SVENSK STANDARD
SS-EN ISO 16000-12:2008

Fastställd/Approved: 2008-04-14
Publicerad/Published: 2008-05-12
Utgåva/Edition: 1
Språk/Language: engelska/English
ICS: 13.040.20

Provtagningsstrategi för polyklorerade bifenyler (PCB), polyklorerade dibenso-p-dioxiner (PCDD), polyklorerade dibensofuraner (PCDF) och polyklorerade aromatiska kolväten (PaH) (ISO 16000-12:2008)

Indoor air –
Part 12: Sampling strategy for polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) and polycyclic aromatic hydrocarbons (PAHs) (ISO 16000-12:2008)

SWEDISH STANDARDS INSTITUTE

Hitta rätt produkt och ett leveranssätt som passar dig

Standarder
Genom att följa gällande standard både effektiviserar och säkrar du ditt arbete. Många standarder ingår dessutom ofta i paket.

Tjänster
Abonnemang är tjänsten där vi uppdaterar dig med aktuella standarder när förändringar sker på dem du valt att abonnera på. På så sätt är du säker på att du alltid arbetar efter rätt utgåva.
e-nav är vår online-tjänst som ger dig och dina kollegor tillgång till standarder ni valt att abonnera på dygnet runt. Med e-nav kan samma standard användas av flera personer samtidigt.

Leveranssätt
Du väljer hur du vill ha dina standarder levererade. Vi kan erbjuda dig dem på papper och som pdf.

Andra produkter
Vi har böcker som underlättar arbetet att följa en standard. Med våra böcker får du ökad förståelse för hur standarder ska följas och vilka fördelar den ger dig i ditt arbete. Vi tar fram många egna publikationer och fungerar även som återförsäljare. Det gör att du hos oss kan hitta över 500 unika titlar. Vi har även tekniska rapporter, specifikationer och "workshop agreement". Matriser är en översikt på standarder och handböcker som bör läsas tillsammans. De finns på sis.se och ger dig en bra bild över hur olika produkter hör ihop.

Standardiseringsprojekt
Du kan påverka innehållet i framtida standarder genom att delta i någon av SIS ca 400 Tekniska Kommittéer.

Find the right product and the type of delivery that suits you

Standards
By complying with current standards, you can make your work more efficient and ensure reliability. Also, several of the standards are often supplied in packages.

Services
Subscription is the service that keeps you up to date with current standards when changes occur in the ones you have chosen to subscribe to. This ensures that you are always working with the right edition.
e-nav is our online service that gives you and your colleagues access to the standards you subscribe to 24 hours a day. With e-nav, the same standards can be used by several people at once.

Type of delivery
You choose how you want your standards delivered. We can supply them both on paper and as PDF files.

Other products
We have books that facilitate standards compliance. They make it easier to understand how compliance works and how this benefits you in your operation. We produce many publications of our own, and also act as retailers. This means that we have more than 500 unique titles for you to choose from. We also have technical reports, specifications and workshop agreements. Matrices, listed at sis.se, provide an overview of which publications belong together.

Standardisation project
You can influence the content of future standards by taking part in one or other of SIS's 400 or so Technical Committees.

Europastandarden EN ISO 16000-12:2008 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN ISO 16000-12:2008.

The European Standard EN ISO 16000-12:2008 has the status of a Swedish Standard. This document contains the official English version of EN ISO 16000-12:2008.

Upplysningar om sakinnehållet i standarden lämnas av SIS, Swedish Standards Institute, telefon 08-555 520 00.
Standarder kan beställas hos SIS Förlag AB som även lämnar allmänna upplysningar om svensk och utländsk standard.

Information about the content of the standard is available from the Swedish Standards Institute (SIS), tel +46 8 555 520 00.
Standards may be ordered from SIS Förlag AB, who can also provide general information about Swedish and foreign standards.

