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Indoor air —

Part 12:

Sampling strategy for polychlorinated biphenyls (PCBs), polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) and polycyclic aromatic hydrocarbons (PAHs)

Air intérieur —

*Partie 12: Stratégie d'échantillonnage des polychlorobiphényles (PCB), des polychlorodibenzo-*p*-dioxines (PCDD), des polychlorodibenzofuranes (PCDF) et des hydrocarbures aromatiques polycycliques (HAP)*



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Contents

Page

Foreword	iv
Introduction	vi
1 Scope	1
2 Normative references	1
3 Sources and incidence of PCBs, PCDDs/PCDFs and PAHs	1
4 Measurement procedure	3
5 Measurement planning	4
Annex A (informative) Structures, toxicity and calculation of toxic equivalents	9
Annex B (informative) Procedure for investigating possible sources of indoor PCB pollution with a view to possible renovation	13
Annex C (informative) Indoor investigations for PCDDs/PCDFs after fires	15
Bibliography	16

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 16000-12 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 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/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*

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- *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/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 23: Performance test for evaluating the reduction of formaldehyde concentrations by sorptive building materials*

The following parts are under preparation:

- *Part 18: Detection and enumeration of moulds — Sampling by impaction*
- *Part 19: Sampling strategy for moulds*
- *Part 24: Performance test for evaluating the reduction of the concentrations of volatile organic compounds and carbonyl compounds (except formaldehyde) by sorptive building materials*
- *Part 25: Determination of the emission of semi-volatile organic compounds for building products — Micro-chamber method*
- *Part 27: Standard method for the quantitative analysis of asbestos fibres in settled dust*
- *Part 28: Sensory evaluation of emissions from building materials and products*

The following parts are planned:

- *Part 20: Detection and enumeration of moulds — Sampling from house dust*
- *Part 21: Detection and enumeration of moulds — Sampling from materials*
- *Part 22: Detection and enumeration of moulds — Molecular methods*

Furthermore, VOC measurements by pumped and diffusive sampling are specified in:

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*

ISO 16017-2, *Indoor, ambient and workplace air — Sampling and analysis of volatile organic compounds by sorbent tube/thermal desorption/capillary gas chromatography — Part 2: Diffusive sampling*

Introduction

ISO 16000 (all parts) specifies general requirements relating to the measurement of indoor air pollutants and the necessary conditions to be observed before or during the sampling of individual pollutants or groups of pollutants as well as the measurement procedures themselves (see Foreword).

Sampling of polychlorinated biphenyls (PCBs), polychlorinated dibenzo-*p*-dioxins (PCDDs) also known as polychlorinated oxanthrenes, and polychlorinated dibenzofurans (PCDFs) in indoor air is described in ISO 16000-13 whereas the corresponding extraction, clean-up and analysis by high-resolution gas chromatography/mass spectrometry is specified in ISO 16000-14. For sampling and analysis of PAHs, ISO 12884 may be employed.

Several PCBs, PCDDs/PCDFs, and PAHs are considered to be potential human carcinogens. There are 209 individual PCBs (congeners), 75 PCDDs and 135 PCDFs. The most toxic PCBs are those that are coplanar and structurally similar to PCDDs. The most toxic PCDD is 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD). The toxicity of PCBs and PCDDs/PCDFs are calculated according to an internationally accepted system (see Annex A and Reference [1]). In 1997 (updated in 2005), a group of experts of the World Health Organization (WHO) fixed toxic equivalent factors (TEFs) for PCDDs/PCDFs and 12 PCBs, known as dioxin-like PCBs (Reference [1]) (see Annex A). These 12 dioxin-like PCBs consist of four non-ortho PCBs and eight mono-ortho PCBs (no or only one chlorine atom in 2-, 2'-, 6- and 6'-position), having a planar or mostly planar structure, see Table A.2.

The principal sources of PCDDs/PCDFs in indoor air are impurities in wood preservatives containing pentachlorophenol (PCP) and emissions from fires involving chlorinated products. PCBs are emitted into the indoor air primarily from concrete sealers, certain paints, or electrical capacitors; their use for these applications has been banned in many countries in recent years. Emissions from nearby landfills and abandoned industrial sites may also contribute PCBs and PCDDs/PCDFs to the indoor environment. The major origin of PAHs indoors is from combustion processes (mostly tobacco smoke and smoke from open fires).

Except for the case where there are direct indoor sources, PCBs and PCDDs/PCDFs enter indoor air from ambient air by ventilation. However, in ambient air these compounds are usually found at extremely low concentrations; e.g. several femtograms per cubic meter for PCDDs/PCDFs and about 10 pg/m³ to several hundred picograms per cubic meter for total PCBs. The compounds addressed in this part of ISO 16000 are usually distributed between the gas and particle phases in ambient or indoor air, depending on the temperature, humidity, degree of chlorination, their concentration and capacity to associate with suspended particulate matter. Separate analyses of the filter and vapour trap will not reflect the original atmospheric phase distributions at normal ambient temperatures because of volatilization of compounds from the filter and should not be attempted.

Shipping of PCDD/PCDF standard reference materials shall comply with national legal regulations. They shall be transported in special containers that are commercially available. Handling should only be done by trained operators.

The sampling strategy specified in this part of ISO 16000 presupposes familiarity with ISO 16000-1.

This part of ISO 16000 uses the definition of indoor environments given by the Expert Council on Environmental Matters (see ISO 16000-1 and Reference [2]): dwellings — having living rooms, bedrooms, DIY (do-it-yourself) rooms, sports rooms and cellars, kitchens and bathrooms; workrooms or work places — in buildings that are not subject to health and safety inspections in regard to air pollutants (e.g. offices, sales premises); public buildings — e.g. hospitals, schools, kindergartens, sport halls, libraries, restaurants and bars, theaters, cinemas or other function rooms); and the interiors of private and public transport vehicles.

This part of ISO 16000 is based on VDI 4300-2[3].