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Water quality — Application of inductively coupled plasma mass spectrometry (ICP-MS) —

Part 1: General requirements

~~*Qualité de l'eau — Application de la spectrométrie de masse avec plasma à couplage inductif (ICP-MS) — Partie 1: Lignes directrices générales*~~

~~Second edition~~

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FDIS stage

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Foreword

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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~~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 147, *Water quality*, Subcommittee SC 2, *Physical, chemical and biochemical methods*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 230, *Water analysis*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 17294-~~-~~1:2004), which has been technically revised.

The main changes are as follows:

— ~~— revision of the~~ scope revised ~~be in line~~align with ISO 17294-~~-~~2;

— ~~— the document has been~~text revised to ~~be in line with the current~~reflect currently available instruments used in routine daily practice in many laboratories;

— Clauses 5~~ Clauses 5~~ and 6~~6 have been~~ revised to ~~be in line with~~reflect the state-of-the-art equipment used to measure elements according to ISO 17294-2;

— ~~— the abbreviations in Clause 9 have been~~abbreviated terms in Clause 9 revised to ~~be in line~~align with ~~the generally~~common terms used ~~terms~~ in other standards;

— Table A.1~~ Table A.1 has been~~ updated.

A list of all parts in the ISO 17294 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.

Introduction

Since the last edition of this document, new developments ~~for~~in metal ~~analyses~~analysis with inductively coupled plasma mass spectrometry (ICP--MS) ~~took~~have taken place. The use of the collision or reaction cell ~~inductively coupled plasma mass spectrometer (ICP-~~(CRC) technology in quadrupole ICP-MS~~)~~ and triple quadrupole ICP--MS has increased in laboratories. For this reason, this document has been revised and new items have been added.

The intention for the revision of this document was to focus on the instrumentation currently available and in use for determining elements according to ISO 17294--2 in daily practice in laboratories. The consequence of this starting point is that the use of correction formulae has been moved to Annex A~~Annex A~~ because of its reduced importance in modern instrumentation. Many principles also apply for high-resolution or accurate mass instrumentation, although they are not described in detail in this document.

Water quality — Application of inductively coupled plasma mass spectrometry (ICP-MS) — ~~Part 1: General guidelines~~

Part 1: General requirements

1 Scope

This document specifies the principles of inductively coupled plasma mass spectrometry (ICP-~~-~~MS) and provides general ~~instructions~~requirements for the use of this technique to determine elements in water, digests of sludges and sediments (e.g. digests of water as described in ISO 15587-~~-~~1 or ISO 15587-~~-~~2). Generally, the measurement is carried out in water, but gases, vapours~~,~~ or fine particulate matter can be introduced too. This document applies to the use of ICP-~~-~~MS for aqueous solution analysis.

The ultimate determination of the elements is described in a separate International Standard for each series of elements and matrix. The individual clauses of this document refer the ~~reader~~user to these guidelines for the basic principles of the method and the configuration of the instrument.

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 5725-1, *Accuracy (trueness and precision) of measurement methods and results — Part 1: General principles and definitions*

ISO 6206, *Chemical products for industrial use — Sampling — Vocabulary*

ISO Guide 30, *Reference materials — Selected terms and definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5725-~~-~~1, ISO 6206~~,~~ and ISO Guide 33 and the following apply.

ISO and IEC maintain ~~terminological~~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
analyte
element(s) to be determined

3.2
blank calibration solution
solution prepared in the same way as the *calibration solution* (3.3~~(3.3)~~) but leaving out the *analyte* (3.1~~(3.1)~~)

3.3
calibration solution
solution used to calibrate the instrument, prepared from a *stock solution(s)* (3.16~~(3.24)~~) or from a certified standard

3.4
calibration check solution
solution of known composition within the range of the *calibration solution* (3.3~~(3.3)~~) but prepared independently

3.5
determination
entire process from preparing the *test sample solution* (3.18~~(3.26)~~) up to and including the measurement and calculation of the final *result* (3.14~~(3.22)~~)

3.6
instrument detection limit
L_{DI}
smallest concentration that can be detected with a defined statistical probability using a contaminant-free instrument and a *blank calibration solution* (3.2~~(3.2)~~)

3.7
~~**laboratory sample**~~
~~a sample as prepared for sending to the laboratory and intended for inspection or testing.~~

~~[SOURCE: ISO 6206:1979, 3.2.10]~~

~~**3.8**~~
linearity
~~the~~ functional relationship between the indicated values and the contents~~.~~

