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

**Part 3:
Hydrofluoric acid and particulate
fluorides**

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

Partie 3: Acide fluorhydrique et fluorures particulaires

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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 21438-3 was prepared by Technical Committee ISO/TC 146, *Air quality*, Subcommittee SC 2, *Workplace atmospheres*.

ISO 21438 consists of the following parts, under the general title *Workplace atmospheres — Determination of inorganic acids by ion chromatography*: **(standards.iteh.ai)**

- *Part 1: Non volatile acids (sulfuric acid and phosphoric acid)*
- *Part 2: Volatile acids, except hydrofluoric acid (hydrochloric acid, hydrobromic acid and nitric acid)*
- *Part 3: Hydrofluoric acid and particulate fluorides*

Introduction

The health of workers in many industries is at risk through exposure by inhalation of hydrofluoric acid and particulate fluorides. 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 part of ISO 21438 has been published in order to make available a method for making valid exposure measurements for hydrofluoric acid and particulate fluorides 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; industrial users of hydrofluoric acid and particulate fluorides, and their workers. It has been assumed in the drafting of ISO 21438 (all parts) 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 atmospheres — Determination of inorganic acids by ion chromatography —

Part 3: Hydrofluoric acid and particulate fluorides

1 Scope

This part of ISO 21438 specifies a method for the determination of the time-weighted average mass concentration of soluble particulate fluorides and hydrofluoric acid (HF) in workplace air by collection of the particulate fluorides on a pre-filter and HF on an alkali-impregnated filter and analysis by ion chromatography.

The method is only applicable to determination of particulate fluorides that are soluble using the sample preparation procedure specified.

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

The method is applicable to the determination of masses of 0,005 mg to at least 1,25 mg of particulate fluorides per sample and 0,012 5 mg to at least 1,2 mg of HF per sample.

The concentration range of particulate fluorides and HF in air for which the measuring procedure is applicable is determined by the sampling method selected by the user. For a 120 l air sample, the working range is approximately 0,04 mg m⁻³ to at least 10 mg m⁻³ for particulate fluorides and approximately 0,13 mg m⁻³ to at least 10 mg m⁻³ for HF.

HF can react with co-sampled particulate matter on the pre-filter, causing an interference on the measured concentration.

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 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*

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

EN 13205, *Workplace atmospheres — Assessment of performance of instruments for measurement of airborne particles*

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:—^[13], 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:—^[13], 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^[17] Art. 2(a)]

3.1.4

exposure by inhalation

situation in which a chemical agent is present in the air that is inhaled by a person

NOTE Adapted from EN 1540:—^[13], 2.4.1.

3.1.5

occupational exposure limit value

limit of the time-weighted average of the concentration of a chemical agent in the air within the breathing zone of a worker in relation to a specified reference period

[Council Directive 98/24/EC^[17], Art. 2(d)]

EXAMPLES Threshold Limit Values[®] (TLVs) established by the ACGIH (Reference [18]) and indicative occupational exposure limit values (IOELVs) promulgated by the European Commission (Council Directive 2006/15/EC^[19]).

3.1.6

measurement procedure for the sampling and analysis of chemical agents in air

measuring procedure for the sampling and analysis of chemical agents in air

set of operations, described specifically, used for the sampling and analysis of chemical agents in air

NOTE A measuring procedure for the sampling and analysis of chemical agents in air usually includes the following steps: preparation for sampling, sampling, transportation and storage, preparation of samples for analysis and analysis.

3.1.7

operating time

period during which a sampling pump can be operated at specified flow rate and back pressure without recharging or replacing the battery

NOTE Adapted from EN 1232:1997^[12], 3.5.

3.1.8**reference period**

specified period of time for which the limit value of a chemical agent applies

NOTE 1 The reference period is usually 8 h for long-term measurements and 15 min for short-term measurements.

NOTE 2 Adapted from EN 1540:—^[13], 2.4.7.

3.1.9**workplace**

defined area or areas in which the work activities are carried out

[EN 1540:—^[13], 2.5.2]

3.2 Particle size fraction definitions**3.2.1****inhalable convention**

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

[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 The inhalable fraction depends on the speed and direction of air movement, on breathing rate and other factors.

[ISO 7708:1995, 2.3]

3.2.3**respirable convention**

target specification for sampling instruments when the respirable fraction is of interest

[ISO 7708:1995, 2.12]

3.2.4**respirable fraction**

mass fraction of inhaled particles which penetrate to the unciliated airways

[ISO 7708:1995, 2.11]

3.2.5**total airborne particles**

all particles surrounded by air in a given volume of air

NOTE Because all measuring instruments are size-selective to some extent, it is often impossible to measure the total airborne particle concentration.

[ISO 7708:1995, 2.13]

3.3 Sampling definitions**3.3.1****air sampler**

device for separating chemical agents from the surrounding air

NOTE 1 Air samplers are generally designed for a particular purpose, e.g. for sampling gases and vapours or for sampling airborne particles.

