



SLOVENSKI STANDARD

SIST ISO 16000-29:2015

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Notranji zrak - 29. del: Preskusne metode za detektorje hlapnih organskih spojin (VOC)

Indoor air - Part 29: Test methods for VOC detectors

Air intérieur - Partie 29: Méthodes d'essai pour détecteurs de composés organiques volatils (COV)

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Indoor air —

Part 29: Test methods for VOC detectors

Air intérieur —

*Partie 29: Méthodes d'essai pour détecteurs de composés organiques
volatils (COV)*

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ISO 16000-29:2014(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.

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 documents 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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is 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 (NO₂)
- 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 20: Detection and enumeration of moulds — Determination of total spore count
- Part 21: Detection and enumeration of moulds — Sampling from materials
- 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 (CO₂)
- Part 27: Determination of settled fibrous dust on surfaces by (SEM) scanning electron microscopy (direct method)
- Part 28: Determination of odour emissions from building products using test chambers
- 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 buildings for pollutants and other injurious factors — Inspections

The following parts are under preparation:

- Part 33: Determination of phthalates with gas chromatography/mass spectrometry (GC-MS)
- Part 34: Strategies for the measurement of airborne particles (PM 2,5 fraction)
- Part 35: Measurement of polybrominated diphenylether, hexabromocyclododecane and hexabromobenzene
- Part 36: Test method for the reduction rate of airborne bacteria by air purifiers using a test chamber

ISO 16000-29:2014(E)**Introduction**

Volatile organic compounds (VOCs) of indoor air diffuse from building materials, bounding agents, furniture, pesticides, and other sources. In such a situation, VOC detectors are expected to be widely used for screening, monitoring indoor VOC concentrations, locating sources, controlling ventilation systems, and so on. Therefore, it is desirable to use highly sensitive VOC detectors that can detect a range of VOCs within a building. Reflecting the situation as such, several VOC detectors are commercially available. This part of ISO 16000 contains important quantitative and technical specifications for VOC testing methods intended to improve the reliability of the VOC detection and realize broader use of VOC detectors.

ISO 16017,^{[1][2]} ISO 12219,^{[3][4][5][6][7]} and ISO 16000-6^[9] also focus on volatile organic compound (VOC) measurements.

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Indoor air —

Part 29: Test methods for VOC detectors

1 Scope

This part of ISO 16000 specifies test methods of the performance of VOC detectors that are designed to monitor indoor and living atmosphere VOC concentration as well as to control indoor air quality in portable, mobile, and remote applications. The provisions in this part of ISO 16000 cover VOCs detectors as well as detectors for individual VOCs. This part of ISO 16000 sets out only the requirements applicable to a test method of VOC detectors such as response time, stability, and measuring range.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61000-4-1, *Electromagnetic compatibility (EMC) — Part 4-1: Testing and measurement techniques — Overview of IEC 61000-4 series* (standards.iteh.ai)

IEC 61000-4-3, *Electromagnetic compatibility (EMC) — Part 4-3: Testing and measurement techniques — Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) — Part 4-4: Testing and measurement techniques — Electrical fast transient/burst immunity test*

3 Terms and definitions

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

3.1

aspirated VOC detector

VOC detectors in which test gas is presented to the VOC sensor(s) in a forced manner (e.g. using a gas sampling pump with a pressure differential to induce test gas flow)

3.2

clean air

air that is free of detectable impurities

Note 1 to entry: For the purposes of this part of ISO 16000, the impurities are VOC, flammable gas, and interfering gas.

3.3

diffusion type VOC detector

VOC detector in which the transfer of VOC gas from the atmosphere to the gas sensor takes place by random molecular movement, i.e. under conditions in which there is no aspirated flow

ISO 16000-29:2014(E)**3.4****final indication**

adjudged or displayed stable indication

Note 1 to entry: For the purposes of this part of ISO 16000, indication is a VOC concentration provided by a VOC detector.

3.5**VOC detector**

assembly with an integrated or a remote VOC sensor that is intended to monitor VOCs

3.6**VOC sensing element**

component of a VOC sensor that responds to variation in VOC concentration

3.7**VOC sensor**

assembly, which contains the VOC sensing element and can also contain circuit components associated with the VOC sensing element

3.8**interferent**

any substance that adversely affects the detection accuracy

Note 1 to entry: For the purposes of this part of ISO 16000, detection accuracy is for final indication of a VOC detector.

