
**Water quality — Determination of
arsenic(III) and arsenic(V) species
— Method using high performance
liquid chromatography (HPLC) with
detection by inductively coupled
plasma mass spectrometry (ICP-
MS) or hydride generation atomic
fluorescence spectrometry (HG-AFS)**

*Qualité de l'eau — Détermination des formes chimiques (III) et (V)
d'arsenic — Méthode par chromatographie en phase liquide à haute
performance (HPLC) avec détection par spectrométrie de masse
par torche à plasma (ICP-MS) ou génération d'hydrure fluorescence
atomique (HG-AFS)*

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Contents

Page

| | |
|--|-----------|
| Foreword | iv |
| Introduction | v |
| 1 Scope | 1 |
| 2 Normative references | 1 |
| 3 Terms and definitions | 2 |
| 4 Principle | 3 |
| 5 Interferences | 3 |
| 6 Apparatus | 3 |
| 7 Reagents and standards | 4 |
| 8 Sampling, preservation and storage of samples | 6 |
| 9 Procedure | 6 |
| 9.1 HPLC instrument optimization..... | 6 |
| 9.2 Calibration..... | 7 |
| 9.3 Sample measurement..... | 7 |
| 10 Expression of results | 7 |
| 11 Test report | 8 |
| Annex A (normative) Detection using inductively coupled plasma mass spectrometry (ICP-MS) | 9 |
| Annex B (normative) Detection using hydride generation atomic fluorescence (HG-AFS) | 20 |
| Annex C (informative) Determination of organic arsenic species | 27 |
| Annex D (informative) Storage and preservation of arsenic species in water samples | 29 |
| Bibliography | 40 |

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).

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: 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*.

Introduction

In the environment, metals and metalloids are found in the form of various chemical species. Chemical speciation makes it possible to identify and quantify these different species. For the same metal or metalloid, given that the toxicity of each compound may vary significantly, it can be useful to quantify each of the species present in a given sample. For arsenic, the toxicity of the various species varies considerably; inorganic species are recognized as being more toxic than organic species and, for example, the toxicity of As(III) is greater than that of As(V). This method is primarily applicable to the determination of arsenite (As(III)) and arsenate (As(V)) as these are the main species of interest and are the predominant species found in potable water samples from the underlying geological strata in many parts of the world. Arsenic speciation measurements are important to establish and select the best water treatment technology for arsenic removal from raw waters containing significant levels of arsenic.

Water quality — Determination of arsenic(III) and arsenic(V) species — Method using high performance liquid chromatography (HPLC) with detection by inductively coupled plasma mass spectrometry (ICP-MS) or hydride generation atomic fluorescence spectrometry (HG-AFS)

WARNING — Persons using this document should be familiar with normal laboratory practice. This document is not intended to cover any safety problems associated with its use, if applicable. It is the responsibility of the user to establish appropriate safety and health practices.

IMPORTANT — It is absolutely essential that tests conducted in accordance with this document be carried out by suitably qualified staff.

1 Scope

This document specifies a method primarily developed for the determination of inorganic arsenic species (arsenite (As(III)) and arsenate (As(V))) dissolved in a sample after a preservation process in waters with a low total organic carbon content such as potable water, tap water, surface waters, ground waters and rain waters. Information is provided on the determination of potentially relevant organo-arsenic species such as methylarsonic acid (MMA) and dimethylarsinic acid (DMA) which may be encountered at very low levels in natural surface waters.

The linear working dynamic range depends on the operating conditions and the method of detection used; under standard conditions, it typically ranges from 0,5 µg/l to 50 µg/l for each species. Samples containing arsenic at concentrations higher than the linear dynamic range can be analysed after suitable dilution.

This method is based on high performance liquid chromatography separation of arsenic species with either inductively coupled mass spectrometry (ICP-MS) or hydride generation atomic fluorescence spectrometry (HG-AFS) as a method of detection.

The sensitivity of this method depends on the method of detection and the instrumental operating conditions selected. The limit of quantification (LOQ) of the method also depends on the operating conditions of the analytical system used and the extent of the calibration range used. LOQ examples for As(III) and As(V) are provided; LOQs are generally less than 1 µg/l.

This document does not apply to arsenobetaine and other organic arsenic species which are not present in natural water samples.

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

ISO 5667-1, *Water quality — Sampling — Part 1: Guidance on the design of sampling programmes and sampling techniques*

ISO 5667-3, *Water quality — Sampling — Part 3: Preservation and handling of water samples*

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

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 **analyte**

substance to be determined

[SOURCE: ISO/TS 28581:2012, 3.1]

3.2 **blank calibration solution**

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

[SOURCE: ISO 17294-1:2004, 3.3]

3.3 **calibration solution**

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

[SOURCE: ISO 17294-1:2004, 3.4]

3.4 **stock solution**

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

[SOURCE: ISO 17294-1:2004, 3.30]

3.5 **determination**

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

[SOURCE: ISO 17294-1:2004, 3.6]

3.6 **limit of quantification**

LOQ

lowest concentration of an analyte that can be determined with a specified degree of accuracy and precision

3.7 **limit of detection**

LOD

lowest concentration of an analyte that can be detected with a specified degree of accuracy and precision