO 16000-5, dealing with the sampling strategy for VOCs in indoor air, is in preparation. It is a link between ISO 16000-1 and the analytical procedures described in this part of ISO 16000.

Furthermore, the two International Standards ISO 16017-1 on pumped sampling and ISO 16017-2 on diffusive sampling focus on VOC measurements.

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## 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

### 1 Scope

This part of ISO 16000 specifies a method for determination of volatile organic compounds (VOCs) in indoor air and in air sampled for the determination of the emission of VOCs from building materials using test chambers and cells. The method is based on use of Tenax TA<sup>®</sup> sorbent with subsequent thermal desorption and gas chromatographic analysis<sup>[1]</sup>.

The method is applicable to the measurement of non-polar and slightly polar VOCs in a concentration range of sub-microgram per cubic metre to up to several milligrams per cubic metre. Using the principles described in this method, some very volatile compounds (VVOC) and semivolatile organic compounds (SVOC) can also be analysed.

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### 2 Normative references

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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 16000-1:—<sup>2)</sup>, *Indoor air — Part 1: General aspects of sampling strategy*

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*

ENV 13419-1:1999, *Building products — Determination of the emission of volatile organic compounds — Part 1: Emission test chamber method*

ENV 13419-2:1999, *Building products — Determination of the emission of volatile organic compounds — Part 2: Emission test cell method*

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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 International Standard 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.

2) To be published.

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### 3 Terms and definitions

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

#### 3.1

##### 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.

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 may be used for classification of organic chemicals<sup>[3]</sup>. SVOCs have vapour pressures between  $10^{-2}$  kPa and  $10^{-8}$  kPa.

#### 3.2

##### volatile organic compound

##### VOC

organic compound whose boiling point is in the range from (50 °C to 100 °C) to (240 °C to 260 °C)

NOTE 1 This classification has been defined by the World Health Organization.

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 may be used for classification of organic chemicals<sup>[3]</sup>. VOCs generally have saturation vapour pressures at 25 °C greater than  $10^2$  kPa.

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#### 3.3

##### very volatile organic compound

##### VVOC

organic compound whose boiling point is in the range from (20 °C to 50 °C) to (50 °C to 100 °C)

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NOTE 1 This classification has been defined by the World Health Organization<sup>[4]</sup>

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 may be used for classification of organic chemicals<sup>[3]</sup>. VVOCs typically have vapour pressures greater than 15 kPa<sup>[3]</sup>.

#### 3.4

##### total volatile organic compounds

##### TVOC

the sum of volatile organic compounds, sampled on Tenax TA<sup>®</sup>, which elute between and including n-hexane and n-hexadecane, are detected with a flame ionization detector (TVOC-FID) or mass spectrometric detector (TVOC-MS), and are quantified by converting the total area of the chromatogram in that analytical window to toluene equivalents

NOTE While this part of ISO 16000 describes the determination of individual VOCs, it is common in practice to generate a single concentration value to characterize the total amount of VOCs present in the air. This value is called the TVOC value (see 12.2 and Clause 14). It should be emphasized that the TVOC value so obtained depends on the sampling and analytical methods used, and therefore should be interpreted taking into account the full description of these methods.

## 4 Principle

A measured volume of sample air is collected from room air or from an emission test chamber (see ENV 13419-1) or an emission test cell (see ENV 13419-2) by drawing through one (or more) sorbent tube containing Tenax TA<sup>®</sup> sorbent. Volatile organic compounds are retained by the sorbent tube, and the compounds are subsequently analysed in the laboratory. The collected VOCs are desorbed by heat and transferred under inert carrier gas via cold trap/sorbent trap into a gas chromatograph equipped with a

capillary column or columns and a flame ionization detector and/or a mass spectrometric detector. The principle is described in ISO 16017-1.

## 5 Reagents and materials

**5.1 Volatile organic compounds** for calibration, of chromatographic quality.

**5.2 Dilution solvent**, for preparing calibration blend solution for liquid spiking.

The solvent should be of chromatographic quality. It shall be free from compounds co-eluting with the compound(s) of interest (5.1).

**NOTE** It is in most cases beneficial to use dilution solvent that is considerably more volatile than the VOCs to be analysed. Methanol most commonly fulfills this criteria. Health and safety data for organic compounds is given in e.g. International Chemical Safety Cards (ICSCS).

**5.3 Tenax TA<sup>®</sup>**, particle size 0,18 mm to 0,25 mm (60 mesh to 80 mesh).

Tenax TA<sup>®</sup> is a porous polymer based on 2,6-diphenylene oxide. Manufactured Tenax TA<sup>®</sup> contains quantities of impurities, which shall be removed before using it for VOC sampling. Perform cleaning by thermal conditioning the Tenax TA<sup>®</sup> under a flow of pure carrier gas. Select cleaning conditions so that no degradation of the polymer occurs, e.g. at temperature of 330 °C for at least 18 h using a carrier gas flowrate of 100 ml/min for packed sampling tubes. Pack precleaned Tenax TA<sup>®</sup> into sampling tubes that are tightly sealed and store in a closed, emission-free container. Check the success of the cleaning procedure by performing an analysis of the cleaned sorbent.

