

---

---

**Workplace atmospheres —  
Determination of inorganic acids by  
ion chromatography —**

**Part 1:  
Non-volatile acids (sulfuric acid and  
phosphoric acid)**

*Air des lieux de travail — Détermination des acides inorganiques par  
chromatographie ionique —*

*Partie 1: Acides non volatils (acide sulfurique et acide phosphorique)*



This document is a preview generated by EUS



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2022

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

Page

<b>Foreword</b>	<b>v</b>
<b>Introduction</b>	<b>vi</b>
<b>1 Scope</b>	<b>1</b>
<b>2 Normative references</b>	<b>1</b>
<b>3 Terms and definitions</b>	<b>2</b>
<b>4 Principle</b>	<b>3</b>
<b>5 Requirement</b>	<b>3</b>
<b>6 Reagents</b>	<b>3</b>
<b>7 Apparatus</b>	<b>4</b>
7.1 Sampling equipment	4
7.2 Laboratory apparatus	6
<b>8 Occupational exposure assessment</b>	<b>7</b>
<b>9 Sampling</b>	<b>7</b>
9.1 Preliminary considerations	7
9.1.1 Selection and use of samplers	7
9.1.2 Sampling period	7
9.1.3 Effect of temperature and pressure on flow rate measurements	7
9.1.4 Sample handling	8
9.1.5 Sampling interferences	8
9.2 Preparation for sampling	8
9.2.1 Cleaning of samplers	8
9.2.2 Loading the samplers with filters	9
9.2.3 Setting the volumetric flow rate	9
9.2.4 Field blanks	9
9.3 Sampling position	9
9.3.1 Personal sampling	9
9.3.2 Static sampling	9
9.4 Collection of samples	9
9.5 Transportation	10
9.5.1 Samplers that collect airborne particles on the filter	10
9.5.2 Samplers with an internal filter cassette	10
9.5.3 Samplers of the disposable cassette type	10
9.5.4 Transport of samples to the laboratory	11
<b>10 Analysis</b>	<b>11</b>
10.1 Preparation of test, calibration solutions and filter samples	11
10.1.1 General	11
10.1.2 Quartz fibre filters	11
10.1.3 PVC and PTFE filters	11
10.1.4 Preparation of calibration solutions	12
10.2 Instrumental analysis	12
10.3 Estimation of detection and quantification limits	13
10.3.1 Estimation of the instrumental detection limits	13
10.3.2 Estimation of the method detection limit and quantification limit	13
10.4 Quality control	13
10.4.1 Reagent blanks and laboratory blanks	13
10.4.2 Quality control solutions	14
10.4.3 Certified reference materials	14
10.4.4 External quality assessment	14
10.5 Measurement uncertainty	14
<b>11 Expression of results</b>	<b>15</b>

<b>12</b>	<b>Method performance</b>	<b>15</b>
12.1	Sample collection and stability	15
12.2	Quantification limits	15
12.3	Upper limits of the analytical range	15
12.4	Bias and precision	16
12.4.1	Analytical bias	16
12.4.2	Analytical precision	16
12.5	Uncertainty of sampling and analysis method	16
12.6	Interferences	16
<b>13</b>	<b>Test report</b>	<b>17</b>
13.1	Test record	17
13.2	Laboratory report	18
<b>Annex A (informative) Temperature and pressure correction</b>		<b>19</b>
<b>Bibliography</b>		<b>21</b>

## 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](http://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](http://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 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](http://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 21438-1:2007), which has been technically revised throughout.

A list of all parts in the ISO 21438 series can be found on the ISO website.

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](http://www.iso.org/members.html).

## Introduction

The health of workers in many industries is at risk through exposure by inhalation of particulate acids such as sulfuric acid or phosphoric acid 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 has been published in order to make available a method for making valid exposure measurements for particulate acids 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; and industrial users of sulfuric and phosphoric acids, and their workers.

It has been assumed in the drafting of the ISO 21438 series that the execution of its provisions and the interpretation of the results obtained are entrusted to appropriately qualified and experienced people.

# Workplace atmospheres — Determination of inorganic acids by ion chromatography —

## Part 1:

## Non-volatile acids (sulfuric acid and phosphoric acid)

### 1 Scope

This document specifies a method for the determination of the time-weighted average mass concentration of sulfuric acid and phosphoric acid in workplace air by ion chromatography. The anions are detected by conductivity.

The method is applicable to the personal sampling of airborne particles, as defined in ISO 7708, and to static (area) sampling.

The method does not apply to the determination of sulfur trioxide.

The procedure does not differentiate between the acids and their corresponding salts if both are present in the workplace air.

The procedure does not differentiate between phosphoric acid and diphosphorus pentoxide (phosphoric anhydride) if both are present in the workplace air.

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

ISO 18158, *Workplace air — Terminology*

ISO 21832:2018, *Workplace air — Metals and metalloids in airborne particles — Requirements for evaluation of measuring procedures*

EN 13205, *Workplace exposure — Assessment of sampler performance for measurement of airborne particle concentrations*