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Workplace air — Determination of mercury and inorganic mercury compounds — Method by cold-vapour atomic absorption spectrometry or atomic fluorescence spectrometry

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee EH/2/2, Work place atmospheres.

A list of organizations represented on this committee can be obtained on request to its secretary.

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INTERNATIONAL STANDARD

ISO 17733

Second edition
2015-12-15

Workplace air — Determination of mercury and inorganic mercury compounds — Method by cold-vapour atomic absorption spectrometry or atomic fluorescence spectrometry

Air des lieux de travail — Détermination du mercure et des composés inorganiques de mercure — Méthode par spectrométrie d'absorption atomique ou spectrométrie de fluorescence atomique de la vapeur froide

Reference number
ISO 17733:2015(E)

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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).

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 2, *Workplace atmospheres*.

This second edition cancels and replaces the first edition (ISO 17733:2004), of which it constitutes a minor revision. This edition corrects a typographical error in the title of 7.10.

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Introduction

The health of workers in many industries is at risk through exposure by inhalation of mercury and inorganic mercury compounds. Industrial hygienists and other public health professionals need to determine the effectiveness of measures taken to control workers' exposure, and this is generally achieved by making workplace air measurements. This International Standard presents a method for making valid exposure measurements for mercury and inorganic mercury compounds in use in industry. It will be of benefit to: agencies concerned with health and safety at work; industrial hygienists and other public health professionals; analytical laboratories; industrial users of mercury and inorganic mercury compounds and their workers, etc.

The procedure described in this International Standard is based upon a method published by the United Kingdom Health and Safety Executive[1], which was developed after a thorough review of sampling and analysis techniques available for determination of mercury and inorganic mercury compounds in air[2]. This procedure has been fully validated and the resulting back-up data are freely available[3, 4]. Similar methods have been published by the United States Occupational Safety and Health Administration (OSHA)[5, 6] and the United States National Institute of Occupational Safety and Health (NIOSH)[7].

It has been assumed in the drafting of this International Standard that the execution of its provisions and the interpretation of the results obtained are entrusted to appropriately qualified and experienced people.

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INTERNATIONAL STANDARD ISO 17733:2015(E)

Workplace air — Determination of mercury and inorganic mercury compounds — Method by cold-vapour atomic absorption spectrometry or atomic fluorescence spectrometry

1 Scope

This International Standard specifies a procedure for determination of the time-weighted average mass concentration of mercury vapour and inorganic mercury compounds in workplace air. Mercury vapour is collected on a solid sorbent using either a diffusive badge or a pumped sorbent tube. Particulate inorganic mercury compounds, if present, are collected on a quartz fibre filter. Samples are analysed using either cold vapour atomic absorption spectrometry (CVAAS) or cold vapour atomic fluorescence spectrometry (CVAFS) after acid dissolution of the mercury collected.

This International Standard is applicable to the assessment of personal exposure to mercury vapour and/or particulate inorganic mercury compounds in air for comparison with long-term or short-term exposure limits for mercury and inorganic mercury compounds and for static (area) sampling.

The lower limit of the working range of the procedure is the quantification limit. This is determined by the sampling and analysis methods selected by the user, but it is typically in the range 0,01 µg to 0,04 µg of mercury (see 13.1). The upper limit of the working range of the procedure is determined by the capacity of the diffusive badge, sorbent tube or filter used for sample collection, but it is at least 30 µg of mercury (see 13.2). The concentration range of mercury in air for which this International Standard is applicable is determined in part by the sampling method selected by the user, but it is also dependent on the air sample volume.

The diffusive badge method is not applicable to measurements of mercury vapour when chlorine is present in the atmosphere, e.g. in chloralkali works, but chlorine does not interfere with the pumped sorbent tube method (see 13.12.1). Gaseous organomercury compounds could cause a positive interference in the measurement of mercury vapour (see 13.12.2). Similarly, particulate organomercury compounds and gaseous organomercury compounds adsorbed onto airborne particles could cause a positive interference in the measurement of particulate inorganic mercury compounds (see 13.12.3).

