



**SLOVENSKI STANDARD**  
**SIST EN ISO 17294-1:2007**  
**01-februar-2007**

---

**Kakovost vode - Uporaba induktivno sklopljene plazme z masno selektivnim detektorjem (ICP-MS) - 1. del: Splošne smernice (ISO 17294-1:2004)**

Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 1: General guidelines (ISO 17294-1:2004)

Wasserbeschaffenheit - Anwendung der induktiv gekoppelten Plasma Massenspektrometrie (ICP-MS) - Teil 1: Allgemeine Anleitung (ISO 17294-1:2004)

**iTeh STANDARD PREVIEW**

Qualité de l'eau - Application de la spectrométrie de masse avec plasma à couplage inductif (ICP-MS) - Partie 1: Lignes directrices générales (ISO 17294-1:2004)

[SIST EN ISO 17294-1:2007](https://standards.iteh.ai/catalog/standards/sist/eb329007-9e7e-43b9-b5c0-94027acc2e82/sist-en-iso-17294-1-2007)

**Ta slovenski standard je istoveten z: EN ISO 17294-1:2006**

---

**ICS:**

13.060.50

**SIST EN ISO 17294-1:2007**

**en,fr,de**

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

SIST EN ISO 17294-1:2007

<https://standards.iteh.ai/catalog/standards/sist/eb329007-9e7e-43b9-b5c0-94b24aec2c82/sist-en-iso-17294-1-2007>

ICS 13.060.50

English Version

Water quality - Application of inductively coupled plasma mass spectrometry (ICP-MS) - Part 1: General guidelines (ISO 17294-1:2004)

Qualité de l'eau - Application de la spectrométrie de masse avec plasma à couplage inductif (ICP-MS) - Partie 1: Lignes directrices générales (ISO 17294-1:2004)

Wasserbeschaffenheit - Anwendung der induktiv gekoppelten Plasma Massenspektrometrie (ICP-MS) - Teil 1: Allgemeine Anleitung (ISO 17294-1:2004)

This European Standard was approved by CEN on 11 September 2006.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

<https://standards.iteh.ai/catalog/standards/sist/eb329007-9e7e-43b9-b5c0-94b24acc2c82/sist-en-iso-17294-1-2007>



EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

## Foreword

The text of ISO 17294-1:2004 has been prepared by Technical Committee ISO/TC 147 "Water quality" of the International Organization for Standardization (ISO) and has been taken over as EN ISO 17294-1:2006 by Technical Committee CEN/TC 230 "Water analysis", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2007, and conflicting national standards shall be withdrawn at the latest by April 2007.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

### Endorsement notice

The text of ISO 17294-1:2004 has been approved by CEN as EN ISO 17294-1:2006 without any modifications.

[SIST EN ISO 17294-1:2007](https://standards.iteh.ai/catalog/standards/sist/eb329007-9e7e-43b9-b5c0-94b24aacc2c82/sist-en-iso-17294-1-2007)

<https://standards.iteh.ai/catalog/standards/sist/eb329007-9e7e-43b9-b5c0-94b24aacc2c82/sist-en-iso-17294-1-2007>

First edition  
2004-09-01

Corrected version  
2005-03-01

---

---

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

**Part 1:  
General guidelines**

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

*Qualité de l'eau — Application de la spectrométrie de masse avec  
plasma à couplage inductif (ICP-MS) —*

*Partie 1: Lignes directrices générales*

SIST EN ISO 17294-1:2007

<https://standards.iteh.ai/catalog/standards/sist/eb329007-9e7e-43b9-b5c0-94b24aacc2c82/sist-en-iso-17294-1-2007>



Reference number  
ISO 17294-1:2004(E)

© ISO 2004

**PDF disclaimer**

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST EN ISO 17294-1:2007](https://standards.iteh.ai/catalog/standards/sist/eb329007-9e7e-43b9-b5c0-94b24aacc2c82/sist-en-iso-17294-1-2007)

<https://standards.iteh.ai/catalog/standards/sist/eb329007-9e7e-43b9-b5c0-94b24aacc2c82/sist-en-iso-17294-1-2007>

