SLOVENSKI STANDARD
oSIST prEN ISO 10703:2020

01-april-2020

Kakovost vode - Radionuklidi, ki sevajo žarke gama - Preskusna metoda z gama spektrometrijo (ISO/DIS 10703:2020)

Water quality - Gamma-ray emitting radionuclides - Test method using gamma-ray spectrometry (ISO/DIS 10703:2020)

Wasserbeschaffenheit - Bestimmung der Aktivitätskonzentration von Radionukliden - Verfahren mittels hochauflösender Gammaspektrometrie (ISO/DIS 10703:2020)

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Qualité de l'eau - Radionucléides émetteurs gamma - Méthode d'essai par spectrométrie gamma (ISO/DIS 10703:2020)

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Ta slovenski standard je istoveten z: **prEN ISO 10703**

ICS:

13.060.60	Preiskava fizikalnih lastnosti vode	Examination of physical properties of water
17.240	Merjenje sevanja	Radiation measurements

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DRAFT INTERNATIONAL STANDARD

ISO/DIS 10703

ISO/TC **147**/SC **3**

Secretariat: **AFNOR**

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Water quality — Gamma-ray emitting radionuclides — Text method using gamma-ray spectrometry

Qualité de l'eau — Radionucléides émetteurs gamma — Méthode d'essai par spectrométrie gamma

ICS: 13.060.60; 17.240

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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 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*.

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This third edition cancels and replaces the second edition (ISO 10703:2007), which has been technically revised.

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Introduction

Radioactivity from several naturally-occurring and anthropogenic sources is present throughout the environment. Thus, water bodies (e.g. surface waters, ground waters, sea waters) can contain radionuclides of natural, human-made, or both origins.

— Natural radionuclides, including 40K, 3H, 14C, and those originating from the thorium and uranium decay series, in particular 226Ra, 228Ra, 234U, 238U, and 210Pb, can be found in water for natural reasons (e.g. desorption from the soil and washoff by rain water) or can be released from technological processes involving naturally occurring radioactive materials (e.g. the mining and processing of mineral sands or phosphate fertilizer production and use).

— Human-made radionuclides, such as transuranium elements (americium, plutonium, neptunium, curium), 3H, 14C, 90Sr, and gamma emitting radionuclides can also be found in natural waters. Small quantities of these radionuclides are discharged from nuclear fuel cycle facilities into the environment as the result of authorized routine releases. Some of these radionuclides used for medical and industrial applications are also released into the environment after use. Anthropogenic radionuclides are also found in waters as a result of past fallout contaminations resulting from the explosion in the atmosphere of nuclear devices and accidents such as those that occurred in Chernobyl and Fukushima.

Radionuclide activity concentration in water bodies can vary according to local geological characteristics and climatic conditions and can be locally and temporally enhanced by releases from nuclear installation during planned, existing and emergency exposure situations[1]. Drinking water may thus contain radionuclides at activity concentrations which could present a risk to human health.

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The radionuclides present in liquid effluents are usually controlled before being discharged into the environment[2]. Water bodies and drinking waters are monitored for their radioactivity content as recommended by the World Health Organization (WHO)[3] so that proper actions can be taken to ensure that there is no adverse health effect to the public. Following these international recommendations, national regulations usually specify radionuclide authorized concentration limits for liquid effluent discharged to the environment and radionuclide guidance levels for water bodies and drinking waters for planned, existing and emergency exposure situations. Compliance with these limits can be assessed using measurement results with their associated uncertainties as specified by ISO/IEC Guide 98-3 and ISO 5667-20[4].

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Depending on the exposure situation, there are different limits and guidance levels that would result in an action to reduce health risk. As an example, during a planned or existing situation, the WHO guidelines for guidance level in drinking water is x $Bq \cdot l^{-1}$ for x activity concentration.

NOTE 1 The guidance level is the activity concentration with an intake of 2 l/d of drinking water for one year that results in an effective dose of 0,1 mSv/a for members of the public. This is an effective dose that represents a very low level of risk and which is not expected to give rise to any detectable adverse health effects[3].

In the event of a nuclear emergency, the WHO Codex guideline levels[5] mentioned that the activity concentration might not be greater than X $Bq \cdot l^{-1}$ for infant food and X $Bq \cdot l^{-1}$ for food other than infant food, including organically bound tritium.

NOTE 2 The Codex guidelines levels (GLs) apply to radionuclides contained in food destined for human consumption and traded internationally, which have been contaminated following a nuclear or radiological emergency. These GLs apply to food after reconstitution or as prepared for consumption, i.e. not to dried or concentrated food, and are based on an intervention exemption level of 1 mSv in a year for members of the public (infant and adult)[5].

Thus, the test method can be adapted so that the characteristic limits, decision threshold, detection limit and uncertainties ensure that the radionuclide activity concentrations test results can be verified to be below the guidance levels required by a national authority for either planned/existing situations or for an emergency situation[6][7].

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Usually, the test methods can be adjusted to measure the activity concentration of the radionuclide(s) in either wastewaters before storage or in liquid effluents before discharge to the environment. The test results will enable the plant/installation operator to verify that, before their discharge, wastewaters/ liquid effluent radioactive activity concentrations do not exceed authorized limits.

The test method described in this document may be used during planned, existing and emergency exposure situations as well as for wastewaters and liquid effluents with specific modifications that could increase the overall uncertainty, detection limit, and threshold.

The test method may be used for water samples after proper sampling, sample handling, and test sample preparation (see the relevant part of the ISO 5667 series).

This document has been developed to answer the need of test laboratories carrying out these measurements, that are sometimes required by national authorities, as they may have to obtain a specific accreditation for radionuclide measurement in drinking water samples.

This document is one of a set of International Standards on test methods dealing with the measurement of the activity concentration of radionuclides in water samples.

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Water quality — Gamma-ray emitting radionuclides — Text method using gamma-ray spectrometry

WARNING — Persons using this document should be familiar with normal laboratory practice. This International Standard does not purport to address all of 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 ensure compliance with any national regulatory conditions.

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

1 Scope

This document specifies a method for the physical pre-treatment and conditioning of water samples and the determination of the activity concentration of various radionuclides emitting gamma rays with energies 40 keV < E < 2 MeV, by gamma-ray spectrometry according to the generic test method described in ISO 20042[9].

NOTE The determination of the activity concentration of radionuclides emitting gamma rays with energy below 40 keV and above 2 MeV is also possible within the scope of this document, provided both the calibration of the measuring system and the shielding are adapted to this purpose.

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This document is only applicable to homogeneous samples. The lowest limit that can be measured as such, i.e. without dilution or concentration of the sample or anti Compton device is about 5.10^{-2} Bq/l for eg ^{137}Cs. The upper limit of the activity corresponds to a dead time of 5%.

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Depending on different factors, such as the energy of the gamma rays and the emission probability per nuclear disintegration, the size and geometry of the sample and the detector, the shielding, the counting time and other experimental parameters, the sample is concentrated by evaporation when activities below 5.10^{-2} Bq/l have to be measured. However, volatile radionuclides (e.g. radon and radioiodine) can be lost during the source preparation.

When the dead time is higher than 5%, the sample is either diluted or an aliquot of the sample is taken or the source to detector distance is increased or a correction for pile-up effects is applied.

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

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 5667-14, *Water quality — Sampling — Part 14: Guidance on quality assurance and quality control of environmental water sampling and handling*

ISO 20042:2019, *Measurement of radioactivity — Gamma-ray emitting radionuclides — Generic test method using gamma-ray spectrometry*

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