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 648, *Laboratory glassware — Single-volume pipettes*

ISO 1042, *Laboratory glassware — One-mark volumetric flasks*

ISO 3585, *Borosilicate glass 3.3 — Properties*

ISO 3696:1987, *Water for analytical laboratory use — Specification and test methods*

ISO 7708:1995, *Air quality — Particle size fraction definitions for health-related sampling*

ISO 8655-1, *Piston-operated volumetric apparatus — Part 1: Terminology, general requirements and user recommendations*

ISO 8655-2, *Piston-operated volumetric apparatus — Part 2: Piston pipettes*

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ISO 8655-5, *Piston-operated volumetric apparatus — Part 5: Dispensers*

ISO 8655-6, *Piston-operated volumetric apparatus — Part 6: Gravimetric methods for the determination of measurement error*

EN 13205:2002, *Workplace atmospheres — Assessment of performance of instruments for measurement of airborne particle concentrations*

3 Terms and definitions

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

3.1 General definitions

3.1.1
chemical agent
any chemical element or compound, on its own or admixed as it occurs in the natural state or as produced by any work activity, whether or not produced intentionally and whether or not placed on the market

Note 1 to entry: This definition is taken from the "Council Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work".

[SOURCE: EN 1540[8]]

3.1.2
breathing zone
<general> space around the worker's face from where he or she takes his or her breath

3.1.3
breathing zone
<technical> hemisphere (generally accepted to be 0,3 m in radius) extending in front of the human face, centred on the midpoint of a line joining the ears, whose base is a plane through this line, the top of the head and the larynx

Note 1 to entry: This definition is not applicable when respiratory protective equipment is used.

[SOURCE: Adapted from EN 1540[8]]

3.1.4
exposure
<by inhalation> situation in which a chemical agent is present in air which is inhaled by a person

3.1.5
measuring procedure
procedure for sampling and analysing one or more chemical agents in the air, including storage and transportation of the sample

3.1.6
operating time
<of a sampling pump> period during which a sampling pump can be operated at specified flow rate and back-pressure without recharging or replacing the battery

[SOURCE: EN 1232[9]]

3.1.7
time-weighted average concentration
TWA concentration
concentration of a chemical agent in the atmosphere, averaged over the reference period

Note 1 to entry: A more detailed discussion of TWA concentrations has been published by the American Conference of Government Industrial Hygienists (ACGIH)[10].

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3.1.8
limit value
reference figure for concentration of a chemical agent in air

3.1.9
reference period
specified period of time stated for the limit value of a specific chemical agent

Note 1 to entry: Examples of limit values for different reference periods are short-term and long-term exposure limits, such as those established by the ACGIH[10].

3.1.10
workplace
defined area or areas in which work activities are carried out

[SOURCE: EN 1540[8]]

3.2 Particle size fraction definitions

3.2.1
inhalable convention
target specification for sampling instruments when the inhalable fraction is of interest

[SOURCE: ISO 7708:1995, 2.4]

3.2.2
inhalable fraction
mass fraction of total airborne particles which is inhaled through the nose and mouth

Note 1 to entry: The inhalable fraction depends on the speed and direction of air movement, on breathing rate and other factors.

[SOURCE: ISO 7708:1995, 2.3]

3.2.3
total airborne particles
all particles surrounded by air in a given volume of air

Note 1 to entry: Because all measuring instruments are size-selective to some extent, it is often impossible to measure the concentration of total airborne particles.

[SOURCE: ISO 7708:1995, 2.13]

3.3 Sampling definitions

3.3.1
diffusive badge
dosimeter
badge-type diffusive sampler
passive badge
diffusive sampler in which the gas or vapour passes to the sorbent by permeation through a thin solid membrane or diffusion across a porous membrane

Note 1 to entry: The cross-sectional area of a diffusive badge is large in relation to the internal air gap.