© ISO 2004

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

Published in Switzerland

## Contents

Page

Foreword.....	iv
1 Scope.....	1
2 Normative references .....	1
3 Terms and definitions .....	1
4 Principle .....	5
5 Apparatus.....	5
6 Interferences by concomitant elements .....	13
7 Adjustment of the apparatus .....	19
8 Preparatory steps.....	21
9 Procedure.....	26
Annex A (informative) Spectral interferences, choice of isotopes and method detection limits for quadrupole ICP-MS instruments .....	29
Bibliography .....	33

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)

[SIST EN ISO 17294-1:2007](https://standards.iteh.ai/catalog/standards/sist/eb329007-9e7e-43b9-b5c0-94b24aacc2c82/sist-en-iso-17294-1-2007)

<https://standards.iteh.ai/catalog/standards/sist/eb329007-9e7e-43b9-b5c0-94b24aacc2c82/sist-en-iso-17294-1-2007>

## 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 17294-1 was prepared by Technical Committee ISO/TC 147, *Water quality*, Subcommittee SC 2, *Physical, chemical and biochemical methods*.

ISO 17294 consists of the following parts, under the general title *Water quality — Application of inductively coupled plasma mass spectrometry (ICP-MS)*:

— *Part 1: General guidelines*

— *Part 2: Determination of 62 elements*

[SIST EN ISO 17294-1:2007](https://standards.iteh.ai/catalog/standards/sist/en-iso-17294-1-2007)

<https://standards.iteh.ai/catalog/standards/sist/en-iso-17294-1-2007>

This corrected version of ISO 17294-1:2004 incorporates correction of symbols for instrument detection limit and method detection limit, corrections to Equations (1) and (3), and various minor editorial corrections.



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

## Part 1: General guidelines

### 1 Scope

This part of ISO 17294 specifies the principles of inductively coupled plasma mass spectrometry (ICP-MS) and provides general directions for the use of this technique for determining elements in water. Generally, the measurement is carried out in water, but gases, vapours or fine particulate matter may be introduced too. This International Standard applies to the use of ICP-MS for water analysis.

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

### 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 reference document (including any amendments) applies.

ISO Guide 30, *Terms and definitions used in connection with reference materials*

ISO Guide 32, *Calibration in analytical chemistry and use of certified reference materials*

ISO Guide 33, *Uses of certified reference materials*

ISO 3534-1, *Statistics — Vocabulary and symbols — Part 1: Probability and general statistical terms*

ISO 3696:1987, *Water for analytical laboratory use — Specification and test methods*

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

ISO 5725-2, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*

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

ISO 6955, *Analytical spectroscopic methods — Flame emission, atomic absorption and fluorescence — Vocabulary*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5725-1, ISO 6206, ISO 6955 and ISO Guide 32 and the following apply.

3.1

**accuracy**

closeness of agreement between test result and the accepted reference value

NOTE The term accuracy, when applied to a set of observed values, describes a combination of random error components and common systematic error components. Accuracy includes precision and trueness.

3.2

**analyte**

element(s) to be determined

3.3

**blank calibration solution**

solution prepared in the same way as the calibration solution but leaving out the analyte

3.4

**calibration solution**

solution used to calibrate the instrument, prepared from (a) stock solution(s) or from a certified standard

3.5

**check calibration solution**

solution of known composition within the range of the calibration solutions, but prepared independently

3.6

**determination**

entire process from preparing the test sample solution up to and including measurement and calculation of the final result

ITIH STANDARD PREVIEW

(standards.iteh.ai)

3.7

**laboratory sample**

sample sent to the laboratory for analysis

[SIST EN ISO 17294-1:2007](https://standards.iteh.ai/catalog/standards/sist/eb329007-9e7e-43b9-b5c0-94b24aec2c82/sist-en-iso-17294-1-2007)

<https://standards.iteh.ai/catalog/standards/sist/eb329007-9e7e-43b9-b5c0-94b24aec2c82/sist-en-iso-17294-1-2007>

3.8

**linearity**

straight line relationship between the (mean) result of measurement (signal) and the quantity (concentration) of the component to be determined

3.9

**linearity verification solution**

solution with a known concentration of the matrix components compared to the calibration solutions, but having an analyte concentration half that of the (highest) calibration solution

3.10

**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

3.11

**mean result**

mean value of  $n$  results, calculated as intensity (ratio) or as mass concentration ( $\rho$ )

NOTE The mass concentration is expressed in units of milligrams per litre.