3.~~9~~8
calibration verification solution
solution with a known concentration of the matrix components compared to the *calibration solutions* (3.4~~(3.4),~~), but having an *analyte* (3.1~~(3.1)~~) concentration half that of the (highest) calibration solution

3.~~10~~9
method detection limit
L_{DM}
smallest *analyte* (3.1~~(3.1)~~) concentration that can be detected with a specified analytical method with a defined statistical probability

3.~~11~~10
net intensity
I
signal obtained after background correction

~~**3.12**~~
~~**net intensity ratio**~~
~~I_R~~
~~*net intensity* (3.11) divided by the net intensity of a reference element~~

~~3.13~~
3.11
optimization solution
solution serving for mass calibration and for the optimization of the apparatus conditions

EXAMPLE Adjustment of maximal *sensitivity* (3.15~~(3.23)~~) with respect to minimal oxide formation rate and minimal formation of doubly charged ions.

3.~~14~~12
precision
closeness of agreement between independent test *results* (3.14~~(3.22)~~) obtained under prescribed conditions

Note 1 to entry: Precision depends only on the distribution of random errors and does not relate to true value or the specified value.

[SOURCE: ISO 5725-~~-~~1:~~1994~~2023, 3.12~~]~~

~~3.15~~
~~**pure chemical**~~
~~chemical with the highest available purity~~, modified — Definition revised and ~~known stoichiometry~~Notes 2 and ~~for which the content of *analyte* (3.1) and contaminants should be known with an established degree of certainty~~3 to entry removed.]

3.~~16~~13
~~**raw intensity**~~
~~I_{raw}~~
~~obtained uncorrected signal~~

~~3.17~~
reagent blank solution
solution prepared by adding to the solvent the same amounts of reagents as those added to the *test sample solution* (3.18~~(3.26)~~) and with the same final volume

~~3.18~~
~~**repeatability**~~
~~*r*~~
~~*precision* (3.14) under *repeatability conditions* (3.19)~~

~~[SOURCE: ISO 5725-1:1994, 3.13]~~

~~3.19~~
~~**repeatability condition**~~
~~condition where independent test *results* (3.22) are obtained with the same method on identical test items in the same laboratory by the same operator using the same equipment within short intervals of time~~

~~[SOURCE: ISO 5725-1:1994, 3.14]~~

~~3.20~~
~~**reproducibility**~~
~~*R*~~
~~*precision* (3.14) under *reproducibility conditions* (3.21)~~

~~[SOURCE: ISO 5725-1:1994, 3.17]~~

~~3.21~~
~~**reproducibility condition**~~
~~condition where test *results* (3.22) are obtained with the same method on identical test items in different laboratories with different operators using different equipment~~

~~[SOURCE: ISO 5725-1:1994, 3.18]~~

~~3.22~~
3.14
result
outcome of a measurement

Note 1 to entry: The result is typically calculated as mass concentration (U), expressed in milligrams per litre.

3.~~23~~15
sensitivity
S
ratio of the variation of the magnitude of the signal (ΔI) to the corresponding variation in the concentration of the *analyte* (3.1~~(3.1)~~) (ΔC) ~~expressed by Formula (1)~~:

Note 1 to entry: Sensitivity is expressed by Formula (1):

$$S = \frac{\frac{\Delta I}{\Delta C}\Delta I}{\Delta C} \quad (1)$$

3.~~24~~16
stock solution
solution with accurately known *analyte* (3.1~~(3.1)~~) concentration(s), prepared from pure chemicals

Note 1 to entry: Stock solutions are reference materials within the meaning of ISO Guide 30.

Note 2 to entry: Pure chemicals are those which have the highest available purity and known stoichiometry and for which the content of analyte and contaminants should be known with an established degree of certainty

3.~~25~~17
test sample
sample prepared from the laboratory sample ~~(3.7),~~

Note 1 to entry: The sample can be prepared, for example, by grinding or homogenizing.

3.~~26~~18
test sample solution
solution prepared with the fraction (test portion) of the *test sample* (3.17~~(3.25)~~) according to the appropriate specifications, such that it can be used for the envisaged measurement

~~3.27~~
~~**trueness**~~
~~closeness of agreement between the average value obtained from a large series of test *results* (3.22) and an accepted reference value~~

~~Note 1 to entry: The measure of trueness is usually expressed in terms of bias, which equals the sum of the systematic error components.~~

~~[SOURCE: ISO 5725-1:1994, 3.7]~~

