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Workplace air — Determination of particulate cadmium and cadmium compounds — Flame and electrothermal atomic absorption spectrometric method

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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 document 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).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 146, *Air quality*, Subcommittee SC 2, *Workplace atmospheres*.

This second edition cancels and replaces the first edition (ISO 11174:1996), which has been technically revised.

The main changes are as follows:

— a reference for handling of sampler wall deposits has been added;

— references and definitions have been updated;

— additional editorial changes have been made.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

The health of workers in many industries, such as mining, metal refining, battery manufacture, foundries, electronics and construction, is at risk through exposure by inhalation of particulate cadmium and cadmium 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 document provides a method for making valid exposure measurements for cadmium. It is of benefit to: agencies concerned with health and safety at work, industrial hygienists and other public health professionals, analytical laboratories, industrial users and workers of metals and metalloids, etc.

The execution of its provisions and the interpretation of the results obtained is entrusted to appropriately qualified and experienced people.

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Workplace air — Determination of particulate cadmium and cadmium compounds — Flame and electrothermal atomic absorption spectrometric method

WARNING — Cadmium and cadmium compounds are toxic and are suspected human carcinogens [1]. Avoid any exposure by inhalation. Personal protection (e.g. an effective respirator) shall be used in all cases where exposure to cadmium or cadmium compounds is possible.

1 Scope

This document specifies a method for the determination of the mass concentration of particulate cadmium and cadmium compounds in workplace air, using either flame or electrothermal atomic absorption spectrometry.

The sample digestion procedure specified in 10.2.2 has been validated[2,3] for a selection of cadmium compounds and pigments and glass enamels containing cadmium.

The analytical method has been validated[2] for the determination of masses of 10 ng to 600 ng of cadmium per sample using electrothermal atomic absorption spectrometry, and 0,15 µg to 96 µg of cadmium per sample using flame atomic absorption spectrometry.[3] The concentration range for cadmium in air for which this procedure is applicable is determined in part by the sampling procedure selected by the user.

The method is applicable to personal sampling of the inhalable or respirable fraction of airborne particles, as defined in ISO 7708, and to stationary sampling.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 648, *Laboratory glassware — Single-volume pipettes*

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

ISO 3585, *Borosilicate glass 3.3 — Properties*

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

ISO 7708, *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: Pipettes*

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

ISO 8655-6, *Piston-operated volumetric apparatus — Part 6: Gravimetric reference measurement procedure for the determination of volume*

ISO 13137, *Workplace atmospheres — Pumps for personal sampling of chemical and biological agents — Requirements and test methods*

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

ISO 18158, *Workplace air — Terminology*

ISO 20581, *Workplace air — General requirements for the performance of procedures for the measurement of chemical agents*

ISO 21832, *Workplace air — Metals and metalloids in airborne particles — Requirements for evaluation of measuring procedures*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 18158 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
exposure by inhalation
situation in which a chemical agent is present in air which is inhaled by a person

3.2
sample dissolution
process of obtaining a solution containing all analytes of interest from a sample, which might or might not involve complete dissolution of the sample

[SOURCE: ISO 15202-2:2020[10], 3.1]

3.3
sample solution
solution prepared from a sample by the process of *sample dissolution* (3.2)

[SOURCE: ISO 15202-2:2020[10], 3.2]

3.4
test solution
blank solution or *sample solution* (3.3) that has been subjected to all operations required to bring it into a state in which it is ready for analysis

[SOURCE: ISO 15202-2:2020[10], 3.3, modified — Note 1 to entry has been deleted.]

4 Principle

4.1 Particulate cadmium and cadmium compounds are collected by drawing a measured volume of air through a sampling substrate (8.2), such as a filter or foam, mounted in a sampler (8.1) designed to collect either the inhalable fraction of airborne particles or the respirable fraction of airborne particles, as appropriate.

4.2 A test solution is prepared by treating the sampling substrate (8.2) and collected sample with 5 ml of nitric acid diluted 1 + 1 (7.3), heating on a hotplate until about 1 ml of concentrated nitric acid (7.2) solution remains, allowing the solution to cool and then diluting to 10 ml with water (7.1).

4.3 The test solution is analysed for cadmium by aspirating into the oxidizing air/acetylene flame of an atomic absorption spectrometer (8.6.5) equipped with a cadmium hollow cathode lamp or electrodeless discharge lamp. Absorbance measurements are made at 228,8 nm and results are obtained by the analytical curve technique.

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