ICS 13.060.60, 13.280, 17.240 SLOVENSKÁ TECHNICKÁ NORMA November 2023

STN	**Kvalita vody** **Radón 222** **Časť 4: Dvojfázová kvapalinová scintilačná skúšobná metóda (ISO 13164-4: 2023)**	**STN** **EN ISO 13164-4** 75 7628

Water quality - Radon-222 - Part 4: Test method using two-phase liquid scintillation counting (ISO 13164-4:2023)

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 10/23

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EUROPEAN STANDARD

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EN ISO 13164-4

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Supersedes EN ISO 13164-4:2020

English Version

Water quality - Radon-222 - Part 4: Test method using two-phase liquid scintillation counting (ISO 13164-4:2023)

Qualité de l'eau - Radon 222 - Partie 4: Méthode d'essai par comptage des scintillations en milieu liquide à deux phases (ISO 13164-4:2023)

This European Standard was approved by CEN on 12 June 2023.

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

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Ref. No. EN ISO 13164-4:2023 E

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European foreword

This document (EN ISO 13164-4:2023) has been prepared by Technical Committee ISO/TC 147 "Water quality" in collaboration with 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of an identical text or by endorsement, at the latest by January 2024, and conflicting national standards shall be withdrawn at the latest by January 2024.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 13164-4:2020.

Any feedback and questions on this document should be directed to the users’ national standards body/national committee. A complete listing of these bodies can be found on the CEN website.

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

Endorsement notice

The text of ISO 13164-4:2023 has been approved by CEN as EN ISO 13164-4:2023 without any modification.

INTERNATIONAL STANDARD

ISO 13164-4

Second edition
2023-07

Water quality — Radon-222 —

Part 4: Test method using two-phase liquid scintillation counting

Qualité de l'eau — Radon 222 —

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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 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 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 3, *Radioactivity measurements,* 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 13164-4:2015), which has been technically revised.

The main changes are as follows:

— 3.2: index has been modified according to more recent standards;

— Clause 8: a note has been added;

— A.4.2: efficiency and repeatability data have been revised and updated;

— A.4.2: subclause on reproducibility has been added.

A list of all the parts in the ISO 13164 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 ^{3}H, ^{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 the 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 could 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. As an example, during either a planned or existing situation, the WHO guidance level for ^{222}Rn in drinking water is 1 $Bq{\cdot}l^{-1}$, 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 $l{\cdot}d^{-1}$ of drinking water for one year, results in an effective dose of 0,1 $mSv{\cdot}a^{-1}$ 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].

The ^{222}Rn activity concentration in surface water is very low, usually below 1 $Bq{\cdot}l^{-1}$. In groundwater, the activity concentration varies from 1 $Bq{\cdot}l^{-1}$ up to 50 $Bq{\cdot}l^{-1}$ in sedimentary rock aquifers, from 10 $Bq{\cdot}l^{-1}$ up to 300 $Bq{\cdot}l^{-1}$ in wells, and from 100 $Bq{\cdot}l^{-1}$ up to 1 000 $Bq{\cdot}l^{-1}$ in crystalline rocks. The highest activity concentrations are normally measured in rocks with a high concentration of uranium[7].

High variations in the activity concentrations of radon in aquifers have been observed. Even in a region with relatively uniform rock types, some well water can exhibit radon activity concentration much higher than the average value for the same region. Significant seasonal variations have also been recorded (see ISO 13164-1:2013, Annex A[8]).

In circumstances where high radon concentrations might be expected in drinking-water, it is prudent to measure for radon and, if high concentrations are identified, consider whether measures to reduce the concentrations present are justified[2].

This document contains method(s) to determine ^{222}Rn in water samples. It has been developed to support laboratories that need either a certification or accreditation to determine ^{222}Rn in water samples. A certification or accreditation are sometimes required by local and national authorities as well as some customers. The certification and accreditation are provided by an independent body.

The method(s) 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.

Water quality — Radon-222 —

Part 4:
Test method using two-phase liquid scintillation counting

WARNING — This document does not purport to address all of the safety issues, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

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

1 Scope

This document describes a test method for the determination of radon-222 (^{222}Rn) activity concentration in non-saline waters by extraction and liquid scintillation counting.

The ^{222}Rn activity concentrations, which can be measured by this test method utilizing currently available instruments, are above 0,5 Bq·l^{-1} which is the typical detection limit for a 10 ml test sample and a measuring time of 1 h.

It is the responsibility of the laboratory to ensure the validity of this test method for water samples of untested matrices.

Annex A gives indication on the necessary counting conditions to meet the required detection limits for drinking water monitoring.

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

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

ISO 80000-10, *Quantities and units — Part 10: Atomic and nuclear physics*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*