3.12

**method detection limit**

$L_{DM}$   
smallest analyte concentration that can be *detected* with a specified analytical method with a defined statistical probability

**3.13**  
**net intensity**

$I$

signal obtained after correction for (poly)atomic ion interferences using an elemental equation

**3.14**  
**net intensity ratio**

$I_R$

net intensity divided by the signal of a reference element

**3.15**  
**optimization solution**

solution serving for mass calibration and for the optimization of the apparatus conditions

EXAMPLE Adjustment of maximal sensitivity with respect to minimal oxide formation rate and minimal formation of doubly charged ions.

**3.16**  
**precision**

closeness of agreement between independent test results obtained under prescribed conditions

NOTE Precision depends only on the distribution of random errors and does not relate to true value or the specified value.

**3.17**  
**“pure chemical”**

chemical with 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

**3.18**  
**raw intensity**

$I_{\text{raw}}$

obtained uncorrected signal

[SIST EN ISO 17294-1:2007](https://standards.iteh.ai/catalog/standards/sist/eb329007-9e7e-43b9-b5c0-94b24aacc2c82/sist-en-iso-17294-1-2007)

<https://standards.iteh.ai/catalog/standards/sist/eb329007-9e7e-43b9-b5c0-94b24aacc2c82/sist-en-iso-17294-1-2007>

**3.19**  
**reagent blank solution**

solution prepared by adding to the solvent the same amounts of reagents as those added to the test sample solution and with the same final volume

**3.20**  
**reproducibility**

$R$

precision under reproducibility conditions

[ISO 3534-1]

**3.21**  
**reproducibility conditions**

conditions where test results are obtained with the same method on identical test items in different laboratories with different operators using different equipment

[ISO 3534-1]

**3.22**  
**reproducibility standard deviation**

standard deviation of test results obtained under reproducibility conditions

[ISO 3534-1]

**3.23  
reproducibility limit**

value less than or equal to which the absolute difference between two single test results obtained under reproducibility conditions may be expected to be, with a probability of, generally, 95 %

**3.24  
repeatability**

*r*  
precision under repeatability conditions

[ISO 3534-1]

**3.25  
repeatability conditions**

conditions where independent test results are obtained with the same method on identical test items in the same laboratory by the same operator using the same equipment within a short interval of time

[ISO 3534-1]

**3.26  
repeatability standard deviation**

standard deviation of test results obtained under repeatability conditions

[ISO 3534-1]

**3.27  
repeatability limit**

value less than or equal to which the absolute difference between two single test results obtained under repeatability conditions may be expected to be, with a probability of, generally, 95 %

**3.28  
result**

outcome of a measurement

iTeh STANDARD PREVIEW

(standards.iteh.ai)

[SIST EN ISO 17294-1:2007](https://standards.iteh.ai/catalog/standards/sist/eb329007-9e7e-43b9-b5c0-94b24acc2c82/sist-en-iso-17294-1-2007)

<https://standards.iteh.ai/catalog/standards/sist/eb329007-9e7e-43b9-b5c0-94b24acc2c82/sist-en-iso-17294-1-2007>

NOTE The result is typically calculated as mass concentration ( $\rho$ ), expressed in milligrams per litre.

**3.29  
sensitivity**

*S*  
ratio of the variation of the magnitude of the signal ( $dI$ ) to the corresponding variation in the concentration of the analyte ( $dC$ ) expressed by the equation:

$$S = \frac{dI}{dC}$$

**3.30  
stock solution**

solution with accurately known analyte concentration(s), prepared from "pure chemicals".

