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**Workplace air — Determination of metals  
and metalloids in airborne particulate  
matter by inductively coupled plasma  
mass spectrometry**

*Air des lieux de travail — Détermination des métaux et métalloïdes  
dans les particules en suspension dans l'air par spectrométrie de  
masse avec plasma à couplage inductif*



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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 30011 was prepared by Technical Committee ISO/TC 146, *Air quality*, Subcommittee SC 2, *Workplace atmospheres*.

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## Introduction

The health of workers in many industries is at risk through exposure by inhalation of toxic metals and metalloids. 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 taking workplace air measurements. ISO 30011 has been published in order to make available a method for making valid ultra-trace exposure measurements for a wide range of metals and metalloids in use in industry. It is intended for: agencies concerned with health and safety at work; industrial hygienists and other public health professionals; analytical laboratories; and industrial users of metals and metalloids and their workers.

ISO 30011 specifies a method for determination of the mass concentration of metals and metalloids in workplace air using quadrupole inductively coupled plasma mass spectrometry (ICP-MS). For many metals and metalloids, analysis by ICP-MS is advantageous when compared to methods such as inductively coupled plasma atomic emission spectrometry, due to its sensitivity and the presence of fewer spectral interferences.

ISO 30011 gives requirements and test methods for analysis of sample solutions by ICP-MS. Users of ISO 30011 are referred to ISO 15202-1 for collection of samples of airborne particulate matter and to ISO 15202-2 for procedures for preparing sample solutions for analysis by ICP-MS.

It has been assumed in the drafting of ISO 30011 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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# Workplace air — Determination of metals and metalloids in airborne particulate matter by inductively coupled plasma mass spectrometry

## 1 Scope

This International Standard specifies a procedure for the use of quadrupole inductively coupled plasma mass spectrometry (ICP-MS) for analysing test solutions prepared from samples of airborne particulate matter collected as specified in ISO 15202-1. Method development, performance checks, and a routine analysis method are specified.

Test solutions for analysis by this International Standard are prepared as specified in ISO 15202-2.

This International Standard is applicable to the assessment of workplace exposure to metals and metalloids for comparison with limit values (see e.g. EN 689<sup>[10]</sup>, ASTM E1370<sup>[8]</sup>).

The following is a non-exclusive list of metals and metalloids for which limit values have been set (see Reference [15]) and for which one or more of the sample preparation methods specified in ISO 15202-2 and the analytical procedure described in this International Standard are applicable. However, there is no information available on the effectiveness of any of these sample preparation methods for those elements listed in italics.

aluminium	caesium	lead	platinum	tungsten
antimony	chromium	lithium	potassium	uranium
arsenic	cobalt	magnesium	rhodium	vanadium
barium	copper	manganese	selenium	yttrium
beryllium	gallium	<i>mercury</i>	silver	zinc
bismuth	<i>germanium</i>	molybdenum	sodium	zirconium
boron	hafnium	nickel	tellurium	
cadmium	indium	<i>niobium</i>	thallium	
calcium	iron	phosphorus	tin	

This International Standard is not applicable to determination of elemental mercury, since mercury vapour is not collected using the sampling method specified in ISO 15202-1.

The procedure is suitable for assessment of exposure against the long-term exposure limits for most of the metals and metalloids listed above when sampling at a typical flow rate of 2 l min<sup>-1</sup> for sampling times in the range 0,5 h to 8 h and for assessment of exposure against the short-term exposure limits, where applicable.

The procedure is subject to no significant spectral interferences (see A.3), provided that suitable analytical isotopes are used. However, inadequate matrix-matching can adversely affect results.

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

ISO 3585, *Borosilicate glass 3.3 — Properties*

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*

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*

ISO 15202-1, *Workplace air — Determination of metals and metalloids in airborne particulate matter by inductively coupled plasma atomic emission spectrometry — Part 1: Sampling*

ISO 15202-2:—, *Workplace air — Determination of metals and metalloids in airborne particulate matter by inductively coupled plasma atomic emission spectrometry — Part 2: Sample preparation*

## 3 Terms and definitions

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

### 3.1 General definitions

#### 3.1.1

##### **breathing zone**

⟨general definition⟩ space around the worker's face from where he or she takes his or her breath

NOTE Adapted from EN 1540:—<sup>[11]</sup>, 2.4.5.

#### 3.1.2

##### **breathing zone**

⟨technical definition⟩ 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; the base of the hemisphere is a plane through this line, the top of the head, and the larynx

NOTE 1 The definition is not applicable when respiratory protective equipment is used.

NOTE 2 Adapted from EN 1540:—<sup>[11]</sup>, 2.4.5.

#### 3.1.3

##### **chemical agent**

any chemical element or compound, on its own or admixed as it occurs in the natural state or as produced, used or released including release as waste, by any work activity, whether or not produced intentionally and whether or not placed on the market

[Council Directive 98/24/EC<sup>[16]</sup>, Art. 2(a)]