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ISO 16000-7

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Indoor air —

Part 7: Sampling strategy for determination of airborne asbestos fibre concentrations

Air intérieur —

Partie 7: Stratégie d'échantillonnage pour la détermination des concentrations en fibres d'amiante en suspension dans l'air

Reference number
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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.

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 16000-7 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*

— *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 (NO_2)*

— *Part 16: Detection and enumeration of moulds — Sampling by filtration*

— *Part 17: Detection and enumeration of moulds — Culture-based method*

The following parts are under preparation:

— *Part 18: Detection and enumeration of moulds — Sampling by impaction*

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

— *Part 24: Performance test for evaluating the concentration reduction 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*

The following parts are planned:

— *Part 19: Sampling strategy for moulds*

— *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*

— *Part 26: Road vehicle interior test stand — Determination of VOC, SVOC and carbonyls including formaldehyde in car interiors*

Furthermore, two International Standards, ISO 16017-1 on pumped sampling and ISO 16017-2 on diffusive sampling, focus on volatile organic compound (VOC) measurements.

Introduction

Measurements of airborne asbestos fibre concentrations in indoor atmospheres are made for several reasons related to short-term or long-term exposure of building occupants to asbestos. One application of such measurements is to ensure that airborne asbestos fibres dispersed in areas of a building that are undergoing asbestos abatement do not result in unacceptable exposures of occupants in other areas of the building. After asbestos abatement is completed, measurements are made prior to removal of containment barriers and before safety precautions are discontinued to determine whether any residual asbestos that may remain in the abated area could give rise to unacceptable airborne asbestos exposures when the areas are re-occupied.

The characterization and assessment of ambient air at a fixed position, whether in a building or outside, is normally based on a series of measurements made over a long period of time, generally months or years. However, the release of asbestos fibres into ambient air is not constant and human, or in some cases animal, activity will result in short-term release episodes. Maintenance activity in particular will disturb asbestos-containing materials and settled dust in buildings. Control and monitoring of these activities will determine the long-term exposure levels [1][2]. Workplace atmospheres are also assessed by a series of repeated measurements, the number of measurements depending on the difference between the measured value and the control limit.

In contrast to the strategy used for assessment of long-term asbestos fibre concentrations and personal exposures, the assessment of asbestos fibre concentrations in connection with asbestos abatement measures is nearly always based on a set of measurements made at one time. This special situation needs to be taken into account, both when planning the measurements, and during collection of the air samples. It is not possible to predict long-term changes of airborne asbestos fibre concentrations resulting from any deterioration of asbestos-containing material or the type of usage of the rooms. However, through the use of an appropriate sampling strategy and sampling technique, and by taking extreme, but realistic, conditions into consideration, it is possible to simulate and estimate the short-term maximum asbestos fibre concentrations that can occur.

The sampling strategy described in this part of ISO 16000 is based on VDI 3492 [3].

Indoor air —

Part 7: Sampling strategy for determination of airborne asbestos fibre concentrations

1 Scope

This part of ISO 16000 specifies procedures to be used in planning of air measurements to determine the concentrations of asbestos in indoor atmospheres. Careful planning of the measurement strategy is important, because the results can become the basis of recommendations for major building renovations, or for the return of a building to normal occupancy status after removal of asbestos-containing materials.

This part of ISO 16000 uses the following definition for indoor environments as specified in ISO 16000-1:

— dwellings having living rooms, bedrooms, do-it-yourself (DIY) rooms, recreation rooms, cellars, kitchens and bathrooms;

— workrooms or workplaces in buildings which are not subject to health and safety inspections in regard to air pollutants (for example, offices and sales premises);

— public and commercial buildings (for example, hospitals, schools, kindergartens, sports halls, libraries, restaurants and bars, theatres and other function rooms);

— cabins of vehicles and public transport.

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

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

3 Sources and occurrence

Airborne fibres in building atmospheres can originate from various sources within or outside the building. Many of the fibres are organic, such as cotton or synthetic fibres released from upholstery fabrics or the clothing of the occupants, or cellulose fibres dispersed during manipulation of paper. Other organic fibres originating from vegetation can infiltrate the building from outside, or can be dispersed from potted plants. Inorganic fibres, such as asbestos, glass fibres, mineral wool fibres and gypsum can be released from various building materials. Release of airborne fibres from building materials can occur intermittently, particularly during disturbances of the materials during maintenance activities. Fragments of the materials can become detached when the materials are contacted, and, if not removed, these fragments can be pulverized by subsequent activities to form dust that can be dispersed into the atmosphere.