NOTE 2 Adapted from EN 1540:—^[13], 3.2.1.

3.3.2

personal sampler

sampler, attached to a person, that collects gases, vapours or airborne particles in the breathing zone to determine exposure to chemical agents

[EN 1540:—^[13], 3.2.2]

3.3.3

personal sampling

process of sampling carried out using a personal sampler

[EN 1540:—^[13], 3.3.3]

3.3.4

static sampler

area sampler

sampler, not attached to a person, that collects gases, vapours or airborne particles at a particular location

[EN 1540:—^[13], 3.2.3]

3.3.5

static sampling

area sampling

process of air sampling carried out in a particular location

[EN 1540:—^[13], 3.3.4]

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3.4 Analytical definitions

3.4.1

analysis

all operations carried out after sample preparation to determine the amount or concentration of the analyte(s) of interest present in the sample

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NOTE Adapted from EN 14902:2005^[16], 3.1.1.

3.4.2

blank solution

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

3.4.3

calibration blank solution

calibration solution prepared without the addition of any working standard solution

NOTE 1 The concentration of fluoride in the calibration blank solution is taken to be zero.

NOTE 2 Adapted from EN 14902:2005^[16], 3.1.3.

3.4.4

calibration solution

solution prepared by dilution of the working standard solution, containing an analyte at concentrations that are suitable for use in calibration of the analytical instrument

NOTE 1 Adapted from EN 14902:2005^[16], 3.1.4.

NOTE 2 For the purposes of this part of ISO 21438, the analyte is fluoride.

3.4.5**field blank**

filter that is taken through the same handling procedure as a sample, except that it is not used for sampling, i.e. it is loaded into a sampler, transported to the sampling site and then returned to the laboratory for analysis

3.4.6**laboratory blank**

unused filter, taken from the same batch used for sampling, that does not leave the laboratory

3.4.7**linear dynamic range**

range of concentrations over which the calibration curve for fluoride is linear

NOTE The linear dynamic range extends from the detection limit to the onset of calibration curvature.

3.4.8**reagent blank**

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

3.4.9**sample dissolution**

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

NOTE Adapted from EN 14902:2005^[16], 3.1.25.

3.4.10**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

NOTE Adapted from EN 14902:2005^[16], 3.1.24.

3.4.11**sample solution**

solution prepared from a sample by the process of sample dissolution

NOTE 1 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.

NOTE 2 Adapted from EN 14902:2005^[16], 3.1.22.

3.4.12**stock standard solution**

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

NOTE Adapted from EN 14902:2005^[16], 3.1.26.

3.4.13**test solution**

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

NOTE 1 "Ready for analysis" includes any required dilution. If a blank solution or sample solution is not subject to any further operations before analysis, it is a test solution.

NOTE 2 Adapted from EN 14902:2005^[16], 3.1.30.

3.4.14

working standard solution

solution, prepared by dilution of the stock standard solution, that contains fluoride at a concentration that is better suited for preparation of calibration solutions than the concentration of fluoride in the stock standard solution

NOTE Adapted from EN 14902:2005^[16], 3.1.32.

3.5 Statistical terms

3.5.1

analytical recovery

ratio of the mass of analyte measured in a sample to the known mass of analyte in that sample

NOTE The analytical recovery is usually expressed as a percentage.

[EN 1540:—^[13], 5.1.1]

3.5.2

bias

difference between the expectation of a test result or measurement result and a true value

NOTE 1 Bias is the total systematic error as contrasted to random error. There can be one or more systematic error components contributing to the bias. A larger systematic difference from the true value is reflected by a larger bias value.

NOTE 2 The bias of a measuring instrument is normally estimated by averaging the error of indication over an appropriate number of repeated measurements. The error of indication is the "indication of a measuring instrument minus a true value of the corresponding input quantity".

NOTE 3 In practice, the accepted reference value is substituted for the true value.

[ISO 3534-2:2006^[1], 3.3.2]

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NOTE 4 In the case of measurement procedures for the sampling and analysis of chemical agents in air, the accepted reference value can be, for example, the certified value of a reference material, the concentration of a standard test atmosphere or the target value of an interlaboratory comparison.

3.5.3

coverage factor

k

numerical factor used as a multiplier of the combined standard uncertainty in order to obtain an expanded uncertainty

NOTE A coverage factor, k , is typically in the range from 2 to 3.

[ISO/IEC Guide 98-3:2008^[4], 2.3.6]

3.5.4

combined standard uncertainty

u_c

standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities, equal to the positive square root of a sum of terms, the terms being the variances or covariances of these other quantities weighted according to how the measurement result varies with changes in these quantities

[ISO/IEC Guide 98-3:2008^[4], 2.3.4]

3.5.5

expanded uncertainty

quantity defining an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand

[ISO/IEC Guide 98-3:2008^[4], 2.3.5]