SIS Förlag AB, SE 118 80 Stockholm, Sweden. Tel: +46 8 555 523 10. Fax: +46 8 555 523 11.
E-mail: sis.sales@sis.se Internet: www.sis.se

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 16000-12

April 2008

ICS 13.040.20

English Version

Indoor air - Part 12: Sampling strategy for polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) and polycyclic aromatic hydrocarbons (PAHs) (ISO 16000-12:2008)

Air intérieur - Partie 12: Stratégie d'échantillonnage des polychlorobiphényles (PCB), des polychlorodibenzo-p-dioxines (PCDD), des polychlorodibenzofuranes (PCDF) et des hydrocarbures aromatiques polycycliques (HAP) (ISO 16000-12:2008)

Innenraumluftverunreinigungen - Teil 12: Probenahmestrategie für polychlorierte Biphenyle (PCB), polychlorierte Dibenzo-p-dioxine (PCDD), polychlorierte Dibenzofurane (PCDF) und polycyclische aromatische Kohlenwasserstoffe (PAH) (ISO 16000-12:2008)

This European Standard was approved by CEN on 21 March 2008.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN ISO 16000-12:2008: E

Contents

Page

Foreword

This document (EN ISO 16000-12:2008) has been prepared by Technical Committee ISO/TC 146 "Air Quality" in collaboration with Technical Committee CEN/TC 264 "Air Quality", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2008, and conflicting national standards shall be withdrawn at the latest by October 2008.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Endorsement notice

The text of ISO 16000-12:2008 has been approved by CEN as a EN ISO 16000-12:2008 without any modification.

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/m^3 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].

Indoor air —

Part 12: Sampling strategy for polychlorinated biphenyls (PCBs), polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) and polycyclic aromatic hydrocarbons (PAHs)

1 Scope

This part of ISO 16000 specifies the planning of measurements for polychlorinated biphenyls (PCBs), polychlorinated dibenzo-*p*-dioxins (PCDDs) also known as polychlorinated oxanthrenes, polychlorinated dibenzofurans (PCDFs) and polycyclic aromatic hydrocarbons (PAHs) in indoor air. In the case of indoor air measurements, the careful planning of sampling and the entire measurement strategy are of particular significance since the result of the measurement may have far-reaching consequences, e.g. with respect to the need for remedial action or the success of such an action.

An inappropriate measurement strategy may contribute more overall uncertainty to the measurement result than the measurement procedure itself.

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 12884, *Ambient air — Determination of total (gas- and particle-phase) polycyclic aromatic hydrocarbons — Collection on sorbent-backed filters with gas chromatographic/mass spectrometric analyses*

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

ISO 16000-13, *Indoor air — 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*

ISO 16362, *Ambient air — Determination of particle-phase polycyclic aromatic hydrocarbons by high performance liquid chromatography*

3 Sources and incidence of PCBs, PCDDs/PCDFs and PAHs

3.1 General

PCBs, PCDDs/PCDFs and PAHs get into indoor air from a variety of sources as explained in 3.2, 3.3, and 3.4. Owing to sorption effects, the compounds originating from primary sources can be sorbed by various surfaces that may then act as secondary sources.

Not all sources and processes that could result in elevated concentrations of these substances in indoor air are known as yet. Table 1 gives an overview of the highest yielding sources that can all be designated as primary. Depending on the strength and period of action of the individual primary sources, vaporization, diffusion, sorption or sedimentation processes lead to contamination of the surfaces in the room. Even after removal of the primary sources, these contaminated surfaces themselves can act as secondary sources.

Table 1 — Possible sources of PCBs, PCDDs/PCDFs and PAHs in indoor air

Class of substance	Sources
PCBs	PCB-containing jointing materials
	Defective capacitors, e.g. in lamps
	Defective transformers
	Paints and varnishes containing flame retardants
	Plasticizers used in plastics, e.g. in sealing material for expansion joints in prefabricated concrete construction
	Forming oil employed in concrete construction
	Soil tracked in from emissions and polluted sites
PCDDs/PCDFs	Pentachlorophenol-containing materials, e.g. wood preservative paints, leather
	Fires in the presence of halogenated materials
	Soil tracked in from emissions and polluted sites
PAHs	Tobacco smoke
	Smoke from open fires
	Dyes or products containing tar oil or pitch (e.g. as glue for parquet flooring)
	Soil tracked in from emissions and polluted sites
	Cooking

When there are no obligatory criteria of assessment for evaluating the indoor air, an initial evaluation of the results of the indoor air investigation can be carried out by comparison with the concentrations of the relevant substances in the ambient air. Table 2 shows some typical ambient air concentrations for benzo[*a*]pyrene (the guide component for PAHs), PCDDs/PCDFs [as toxic equivalents (TEQ) according to WHO, see Annex A.3] and PCBs [as the sum of the concentrations of six congeners; see footnote a) to Table 2].