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3.9**poisoning**

phenomenon caused by any interferent that permanently affects the sensitivity of a sensing element

Note 1 to entry: For the purposes of this part of ISO 16000, the sensing element is used for a VOC detector.

3.10**stabilization**

state in which three successive readings of a VOC detector indicate no change greater than 10 % of the concentration of the test gas

3.11**test gas**

mixture of clean air with a known concentration of one or more VOCs

Note 1 to entry: For the purposes of this part of ISO 16000, test gas is used for performance testing of a VOC detector.

3.12**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 to entry: This classification has been defined by the World Health Organization.

Note 2 to entry: 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.

3.13**warm-up time**

time interval between the time when the apparatus is switched on and the time when the apparatus is ready to measure

Note 1 to entry: For the purposes of this part of ISO 16000, the apparatus is a VOC detector.

4 Principle

VOC detectors are designed to detect one or more VOCs as target compounds. Test methods for assessing the performance of VOC detectors are defined. VOC detectors are classified into two categories; one is for specific VOC detection and the other for VOC mixtures (VOCs). In the case of the specific VOC detector, the target VOC concentration is provided upon testing of a standard test gas containing the VOC as one component. The component of standard test gas for VOC mixture detectors has been determined experimentally as described in [Annex C](#). To improve the reliability of VOC detectors, this part of ISO 16000 sets out test methods of VOC detectors which also evaluate response time, stability, poisoning, and so on.

There are several types of VOC detectors with different detection principles such as semiconducting type, PID type, and interference-enhanced reflection type detectors. The principle of operation of the semiconducting type detector depends upon changes of electrical conductance that occur by chemisorption on the surface of the heated sensing element when exposed to gas other than air. Gas concentrations are inferred by measuring the change of resistance. In the PID type detector, the detection principle is based on ionization of gases by ultraviolet radiation from a special lamp of known wavelength, and hence photon energy, usually quoted in electronvolts (e.g. 10,6 eV). The PID type detector can detect most of VOCs. Ionization potential of various substances can be found in the literature or a list can be obtained from the apparatus supplier. The detection principle of the interference-enhanced reflection type detector is based on the adsorption of VOCs into polymer film. The swelling of the polymer film makes the film thickness increase. This change of the film thickness is detected by reflectivity using LED light.

NOTE The concentration given by each detector type when exposed to mixtures in an environment is not equivalent because of the different nature of the detection principles. Even if each detector is calibrated against the same calibration gas mixture, it would not result in equivalency for environmental measurement. The VOC mixture concentration from any such detector would not be equivalent to the TVOC or TVOC SUM values defined in ISO 16000-6.

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5 Test

5.1 Requirements for tests

5.1.1 Number of samples

The tests shall be carried out on one VOC detector. Another VOC detector can be used for the poisoning test (see [5.4.10](#)).

5.1.2 Sequence of tests

The drop test shall be performed at the beginning of the test sequence. Other tests specified in [5.4](#) shall be carried out in a sequence to be defined by the organization performing the tests.

5.1.3 Preparation of the VOC detector before testing

The VOC detector shall be prepared and mounted in a manner representative of the typical application, in accordance with the instruction manual, including all necessary interconnections, initial adjustments, calibration, and warm-up time. In order to keep the detector condition appropriate, the calibration and adjustments, including zero adjustment and span adjustment, can be carried out, where necessary, at the beginning of each test.

- a) Battery-powered detectors: When an indication of low battery condition is provided for detectors powered with integral batteries, the nature and purpose of this indication shall be checked in the manual.
- b) Software-controlled detectors: In software-controlled detectors, the risks arising from faults in the program shall be taken into account including conversion and data transmission errors.

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5.1.4 Performance requirements

The guidelines of the performance requirements specified in the test are indicated in [Annex A](#).

5.2 Test equipment

Mask-type, flow-type, or chamber-type gas delivery equipment is recommended in [Annex B](#). Alternative equipment can also be used. The test procedure specific to each test method shall be followed. When a mask is used for the injection of test gas into the detector, the design and operation of the mask (in particular, the pressure and velocity inside the mask) shall not inadmissibly influence the response of the detector or the results obtained.