3.3.2
diffusive sampler
passive sampler
device which is capable of taking samples of gases or vapours from the atmosphere at a rate controlled by a physical process such as gaseous diffusion through a static air layer or permeation through a membrane, but which does not involve the active movement of air through the sampler

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[SOURCE: EN 838[11]]

3.3.3
personal sampler
device attached to a person that samples air in the breathing zone

[SOURCE: EN 1540[8]]

3.3.4
personal sampling
process of sampling carried out using a personal sampler

[SOURCE: EN 1540[8]]

3.3.5
sampler
device for collecting airborne particles

Note 1 to entry: Instruments used to collect airborne particles are frequently referred to by a number of other terms, e.g. sampling heads, filter holders, filter cassettes, etc.

3.3.6
pumped sorbent tube
tube, usually made of metal or glass, containing an active sorbent or reagent-impregnated support, through which sampled atmosphere is passed at a rate controlled by an air sampling pump

[SOURCE: EN 1076[12]]

3.3.7
static sampler
area sampler
device, not attached to a person, that samples air in a particular location

3.3.8
static sampling
area sampling
process of air sampling carried out using a static sampler

3.4 Analytical definitions

3.4.1
blank solution
solution prepared by taking a reagent blank, laboratory blank or field blank through the same procedure used for sample preparation

3.4.2
calibration blank solution
calibration solution prepared without the addition of any working standard solution

Note 1 to entry: The concentration of mercury in the calibration blank solution is taken to be zero.

3.4.3
calibration solution
solution prepared by dilution of the working standard solution, containing mercury at a concentration that is suitable for use in calibration of the analytical instrument

Note 1 to entry: The technique of matrix-matching is normally used when preparing calibration solutions.

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3.4.4
field blank
sorbent capsule, filter or sorbent tube that is taken through the same handling procedure as a sample, except that it is not used for sampling

Note 1 to entry: For the purposes of this International Standard, the field blank is loaded into a diffusive badge, sampler or sorbent tube holder, transported to the sampling site and then returned to the laboratory for analysis.

3.4.5
laboratory blank
unused sorbent capsule, filter or sorbent tube, taken from the same batch used for sampling, that does not leave the laboratory

3.4.6
linear dynamic range
range of concentrations over which the calibration curve for mercury is linear

Note 1 to entry: The linear dynamic range extends from the detection limit to the onset of calibration curvature.

3.4.7
matrix interference
matrix effect
non-spectral interference
interference of a non-spectral nature caused by a difference between the matrices of the calibration and test solutions

3.4.8
matrix-matching
technique used to minimize the effect of matrix interferences on analytical results, involving the preparation of calibration solutions in which the concentrations of acids and other major solutes are matched with those in the test solutions

3.4.9
reagent blank
combination of all reagents used in sample dissolution, in the same quantities used for preparation of laboratory blank, field blank and sample solutions

3.4.10
sample dissolution
process of obtaining a solution containing mercury from a sample, which might or might not involve complete dissolution of the sample

3.4.11
sample preparation
all operations carried out on a sample, after transportation and storage, to prepare it for analysis, including transformation of the sample into a measurable state, where necessary

3.4.12
sample solution
solution prepared from a sample by the process of sample dissolution

Note 1 to entry: A sample solution might need to be subjected to further operations, e.g. dilution, in order to produce a test solution that is ready for analysis.

3.4.13
stock standard solution
solution, used for preparation of the calibration solutions, containing mercury at a certified concentration that is traceable to national standards

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3.4.14
test solution
blank solution or sample solution that has been subjected to all operations, including dilution, required to bring it into a state in which it is ready for analysis

Note 1 to entry: The blank test solution is the blank solution and the sample test solution is the sample solution, if these solutions are not subjected to any further operations before analysis.

3.4.15
working standard solution
solution, prepared by dilution of the stock standard solution, that contains mercury at a concentration that is better suited to preparation of calibration solutions than the concentration of mercury in the stock standard solution

3.5 Statistical terms

3.5.1
analytical recovery
ratio of the mass of analyte measured when a sample is analysed to the known mass of analyte in that sample

Note 1 to entry: It is expressed as a percentage.