**5.4 Standard atmospheres.** (standards.iteh.ai)

Prepare standard atmospheres of known concentrations of the compound(s) of interest by a recognized procedure. Methods described in ISO 6141 and the appropriate part of ISO 6145 are suitable. Prepare standard atmospheres equivalent to 100 µg/m<sup>3</sup>. If the procedure is not applied under conditions that allow the establishment of full traceability of the generated concentrations to primary standards of mass and/or volume, or if the chemical inertness of the generation system cannot be guaranteed, the concentrations shall be confirmed using an independent procedure.

**5.5 Standard sorbent tubes**, loaded by spiking from standard atmospheres (5.4).

Prepare loaded sorbent tubes by passing an accurately known volume of the standard atmosphere through the sorbent tube, e.g. by means of a pump. The volume of atmosphere sampled shall not exceed the breakthrough volume of the analyte-sorbent combination. After loading, disconnect and seal the tube. Prepare fresh standards with each batch of samples. For indoor air and test chamber air, load sorbent tubes with e.g. 100 ml, 200 ml, 400 ml, 1 l, 2 l, 4 l or 10 l of the 100 µg/m<sup>3</sup> standard atmosphere selected.

**5.6 Calibration blend solutions** for liquid spiking.

The stability and safe storage times of calibration blend solutions prepared in 5.6.1 to 5.6.5 shall be determined. Fresh standard solutions shall be prepared accordingly or if evidence is noted of deterioration, e.g. reactions between alcohols and ketones.

**5.6.1 Solution containing approximately 10 mg/ml of each liquid component.**

Introduce 50 ml of dilution solvent into a 100 ml volumetric flask. Accurately weigh approximately 1 g of substance or substances of interest into a 100 ml volumetric flask, starting with the least volatile substance. Make up to 100 ml with dilution solvent, stopper and shake to mix.

**ISO 16000-6:2004(E)****5.6.2 Solution containing approximately 1 000 µg/ml of each liquid component.**

Introduce 50 ml of dilution solvent into a 100 ml volumetric flask. Add 10 ml of solution 5.6.1. Make up to 100 ml with dilution solvent, stopper and shake to mix.

**5.6.3 Solution containing approximately 100 µg/ml of each liquid component.**

Introduce 50 ml of dilution solvent into a 100 ml volumetric flask. Add 10 ml of solution 5.6.2. Make up to 100 ml with dilution solvent, stopper and shake to mix.

**5.6.4 Solution containing approximately 10 µg/ml of each liquid component.**

Introduce 50 ml of dilution solvent into a 100 ml volumetric flask. Add 10 ml of solution 5.6.3. Make up to 100 ml with dilution solvent, stopper and shake to mix.

**5.6.5 Solution containing approximately 1 µg/ml of each liquid component.**

Introduce 50 ml of dilution solvent into a 100 ml volumetric flask. Add 10 ml of solution 5.6.4. Make up to 100 ml with dilution solvent, stopper and shake to mix.

**5.7 Standard sorbent tubes, loaded by spiking.**

Standard sorbent tubes are prepared by injecting aliquots of standard solutions onto clean sorbent tubes as follows. A sorbent tube is fitted to the injection unit of the gas chromatograph (GC) (6.10) through which inert purge gas is passed at 100 ml/min, and a 1 µl to 5 µl aliquot of an appropriate standard solution is injected through the septum. After 5 min, the tube is then disconnected and sealed. Prepare fresh standard tubes with each batch of samples.

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Introducing liquid standards onto sorbent tubes via a GC injector is considered the optimum approach to liquid standard introduction, as components reach the sorbent bed in the vapor phase. Alternatively, liquid standards may be introduced directly onto the sorbent bed using a syringe (6.3).

NOTE Calibration mixtures should be prepared in controlled environmental temperature conditions. Before use the solutions are tempered accordingly.

**5.8 Commercial, preloaded standard tubes.**

Certified, preloaded commercial standard tubes are available. They can be used for establishing analytical quality control and for routine calibration.

**5.9 Inert carrier gas, e.g. He, Ar, N<sub>2</sub>.**

The purity of the carrier gas should permit the detection of an injection of 0,5 ng of toluene.

NOTE The quality of the carrier gas is of great importance, as contaminants possibly contained in the gases are enriched in the cold trap together with the substances to be analysed.

**6 Apparatus**

Ordinary laboratory apparatus and the following.

**6.1 Sorbent tubes, of stainless steel or glass, containing at least 200 mg of Tenax TA<sup>®</sup> sorbent (5.3), with metal screw caps and polytetrafluoroethene (PTFE) ferrules.**

Tubes with outside diameter of 6 mm, inside diameter of 5 mm, and of length 90 mm fulfil the requirement and are used in many commercial thermal desorbers. Use deactivated glass wool or other suitable mechanism, e.g. stainless steel frit, to retain the sorbent in the tube.