A chamber that can be sealed with controlled conditions of temperature, humidity, and test gas concentration shall be used. A chamber shall be made of materials not prone to appreciable absorption and desorption of VOCs such as stainless steel. The type of test equipment shall be described when the results of the tests are indicated in a specification sheet.

It is recommended that the testing laboratory should consult with the manufacturer in determining the design of the mask. The manufacturer should provide a suitable mask together with details of suggested pressure or flow for application of the test gases with the VOC detector. Any other methods specified in an International Standard or Technical Specification should be used, provided that such methods are demonstrated independently for their validity.

5.3 Conditions for standard response test**5.3.1 Temperature**

Unless otherwise specified, the tests shall be carried out at a temperature within $20\text{ °C} \pm 5\text{ °C}$ and the temperature variation shall not cross over $20\text{ °C} \pm 5\text{ °C}$ throughout the duration of each test.

5.3.2 Pressure

Unless otherwise specified, the tests shall be performed at pressures between 86 kPa and 108 kPa and the pressure shall be kept constant within $\pm 1\text{ kPa}$ throughout the duration of each test.

5.3.3 Humidity

Unless otherwise specified, the tests shall be carried out at a relative humidity (RH) within $50\% \pm 30\%$ and the RH shall be maintained constant within $\pm 10\%$ throughout the duration of each test.

5.3.4 Voltage

Unless otherwise specified, commercial-powered and given DC-powered VOC detectors shall be operated within 2 % of the manufacturer's recommended supply voltage and frequency in the case of commercial power.

Battery-powered detectors shall be equipped with new or fully charged batteries at the commencement of each series of tests.

5.3.5 Orientation

The VOC detectors shall be tested in the orientation recommended by the manufacturer indicated in an instruction manual.

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5.4 Test methods

5.4.1 Standard response test

5.4.1.1 Standard test gas

The composition of the standard test gas shall be as follows.

a) Detectors for VOC mixtures:

- 1) gas component [types i) and ii) are detectors with high sensitivity; type iii) is a detector with low sensitivity]:
 - i) semiconducting type: VOC mixed gas of *n*-octane and xylene;
 - ii) PID type: VOC mixed gas of toluene, *n*-decane, α -pinene, and methyl isobutyl ketone;
 - iii) interference-enhanced reflection type: VOC mixed gas of toluene, *n*-decane, α -pinene, methyl isobutyl ketone, *p*-dichlorobenzene, and butyl acetate;
- 2) gas concentration: For all types of detectors, the total concentration of each gas component shall be 300 $\mu\text{g}/\text{m}^3$. Each gas component in the standard test gas shall have the same concentration. If this is not possible due to instrument limitations, gas concentration shall be set as low as possible for the measuring range of the VOC detectors.

b) Detectors for individual VOCs:

- 1) gas component: target gas indicated in specification sheet of the VOC detector;
- 2) gas concentration: one-fourth of the calibration gas concentration specified by manufacturer, however below 1 mg/m^3 . [SIST ISO 16000-29:2015](https://standards.iteh.ai/catalog/standards/sist/b3fc94c9-7d07-42da-aa6a-0008460a4536/iso-16000-29-2015)

Choose the detector in function of the gas components being measured. Apply the criteria for the selection of test gases in [Annex C](#).

The uncertainty of the test gas concentration shall not exceed 5 %. The standard test gas can be supplied e.g. by cylinder gas or diffusion tube method (see [Annex D](#)) or permeation tube method.

NOTE Gas concentration is expressed as the mass of VOCs included in a volume of 1 m^3 under standard conditions of temperature and pressure of 20 °C and 101,325 kPa.

5.4.1.2 Procedure

The VOC detector shall be exposed to clean air until stable test conditions indicated in [5.3.1](#), [5.3.2](#), and [5.3.3](#) are achieved. The indication shall be recorded as the offset value. The atmosphere shall be changed to the standard test gas, and the final indication shall be recorded.

5.4.2 Validation of accuracy

After the calibration and adjustment of [5.1.3](#), the VOC detector shall be exposed to the gas with a composition in accordance with [5.4.1.1](#) at four gas concentrations evenly distributed over the measuring range defined by the lowest and highest measurable concentration, starting with the lowest and finishing with the highest of the selected gas concentrations. This operation shall be carried out three times consecutively.