Table 2 — Concentration ranges of PCBs, PCDDs/PCDFs and PAHs in the ambient air of urban areas

Class of substance	Ambient air, mean concentration range	
	urban level	high concentration site
PCBs [a]	5 ng/m^3 to 10 ng/m^3	—[b]
PCDDs/PCDFs [c]	0,05 pg/m^3 to 0,15 pg/m^3	0,15 pg/m^3 to 0,5 pg/m^3
PAHs (only benzo[*a*]pyrene)	0,5 ng/m^3 to 1 ng/m^3	1 ng/m^3 to 21 ng/m^3(Reference [7])

[a] Sum of the six PCB congeners (28, 52, 101, 138, 153, 180 according to the Ballschmiter System), multiplied by 5 to calculate the total PCB content.

[b] PCBs are ubiquitous, increased concentrations are encountered only in the immediate vicinity of contaminated buildings.

[c] Toxic equivalents, see Annex A.

3.2 PCBs

In the past, PCBs have been deliberately and openly employed indoors in a number of materials so as to achieve certain material properties. Thus, polymer-based sealing materials containing PCBs as plasticizers have been employed especially in buildings using the open concrete slab method of construction. In addition, lightweight boards treated with PCB-containing emulsion paints have been used for suspended ceilings, and wooden surfaces painted with PCB-containing flame retardants have also been found.

Closed systems are, for example, small PCB-containing capacitors which have found widespread use, among other things, in lamps. Due to government mandates and voluntary restrictions applied by manufacturers, PCBs are no longer used in capacitors, either in lamps or elsewhere.

If there are important sources of emission in the vicinity of the building being examined, the ambient air shall also be considered as a source.

3.3 PCDDs/PCDFs

PCDDs/PCDFs are present as impurities in pentachlorophenol (PCP). They can get into the indoor environment from pentachlorophenol-containing materials used up to the end of the 1970s and to a small extent up to the middle of the 1980s (Reference [4]). PCB-containing jointing compounds can also contain PCDDs/PCDFs and release them into room air.

In the case of fire, chlorine-containing organic materials, e.g. electric cable sheathing, floor coverings, and PVC door and window frames give rise to PCDDs/PCDFs bound to soot and other particles, which deposit on surfaces and, if not cleaned off, are a continual source of pollution in the indoor air. Recommendations for the renovation, evaluation, disposal, and procedures in the case of rooms contaminated in this way have been prepared by the German Federal Health Office (References [5] and [6]).

3.4 PAHs

PAHs are formed in all incomplete-combustion processes. The best known example is cigarette smoking. However, chimneys that do not draw properly or candles burning with a sooty flame can give rise to measurable amounts of PAHs. They can also be released by pitch-containing materials used in interior construction work.

4 Measurement procedure

4.1 General

Most PCBs, PCDDs/PCDFs and PAHs belong to the semi-volatile group of organic compounds. In indoor air, they are encountered both bound to particles (suspended and settled dust) and in the gas phase.

Sampling and analytical procedures for pollution measurement are subject to standardization (see Table 3).

Table 3 — Sampling and analytical procedures

Class of substance	Procedure	Brief description
PCBs	ISO 16000-13	Sampling using either a low volume sampler or a high volume sampler with a polyurethane foam or other suitable adsorbent material preceded by a particle filter.
PCDDs/PCDFs	ISO 16000-13	Sampling using either a low volume sampler or a high volume sampler with a polyurethane foam or other suitable adsorbent material preceded by a particle filter.
PAHs	ISO 12884, ISO 16362, national standards	ISO 12884 and ISO 16362 apply to ambient air and indoor air measurements. In the latter case, the user shall take into consideration that, due to noise, only a low volume sampler should be used (see ISO 16000-13). In this case, some adaptation is necessary.