4 Terms and definitions

For the purposes of this part of ISO 16000, the following definitions apply.

4.1
abatement
activity undertaken to control the potential emission of asbestos fibres from an asbestos-containing building material by removing, enclosing or encapsulating the material, or by repairing damaged material

4.2
abatement containment area
space within which an asbestos abatement activity is performed and which is separated from the remainder of the building by a containment barrier

4.3
ambient sampling
air sampling to determine the airborne asbestos fibre concentration in the immediate vicinity of the building exterior

4.4
analytical sensitivity
calculated airborne asbestos fibre concentration, equivalent to counting of one asbestos fibre in the analysis

4.5
asbestos
term applied to a group of silicate minerals belonging to the serpentine and amphibole groups which have crystallized in the asbestiform habit, causing them to be easily separated into long, thin, flexible, strong fibres when crushed or processed.

NOTE NOTE The Chemical Abstracts Service Registry Numbers of the most common asbestos varieties are: chrysotile (12001-29-5), crocidolite (12001-28-4), grunerite asbestos (amosite) (12172-73-5), anthophyllite asbestos (77536-67-5), tremolite asbestos (77536-68-6) and actinolite asbestos (77536-66-4).

4.6
asbestos structure
term applied to an individual asbestos fibre, or any connected or overlapping grouping of asbestos fibres or bundles of asbestos fibres, with or without other particles

4.7
aspect ratio
ratio of length to width of a particle

4.8
background sampling
air sampling performed to determine the short-term asbestos fibre concentration in the air of occupied spaces during normal usage before an activity that can disturb asbestos

4.9
blank
unused filter submitted for analysis as a control

4.10
clearance sampling
air sampling performed following an asbestos abatement activity with the purpose of determining whether airborne levels of asbestos are below a specified level at which re-occupancy of an asbestos abatement area is permitted

4.11
cluster
structure in which two or more asbestos fibres, or bundles of asbestos fibres, are randomly oriented in a connected grouping

4.12
containment barrier
impervious barrier enclosing the asbestos abatement containment area

4.13
containment clearance
air sampling performed within the asbestos abatement containment area with the purpose of determining whether airborne levels of asbestos are below a specified level at which the containment barrier can be removed

4.14
electron diffraction
technique in electron microscopy in which the crystal structure of a small area of a sample is examined

4.15
energy-dispersive X-ray analysis
determination of elemental composition through measurement of the energies and intensities of X-rays by use of a solid state detector and multi-channel analyzer system

4.16
field blank

filter cassette which has been taken to the sampling site, opened, and then closed

NOTE Field blanks are used to determine whether contamination can have occurred during field handling of the cassettes.

4.17
fibre
elongated particle, with a minimum length to width ratio of 3:1

NOTE The dimensional parameters used to define a fibre are specific to the analytical method used, and are separately defined in each analytical method.

4.18
fibre bundle
structure composed of parallel, smaller-width fibres attached along their lengths

NOTE A fibre bundle can exhibit diverging fibres at one or both ends.

4.19
fibrous structure
fibre, or connected grouping of fibres, with or without other particles

4.20
HEPA filter
High Efficiency Particulate Absolute filter

NOTE Specifications for an HEPA filter (class H13) require that it has a collection efficiency of 99,95 % for the most penetrating particle size (MPPS) according to EN 1822 [4]. Filters with higher efficiency may be used.

4.21
indoor baseline concentration
long-term asbestos fibre concentration measured in a building during normal usage

4.22
interim corrective actions
any simple measures, short of full asbestos abatement, used to alleviate emissions of airborne asbestos fibres from building materials

4.23
investigative sampling
air sampling performed to determine the impact of an occurrence or a simulated activity on airborne asbestos fibre concentrations

4.24
leakage sampling
air sampling performed around the perimeter of an asbestos abatement containment area for the purposes of determining whether leakage of airborne asbestos fibres from the containment area has occurred or is occurring

4.25
limit of detection
numerical asbestos fibre concentration that will not be exceeded at a probability of 95 % by the actual asbestos fibre concentration, if no asbestos fibres are detected during analysis

4.26
long-term
period of time exceeding 24 h

4.27
matrix
structure in which one or more asbestos fibres, or bundles of asbestos fibres, touch, are attached to, or partially concealed by, a single particle or connected group of non-fibrous particles

4.28
negative pressure
pressure differential between an asbestos abatement containment area and its surroundings when the asbestos abatement containment area is maintained at a pressure lower than that of its surroundings

NOTE The expression is frequently loosely applied to the pressure in the asbestos abatement containment area.