3.5.2
bias
consistent deviation of the measured value from the value of the air quality characteristic itself, or the accepted reference value

3.5.3
overall uncertainty
<of a measuring procedure or of an instrument> quantity used to characterize as a whole the uncertainty of a result given by an apparatus or measuring procedure

Note 1 to entry: It is expressed, as a percentage, by a combination of bias and precision, usually according to the formula:

$$\frac{\left|\bar{x} - x_{\text{ref}}\right| + 2s}{x_{\text{ref}}} \times 100$$

where

$\bar{x}$ is the mean value of results of a number (n) of repeated measurements;

x_{ref} is the true or accepted reference value of the measurement;

s is the standard deviation of the measurements.

[SOURCE: EN 482[14]]

3.5.4
precision
closeness of agreement between independent test results obtained under stipulated conditions

3.5.5
true value
value which characterizes a quantity perfectly defined in the conditions which exist when that quantity is considered

Note 1 to entry: The true value of a quantity is a theoretical concept and, in general, cannot be known exactly.

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3.5.6
uncertainty
<of measurement> parameter associated with the result of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the measurand

Note 1 to entry: The parameter might be, for example, a standard deviation (or a given multiple of it), or the width of a confidence interval.

Note 2 to entry: Uncertainty of measurement comprises, in general, many components. Some of these components can be evaluated from the statistical distribution of the results of series of measurements and can be characterized by standard deviations. The other components, which also can be characterized by standard deviations, are evaluated from assumed probability distributions based on experience or other information. ISO/IEC Guide 98-3:2008 (hereafter referred to as the "GUM")[17] refers to these different cases as Type A and Type B evaluations of uncertainty, respectively.

[SOURCE: ISO/IEC Guide 99:2007 (also known as the "VIM")[16]]

4 Principle

Mercury vapour is collected either actively or passively. Active sampling involves drawing a known volume of air through a sorbent tube using a pump, while passive sampling relies upon the principle of controlled diffusion into a badge. In both the pumped and diffusive sampling methods, mercury vapour entering the sampling device is collected on a proprietary solid sorbent that is widely known as Hydrar (see 8.1.2) but is currently marketed as Anasorb C 300.

Different sampling methods are used depending on the specific application.

a) If it is known that no particulate inorganic mercury compounds are present in the test atmosphere, mercury vapour is collected using a diffusive badge or by drawing a known volume of air through a sorbent tube using a pump.

b) If it is known that no mercury vapour is present in the test atmosphere, particulate inorganic mercury compounds are collected by drawing a known volume of air through a quartz fibre filter mounted in a sampler designed to collect the inhalable fraction of airborne particles, as defined in ISO 7708, using a pump.

c) A pumped sorbent tube is also used for sampling air that contains both mercury vapour and particulate inorganic mercury compounds. The sorbent tube, which collects mercury vapour, is preceded by a quartz fibre filter to collect particulate inorganic mercury compounds, unless these do not make up a significant proportion (e.g. > 10 %) of the total inorganic mercury (mercury vapour and particulate inorganic mercury compounds) present in the test atmosphere (see 10.1.3).

After sampling, the sorbent and/or filter are treated with 2 ml of concentrated nitric acid and 2 ml of concentrated hydrochloric acid and heated in a thermostatically-controlled water bath at 50 °C for 1 h to dissolve the collected mercury. Sample solutions are mixed with tin(II) chloride solution in a continuous flow, flow injection, or discrete injection cold-vapour generation system. Mercury vapour is formed by reduction of divalent mercury ions and this is flushed by a stream of inert gas into the measurement cell of an atomic absorption spectrometer or an atomic fluorescence spectrometer equipped with a mercury hollow cathode lamp or electrodeless discharge lamp. Absorbance or fluorescence measurements are made at 253,7 nm and analytical results are obtained by the analytical curve technique (see ISO 6955:1982, 6.1[18]).

The results may be used for the assessment of workplace exposure to mercury vapour, inorganic mercury compounds or total inorganic mercury (see EN 689[19]).

5 Interferences

The diffusive badge method is unsuitable for making measurements of mercury vapour when chlorine is present in the atmosphere, e.g. in chloralkali works. However, chlorine does not interfere with the pumped sorbent tube method (see 13.12.1). Gaseous organomercury compounds could interfere

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positive interference in the measurement of mercury vapour (see 13.12.2). Particulate organomercury compounds contained within airborne particles and gaseous organomercury compounds adsorbed onto airborne particles could cause a positive interference in the measurement of particulate inorganic mercury compounds (see 13.12.3). Spectral interferences are not significant when measuring mercury by CVAAS using the procedure described in this International Standard and they do not occur when measuring mercury by CVAFS (see 13.12.4).

