



BSI Standards Publication

Water quality — Thorium 232

Part 1: Test method using alpha spectrometry

National foreword

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Partie 1: Méthode d'essai par spectrométrie alpha



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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.

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 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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This document was prepared by Technical Committee ISO/TC 147, *Water quality*, Subcommittee SC 3, *Radioactivity measurements*.

A list of all parts in the ISO 4722 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

Radionuclides are present throughout the environment; thus, water bodies (e.g. surface waters, ground waters, sea waters) contain radionuclides, which can be of either natural or anthropogenic origin.

- Naturally-occurring radionuclides, including ^3H , ^{14}C , ^{40}K and those originating from the thorium and uranium decay series, in particular ^{210}Pb , ^{210}Po , ^{222}Rn , ^{226}Ra , ^{228}Ra , ^{227}Ac , ^{231}Pa , ^{234}U and ^{238}U , can be found in water bodies due to either natural processes (e.g. desorption from the soil, runoff by rain water) or released from technological processes involving naturally occurring radioactive materials (e.g. mining; mineral processing; oil, gas and coal production; water treatment; and production and use of phosphate fertilisers).
- Anthropogenic radionuclides such as ^{55}Fe , ^{59}Ni , ^{63}Ni , ^{90}Sr , ^{99}Tc , transuranic elements (e.g. Np, Pu, Am and Cm) and some gamma emitting radionuclides such as ^{60}Co and ^{137}Cs can also be found in natural waters. Small quantities of anthropogenic radionuclides can be discharged from nuclear facilities to the environment as a result of authorized routine releases. The radionuclides present in liquid effluents are usually controlled before being discharged to the environment^[1] and water bodies. Anthropogenic radionuclides used in medical and industrial applications can be released to the environment after use. Anthropogenic radionuclides are also found in waters due to contamination from fallout resulting from above-ground nuclear detonations and accidents such as those that have occurred at the Chornobyl and Fukushima nuclear facilities.

Radionuclide activity concentrations in water bodies can vary according to local geological characteristics and climatic conditions and can be locally and temporally enhanced by releases from nuclear facilities during planned, existing and emergency exposure situations.^{[2][3]} Some drinking water sources can thus contain radionuclides at activity concentrations that can present a human health risk. The World Health Organization (WHO) recommends to routinely monitor radioactivity in drinking waters^[4] and to take proper actions when needed to minimize the health risk.

National regulations usually specify the activity concentration limits that are authorized in drinking waters, water bodies and liquid effluents to be discharged to the environment. These limits can vary for planned, existing, and emergency exposure situations. For example, during either a planned or existing situation, the WHO guidance level for ^{232}Th in drinking water is $1 \text{ Bq}\cdot\text{l}^{-1}$ (see NOTE). Compliance with these limits is assessed by measuring radioactivity in water samples and by comparing the results obtained, with their associated uncertainties, as specified by ISO/IEC Guide 98-3^[5] and [ISO 5667-20](#)^[6].

NOTE The guidance level calculated in Reference ^[4] is the activity concentration that, with an intake of $2 \text{ l}\cdot\text{d}^{-1}$ of drinking water for one year, results in an effective dose of $0,1 \text{ mSv}\cdot\text{a}^{-1}$ to members of the public. This is an effective dose that represents a very low level of risk to human health and which is not expected to give rise to any detectable adverse health effects^[4].

In the event of a nuclear emergency, the WHO Codex Guideline Levels^[7] states that the activity concentration can possibly be not greater than $1 \text{ Bq}\cdot\text{l}^{-1}$ and $10 \text{ Bq}\cdot\text{l}^{-1}$ for ^{232}Th , respectively, for infants and other than infants.

This document contains a method to determine ^{232}Th in water samples. The test method has been developed to support laboratories to determine ^{232}Th in water samples.

The detection limit for measurement of a test portion of about 500 ml is approximately $5 \text{ mBq}\cdot\text{l}^{-1}$ with a counting time of about 200 000 s.

The methods described in this document can be used for various types of waters (see [Clause 1](#)). Minor modifications such as sample volume and counting time can be made if needed to ensure that the characteristic limit, decision threshold, detection limit and uncertainties are below the required limits. This can be done for several reasons such as emergency situations, lower national guidance limits and operational requirements.

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Water quality — Thorium 232 —

Part 1:

Test method using alpha spectrometry

WARNING — Persons using this document should be familiar with normal laboratory practice. This document does not purport to address all the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to determine the applicability of any other restrictions.

IMPORTANT — It is essential that tests conducted according to this document be carried out by suitably trained staff.

1 Scope

This document specifies the method and the conditions for the determination of ^{232}Th activity concentration in samples of environmental water (including sea waters) and waste waters before release to the environment using alpha spectrometry and ^{229}Th as a recovery tracer. A chemical separation allows to separate and purify thorium from a test portion of the sample.

The general principles outlined in this document can be applied for the analysis of other alpha-emitting thorium isotopes such as ^{228}Th and ^{230}Th in aqueous 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 11929-1](#), *Determination of the characteristic limits (decision threshold, detection limit and limits of the coverage interval) for measurements of ionizing radiation — Fundamentals and application — Part 1: Elementary applications*

[ISO/IEC 17025](#), *General requirements for the competence of testing and calibration laboratories*

[ISO 80000-10](#), *Quantities and units — Part 10: Atomic and nuclear physics*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in [ISO 11929-1](#) and [ISO 80000-10](#) apply.

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

— ISO Online browsing platform: available at <https://www.iso.org/obp>