4.29
negative pressure ventilation unit
device used to exhaust air from an asbestos abatement containment area in order to establish a negative pressure differential between the asbestos abatement containment area and its surroundings

NOTE Typically, the air is exhausted through an HEPA filter, or a filter of higher efficiency, to minimize the escape of airborne asbestos fibres from the asbestos abatement containment area to its surroundings.

4.30
outdoor baseline concentration
long-term asbestos fibre concentration measured outdoors and sufficiently close to a building to be representative of air drawn into the building

4.31
PCM-equivalent fibre
asbestos fibre of aspect ratio greater than or equal to 3:1, longer than 5 µm, and which has a width between 0,2 µm and 3,0 µm

4.32
PCM-equivalent structure
fibrous structure of aspect ratio greater than or equal to 3:1, longer than 5 µm, and which has a width between 0,2 µm and 3,0 µm

NOTE A PCM-equivalent structure does not necessarily contain any fibres longer than 5 µm, and can consist of a grouping of parallel asbestos fibres, all of which are shorter than 5 µm.

4.33
personal sampling
air sampling performed in the breathing zone of an individual in order to determine that individual's potential exposure to airborne asbestos fibres

4.34
phase contrast optical microscopy
microscopy technique in which the differential phase shift of the energy passing through a sample is converted into an amplitude effect.

NOTE In asbestos fibre monitoring, this technique is implemented on the light microscope and is widely accepted for monitoring asbestos exposure in a workplace.

4.35
pre-activity (background) concentration
short-term asbestos fibre concentration measured immediately before an activity

4.36
prevalent level sampling
air sampling performed within an area to determine asbestos fibre concentrations during normal occupancy of, and during normal activities in, that area

4.37
procedure validation sampling
air sampling to determine the impact on prevalent levels resulting from maintenance or other activities in a building in which asbestos-containing materials are installed

4.38
replicate sample
one or more air samples collected in close proximity to another air sample, such that the analytical results from the samples are expected to be consistent

4.39
room unit
room that has a maximum floor area of 100 m^2 and a maximum length of 15 m

NOTE In special situations, up to four smaller rooms, for which the total floor area does not exceed 100 m^2, can be considered as a single room unit, provided that there is efficient air exchange between the rooms. Otherwise, a small, individual room is considered as a single room unit.

4.40
short-term
period of time less than or equal to 24 h

4.41
simulation
activity designed to replicate specific activities performed under controlled conditions in order to test the impact of these activities on airborne asbestos fibre concentrations

4.42
small room
room of area of less than 10 m^2

4.43
structure
single fibre, fibre bundle, cluster or matrix

4.44
stratified sampling
air sampling conducted according to a defined strategy in which the samples are grouped on the basis of detailed knowledge of the building characteristics

5 Symbols and abbreviations

5.1 Symbols

n_{RU} the number of room units

A the area of a room in square metres, m^2

L_{LCL} factor by which a PCM fibre concentration shall be multiplied to obtain the lower 95 % confidence limit

L_{UCL} factor by which a PCM fibre concentration shall be multiplied to obtain the upper 95 % confidence limit

s_R the subjective component of the interlaboratory coefficient of variation for PCM fibre counts

x the number of fibres counted

x_{LCL} the lower 95% confidence limit of a fibre count made by either SEM or TEM

x_{UCL} the upper 95% confidence limit of a fibre count made by either SEM or TEM

α statistical significance level

D_1 for a fibre count of x, the value of the χ^2 distribution with $2x$ degrees of freedom and a significance level of $(1 - \alpha/2)$

D_2 for a fibre count of x, the value of the χ^2 distribution with $2(x + 1)$ degrees of freedom and a significance level of $\alpha/2$

E limit of detection

z standard normal deviate

5.2 Abbreviations

ED Electron diffraction

EDXA Energy dispersive X-ray analysis

HEPA High efficiency particle absolute

MEC Mixed esters of cellulose

PC Polycarbonate

PCM Phase contrast optical microscopy

SAED Selected area electron diffraction