
Indoor air —

**Part 32:
Investigation of buildings for the
occurrence of pollutants**

Air intérieur —

*Partie 32: Investigation sur la présence de polluants dans les
bâtiments*

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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 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).

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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 the occurrence of pollutants

Introduction

Investigations on the occurrence of pollutants in buildings and their technical installations make it possible to determine the level of pollution (e.g. polychlorinated biphenyls, asbestos) at the time of the investigation (actual condition) and to assess its impact.

During the investigation it should be considered that structural changes (e.g. thicker building envelope), hygiene conditions (e.g. ventilation, air flows) and other factors may affect the actual condition as surveyed and should therefore be indicated if necessary.

In specific circumstances it may be expedient to assess the indoor air quality in order to undertake an investigation on pollutants.

Treatment of contaminated construction products resulting from the demolition, partial dismantling and remediation of buildings is not covered by this part of ISO 16000.

The legal regulations in the different countries have to be taken into account.

This part of ISO 16000 is based on Reference [1].

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Indoor air —

Part 32: Investigation of buildings for the occurrence of pollutants

1 Scope

This part of ISO 16000 specifies the requirements for investigating buildings and other structures and their technical installations for the occurrence of pollutants, as a basis for subsequent sampling of suspect areas and determination of the type and quantity of pollutants, which are described in other parts of ISO 16000.

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.

ISO 16000-1, *Indoor air — Part 1: General aspects of sampling strategy*

3 Terms and definitions

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

3.1

construction product **building product**

material, material preparation or combination of materials which form(s) a permanent part of a building

Note 1 to entry: Construction product is the official term for building material in the European legislation which is cited in this part of ISO 16000.

3.2

structural element

building element or component of a building element

EXAMPLE Wall, floor, roof or part thereof.

3.3

component of structural element

one of several components or layers of a structural element comprising one construction product with uniform characteristics

EXAMPLE Bricks as components or plasterwork as a layer on a wall.

3.4

building

part of the collective outcome of a construction and civil engineering work that, when taken as a whole, fulfils an economic and technical function

3.5

site visit

visual site investigation of the spatial entity on which the pollution investigation concept is based

3.6

sampling

collecting of samples from construction elements or from other media (e.g. air, water) in and around the building in order to conduct appropriate analyses to give an indication of the extent of contamination in the building under investigation

3.7

pollutant

substance which either alone or in combination with other substances or through its products of degradation or emissions can have a harmful effect on human health or the environment or can lead to a reduction in the value or restriction in the use of the building

3.8

pollution investigation

investigation of the condition of the building with regard to the extent of contamination

3.9

remediation

removal, immobilisation and control measures of pollutants and other hazards to achieve the specified remediation target

3.10

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 (see Reference [2]).

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 may be used for classification of organic chemicals (see Reference [3]).

Note 3 to entry: Due to practical reasons to be taken into account for test chambers, the definition given in ISO 16000-9 differs from that defined in this part of ISO 16000.

3.11

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 to entry: This classification has been defined by the World Health Organization (see Reference [2]).

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 may be used for classification of organic chemicals (see Reference [3]).

4 Type, origin and causes of pollutants in buildings

Pollutants include hazardous materials and preparations which are listed in different national laws or European laws in the different fields, e.g. Construction Product Regulation^[4] and REACH^[5]. Other factors (e.g. anthropogenic emissions or electromagnetic fields, which are not dealt with in this part of ISO 16000) which may have an adverse effect on human health and well-being should also be considered. Pollutants may be of very diverse origin.

The following causes of pollution have been identified.

- a) Primary sources of pollutants in the construction products themselves: asbestos, man-made mineral fibres, heavy metals, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), halogenated organic compounds, volatile organic substances (VOCs) biocide active agents from wood preservatives, odour emissions from construction products and radioactive construction products.

- b) During interaction of several primary sources new pollutions not originally existing in the construction products can be generated by chemical reactions between single construction products (secondary emission of a primary source), e.g. odour emissions from multi-layered sandwich structure of a flooring.
- c) Such secondary emissions can be generated by chemical reaction in air (e.g. by reaction of VOC with ozone).
- d) Secondary sources of pollutants generated by the transfer of pollutants to other structural elements or building areas: e.g. asbestos dust, PCBs, PAHs, contaminations due to the use of solvents and operation, e.g. from building preservation (such as cleaning, disinfection or pest control), production processes (e.g. tetrachloroethylene used for dry cleaning, toluene used in printing works), microbial contamination in consequence of water damages.
- e) The influence of pollution from geogenic (e.g. radon) or anthropogenic sources (e.g. particles and dust, pet or vermin allergens, soot).
- f) Electromagnetic fields, sound, vibrations; not dealt with in this part of ISO 16000.
- g) Biological hazards (potential sensitizing, toxic or infectious effects of mould, microbial volatile organic compounds (MVOC), bacteria, pigeon droppings, mess and rests of rodents and, vermin.
- h) Transient pollution and emissions caused by use: anthropogenic carbon dioxide, bodily exhalations, humidity, odours.
- i) Pollutants that enter the building by infiltration and ventilation provision.
- j) Structural-physical weaknesses as origin of humidity penetration and mould.