6 Requirement

The measurement procedure shall comply with any relevant international, European or national standard that specifies performance requirements for procedures for measuring chemical agents in workplace air (e.g. ISO 9169[13]).

7 Reagents

During the analysis, use only reagents of recognized analytical grade and only water as specified in 7.1.

7.1 Water, complying with the requirements for ISO 3696 grade 2 water (electrical conductivity less than 0,1 mS·m^{-1} and resistivity greater than 1 MΩ·cm at 25 °C).

It is recommended that the water used be obtained from a water purification system that delivers ultrapure water having a resistivity greater than 18 MΩ·cm.

7.2 Nitric acid (HNO_3), concentrated, ρ ~1,42 g·ml^{-1}, mass fraction ~70 %.

The concentration of mercury shall be less than 0,002 mg·l^{-1}.

WARNING — Concentrated nitric acid is corrosive and oxidizing, and nitric acid fumes are irritant. Avoid contact with the skin or eyes, or inhalation of fumes. Use suitable personal protective equipment (including gloves, face shield or safety glasses, etc.) when working with nitric acid, and carry out sample dissolution with concentrated nitric acid in open vessels in a fume hood.

7.3 Nitric acid, diluted 1:9.

Add approximately 700 ml of water (7.1) to a 1 000 ml one-mark volumetric flask (8.3.1.4). Carefully add 100 ml of concentrated nitric acid (7.2) to the flask and swirl to mix. Allow to cool, dilute to the mark with water, stopper and mix thoroughly.

7.4 Hydrochloric acid (HCl), concentrated, ρ ~1,18 g·ml^{-1}, mass fraction ~36 %.

The concentration of mercury shall be less than 0,002 mg·l^{-1}.

WARNING — Concentrated hydrochloric acid is corrosive and hydrochloric acid vapour is irritant. Avoid contact with the skin or eyes, or inhalation of the vapour. Use suitable personal protective equipment (including gloves, face shield or safety glasses, etc.) when working with hydrochloric acid. Handle open vessels containing concentrated hydrochloric acid in a fume hood. The vapour pressure of hydrochloric acid is high, therefore beware of pressure build-up in stoppered flasks when preparing hydrochloric acid/water mixtures.

7.5 Nitric acid and hydrochloric acid, diluted 1:1:23.

Add approximately 700 ml of water (7.1) to a 1 000 ml one-mark volumetric flask (8.3.1.4). Carefully add 40 ml of concentrated nitric acid (7.2) and 40 ml of concentrated hydrochloric acid (7.4) to the flask and swirl to mix. Allow to cool, dilute to the mark with water, stopper and mix thoroughly.

NOTE This reagent is only required for analysis of sorbent tube samples.

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7.6 Nitric acid and hydrochloric acid, diluted 2:2:21.

Add approximately 700 ml of water (7.1) to a 1 000 ml one-mark volumetric flask (8.3.1.4). Carefully add 80 ml of concentrated nitric acid (7.2) and 80 ml of concentrated hydrochloric acid (7.4) to the flask and swirl to mix. Allow to cool, dilute to the mark with water, stopper and mix thoroughly.

NOTE This reagent is only required for analysis of diffusive badge samples.

7.7 Tin(II) chloride dihydrate ($SnCl_2 \cdot 2H_2O$).

The concentration of mercury shall be less than 10 $\mu g \cdot kg^{-1}$.

Tin(II) chloride of a lower purity may be used if mercury contamination is removed from the tin(II) chloride solution before use by bubbling through nitrogen or clean air.

7.8 Tin(II) chloride solution, ρ = 10 $g \cdot l^{-1}$.

Weigh 10 g of tin(II) chloride (7.7) into a 500 ml beaker (8.3.1.1), add 30 ml of hydrochloric acid (7.4), cover with a watchglass and leave for approximately 15 min until dissolved. Transfer to a 1 000 ml one-mark volumetric flask (8.3.1.4), dilute to the mark with water (7.1), stopper and mix thoroughly. Prepare this solution fresh on the day of use.