NOTE Stock solutions are reference materials within the meaning of ISO Guide 30.

**3.31  
test sample**

sample prepared from the laboratory sample, for example by grinding or homogenizing

**3.32  
test sample solution**

solution prepared with the fraction (test portion) of the test sample according to the appropriate specifications, such that it can be used for the envisaged measurement

**3.33****trueness  
bias**

closeness of agreement between the average value obtained from a large series of test results and an accepted reference value

NOTE The measure of trueness is usually expressed in terms of bias, which equals the sum of the systematic error components.

**3.34****uncertainty of measurement**

parameter, associated with the result of a measurement, that characterises the dispersion of the values that could reasonably be attributed to the analyte concentration

**4 Principle**

ICP-MS stands for Inductively Coupled Plasma Mass Spectrometry. In the present context, a plasma is a small cloud of hot (6 000 K to 10 000 K) and partly ionized (approximately 1 %) argon gas. Cool plasmas have temperatures of only about 2 500 K. The plasma is sustained by a radio-frequency field. The sample is brought into the plasma as an aerosol. Liquid samples are converted into an aerosol using a nebulizer. In the plasma, the solvent of the sample evaporates, and the compounds present decompose into the constituent atoms (dissociation, atomization). The analyte atoms are in most cases almost completely ionized.

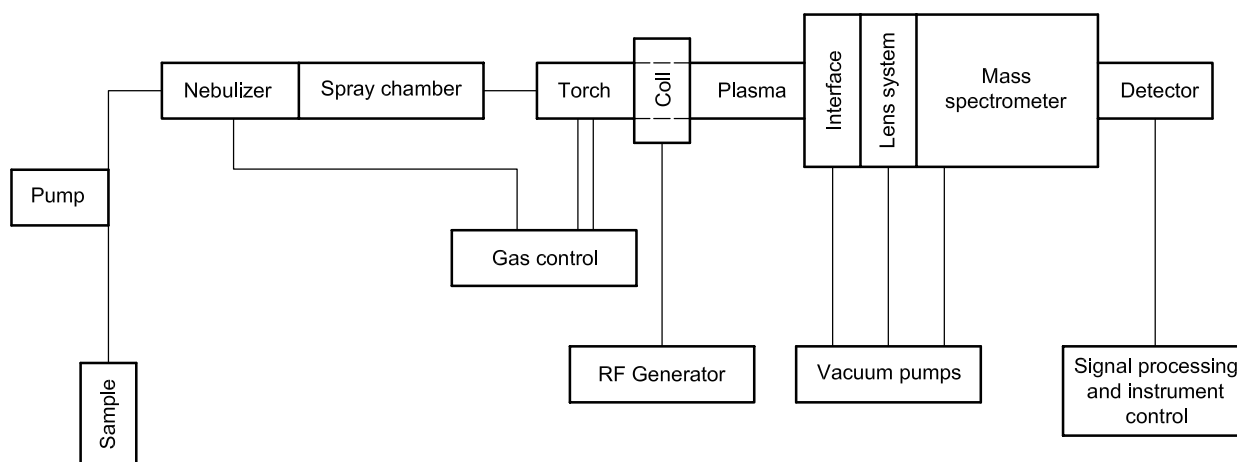
In the mass spectrometer, the ions are separated and the elements identified according to their mass-to-charge ratio,  $m/z$ , while the concentration of the element is proportional to the number of ions.

ICP-MS is a relative technique. The proportionality factor between response and analyte concentration relates to the fact that only a fraction of the analyte atoms that are aspirated reach the detector as an ion. The proportionality factor is determined by measuring calibration solutions (calibration).

<https://standards.iteh.ai/catalog/standards/sist/eb329007-9e7e-43b9-b5c0-94b24acc2c82/sist-en-iso-17294-1-2007>

**5 Apparatus****5.1 General**

The principal components of the ICP-mass spectrometer are as shown in Figure 1 in the form of a schematic block diagram.



**Figure 1 — Schematic block diagram of an ICP-mass spectrometer**