[Annex A](#) lists examples of pollutants contained in specific structural elements whereas in [Annex B](#) important examples of VOCs and their possible sources (see [Table B.1](#)) and vice versa building related VOC sources and their VOC emissions (see [Table B.2](#)) are given.

5 Method of undertaking an investigation of pollutants in buildings

5.1 General

Investigations and assessments are performed by specialists and inspection bodies that have the relevant expertise in the following fields:

- a) building and associated installations or equipment;
- b) materials science and material testing;
- c) pollutants in buildings and their technical installations originating from used construction materials, use or maintenance;
- d) laws, regulations and technical rules;
- e) health protection, environment protection and occupational safety, if necessary.

Prior to initiating an investigation of pollutants in buildings, a pollution investigation concept shall be submitted which outlines the procedure.

The pollution investigation concept shall be described in the pollution investigation report, based on:

- the aim of the pollution investigation and
- the motive for the pollution investigation.

5.1.1 Aim of the investigation of pollutants in buildings

The pollution investigation will focus on:

- a) a specific pollutant;
- b) a specific group of pollutants; or
- c) an indeterminate range of pollutants.

It shall also be established whether the spatial entity on which the pollution investigation is based involves:

- a part of a building;
- an entire building;
- several building units;
- exterior as well as interior of a building.

5.1.2 Motive for the investigation of pollutants in buildings

An investigation of buildings for contamination may be motivated by the following factors:

- a) inventory control;
- b) complaints;
- c) purchase or sales examination (due diligence);
- d) preparation for remediation, conversion or demolition;
- e) as a basis for facility management and maintenance (facility management tool).

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5.2 Phases of the pollution investigation

An investigation of buildings for contamination generally takes place in several, systematically coordinated phases which focus on the following key areas:

- a) research into the circumstances relating to site, building and use;
- b) evaluation and recording of complaints;
- c) site visit;
- d) set-up of a sampling plan;
- e) sampling and analysis;
- f) evaluation and assessment.

This represents the ideal sequence of events. In practice, individual phases may be omitted (e.g. research phase in the absence of any documents or information), reduced in scope (e.g. site visit if access is restricted) or repeated in the light of new information (e.g. unexpected results of sampling and analysis call for further investigation of the building's history, or additional visits). This shall be recorded in the investigation report.

The omission or reduction in the scope of research may result in extra time spent on site visits; however, no amount of research can compensate for the omission or curtailment of the site visit.

It may be sensible to undertake the sampling and analysis phase gradually by conducting preliminary qualitative and/or semi quantitative investigations (e.g. screening with dust samples, composite

samples, cumulative parameters, indoor air measurements) which consolidate information about the possible range of pollutants.

5.2.1 Research into the circumstances relating to site, building and use

The research phase involves gathering and recording all documentation and/or information relating to the building under investigation, its location and its former use.

This documentation and/or information may offer firm evidence or indications of the presence of certain pollutants, or even grounds for ruling out their existence, and serves as a useful tool for the subsequent investigative phases.

5.2.1.1 Researching the site

Site-related factors may affect the building due to interactions between the building and its location. These may be of geogenic nature (e.g. radon), they may be attributable to earlier environmental contamination on the site (e.g. brownfield sites, land contaminated by war) or caused by current emissions (e.g. traffic, industry). They may also be affected by climatic and/or other natural factors.

The following data sources may be used for investigating the site:

- a) registers of contaminated land and areas of potential pollution;
- b) underground radon levels;
- c) aerial photographs;
- d) archive material derived from various sources;
- e) environmental studies;
- f) interviews with eyewitnesses (familiar with the site or facility).

5.2.1.2 Researching the building

Research into the building, as the focal point of the pollution investigation, should provide all requisite qualitative and quantitative information regarding:

- a) the recorded building stock;
- b) the relevant construction products used;
- c) heating and sewage systems and, where applicable, ventilation and hydraulic systems;
- d) any maintenance, renovation and conversion work that has been carried out;
- e) events involving accidents, fire, war damage, water damages.

The following data sources may be used for this purpose:

- company archives (building documentation, building plans, technical specifications),
- government archives,
- official certificates and relating correspondence,
- historical tender documents or construction product specifications,
- enquiry of users in the past (maintenance man, users of the building in the past).