7.9 Stock mercury standard solution, ρ = 1 000 $mg \cdot l^{-1}$.

Use a commercial standard solution with a certified mercury concentration traceable to national standards. Observe the manufacturer's expiration date or recommended shelf life.

WARNING — Mercury compounds are toxic by skin absorption. Take great care when working with solutions containing mercury to avoid skin contamination.

A stock mercury standard solution with a different concentration of mercury may be used, if desired. However, in such circumstances, the volumes of solution used to prepare working mercury standard solution A (7.10) and mercury standard solution B (7.11) shall be adjusted accordingly.

7.10 Working mercury standard solution A, ρ = 10 $mg \cdot l^{-1}$.

Accurately pipette 0,5 ml of stock mercury standard solution (7.9) into a 50 ml volumetric flask (8.3.1.4). Add 1 ml of concentrated nitric acid (7.2), dilute to the mark with water (7.1), stopper and mix thoroughly. Prepare this solution fresh weekly.

7.11 Working mercury standard solution B, ρ = 1 $mg \cdot l^{-1}$.

Accurately pipette 5 ml of working mercury standard solution A (7.10) into a 50 ml volumetric flask (8.3.1.4). Add 1 ml of concentrated nitric acid (7.2), dilute to the mark with water (7.1), stopper and mix thoroughly. Prepare this solution fresh weekly.

7.12 Laboratory detergent solution.

Dilute a laboratory grade detergent, suitable for cleaning of samplers and labware, with water (7.1) according to the manufacturer's instructions.

7.13 Argon, suitable for use in cold vapour atomic absorption spectrometry or cold vapour atomic fluorescence spectrometry.

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8 Apparatus

8.1 Sampling equipment for diffusive sampling

8.1.1 Diffusive badges, lightweight, reusable, designed to be used with sorbent capsules (8.1.2) for diffusive sampling of mercury vapour (see 10.3.1).

NOTE Diffusive badges suitable for sampling of mercury vapour are commercially available[22, 23]. The design of these badges is illustrated as an exploded diagram in Figure 1.

8.1.2 Sorbent capsules, suitable for sampling of mercury vapour when used in diffusive badges (8.1.1), containing 800 mg of Hydrar (Anasorb C 300), supplied in sealed plastic pouches that can be resealed after sampling to prevent contamination during transport and storage.

NOTE 1 Hydrar is a name previously given by SKC Inc. to the sorbent used in the diffusive badges and pumped sorbent tubes it manufactures for sampling mercury vapour. Hydrar is a granular preparation of hopcalite (a mixture of copper and manganese oxides) deposited on a ceramic substrate. It is manufactured by Carus under the trade name Carulite 300, primarily for use as an industrial catalyst. SKC uses Carulite 300 in its diffusive badges and pumped sorbent tubes, after grinding to a suitable mesh size, and it currently refers to this sorbent as Anasorb C 300[1)].

Hopcalite has been shown to have an irreversible affinity for mercury and to be a suitable sorbent for sampling mercury vapour in air[20, 21]. Hopcalite is completely dissolved by the mixture of nitric acid and hydrochloric acid used in the sample dissolution method (11.4.1), yielding a clear blue/green solution. However, an insoluble residue of ceramic substrate remains after treatment of Anasorb with acid, resulting in a milky suspension. This has to be removed before analysis by centrifugation or filtration.

NOTE 2 Mercury vapour enters the diffusive badges by positively controlled diffusion. It is then irreversibly absorbed by the Anasorb C 300 contained in the sorbent capsule. No sampling pump is required. Samplers can be cleaned and reused with new sorbent capsules.

NOTE 3 Similar diffusive badges and corresponding sorbent capsules packed with Anasorb C 300 or a similar sorbent may be used if it can be demonstrated that they give equivalent performance.

1) Anasorb C 300 is the trade name of a product supplied by SKC Inc. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

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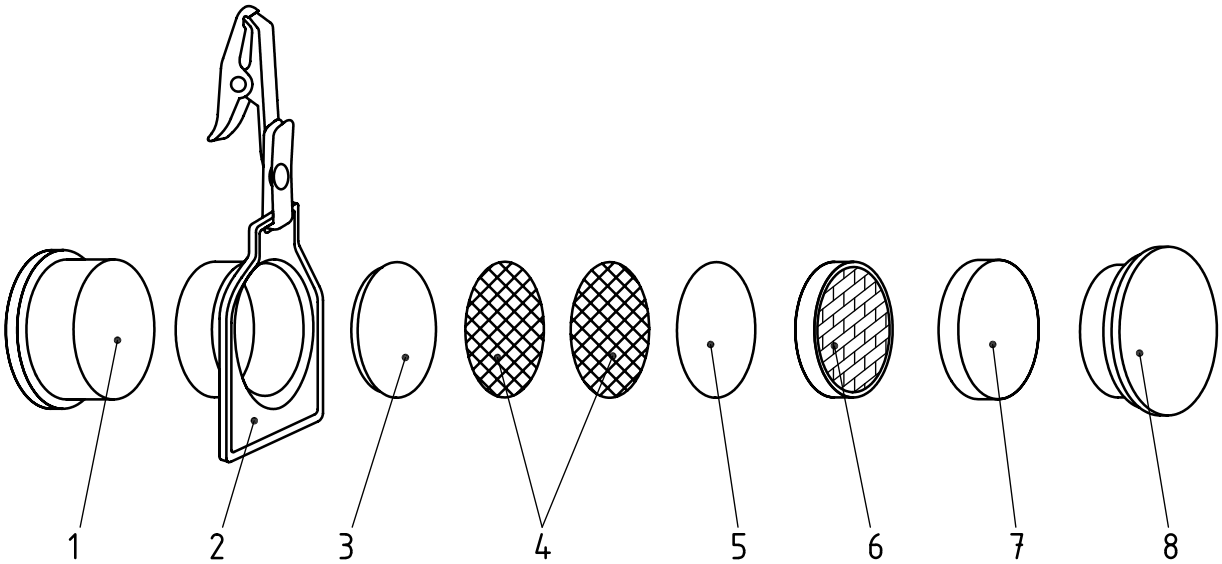

Key

1 sealing cap
2 sampler housing
3 sampling face disc
4 mesh discs
5 "O" ring
6 sorbent capsule
7 foam disc
8 removable back cover

Figure 1 — Mercury diffusive badge

8.2 Sampling equipment for pumped sampling

8.2.1 Sorbent tubes, glass, containing a single section of 200 mg or 500 mg of Anasorb C 300, flame-sealed at each end, with plastic end caps, for pumped sampling of mercury vapour (see 10.4.1.1.1 and 10.4.1.1.3).

NOTE 1 Two types of sorbent tube packed with Anasorb C 300 are commercially available[24, 25]. The smaller, standard tube is 70 mm long, with an external diameter of 6 mm and an internal diameter of 4 mm, and contains 200 mg of Anasorb C 300 granules retained by small glass wool plugs. The larger tube is 110 mm long, with an external diameter of 8 mm and an internal diameter of 6 mm. It contains 500 mg of Anasorb C 300 and is intended for sampling at higher air flow rates, in order to measure low concentrations of mercury, or for shorter sampling periods (<1 h). The construction of these sorbent tubes is illustrated in Figure 2. Similar sorbent tubes packed with Anasorb C 300 or a similar sorbent may be used if it can be demonstrated that they give equivalent performance.

NOTE 2 Sorbent tubes containing Anasorb C 300 have a lower mercury content than sorbent tubes containing hopcalite. This lowers the method detection limit and reduces the minimum air sample volume that can be used. On the other hand, Anasorb C 300 has the disadvantage that it is more friable than hopcalite. This means that it is liable to be pulverized if handled roughly, and poor grades of Anasorb C 300 have a high proportion of "fines". These can cause problems by clogging the glass wool plugs of the sorbent tubes, reducing the achievable air sampling rates.

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