SLOVENSKI STANDARD
SIST EN ISO 13160:2016

01-februar-2016

Kakovost vode - Stroncij Sr-90 in stroncij Sr-89 - Preskusne metode s štetjem s tekočinskim scintilatorjem ali proporcionalnim štetjem (ISO 13160:2012)

Water quality - Strontium 90 and strontium 89 - Test methods using liquid scintillation counting or proportional counting (ISO 13160:2012)

Wasserbeschaffenheit - Strontium 90 und Strontium 89 - Verfahren mittels Flüssigszintillationszählung oder Proportionalzählung (ISO 13160:2012)

Qualité de l'eau - Strontium 90 et strontium 89 - Méthodes d'essai par comptage des scintillations en milieu liquide ou par comptage proportionnel (ISO 13160:2012)

Ta slovenski standard je istoveten z: EN ISO 13160:2015

ICS:

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

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EUROPEAN STANDARD

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English Version

Water quality - Strontium 90 and strontium 89 - Test methods using liquid scintillation counting or proportional counting (ISO 13160:2012)

Qualité de l'eau - Strontium 90 et strontium 89 - Méthodes d'essai par comptage des scintillations en milieu liquide ou par comptage proportionnel (ISO 13160:2012)

Wasserbeschaffenheit - Strontium 90 und Strontium 89 - Verfahren mittels Flüssigszintillationszählung oder Proportionalzählung (ISO 13160:2012)

This European Standard was approved by CEN on 27 September 2015.

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COMITÉ EUROPÉEN DE NORMALISATION
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Contents Page

European foreword

The text of ISO 13160:2012 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 13160:2015 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of an identical text or by endorsement, at the latest by April 2016, and conflicting national standards shall be withdrawn at the latest by April 2016.

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

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Endorsement notice

The text of ISO 13160:2012 has been approved by CEN as EN ISO 13160:2015 without any modification.

INTERNATIONAL STANDARD

ISO 13160

First edition
2012-07-15

Water quality — Strontium 90 and strontium 89 — Test methods using liquid scintillation counting or proportional counting

Qualité de l'eau — Strontium 90 et strontium 89 — Méthodes d'essai par comptage des scintillations en milieu liquide ou par comptage proportionnel

Reference number
ISO 13160:2012(E)

Contents

Page

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 13160 was prepared by Technical Committee ISO/TC 147, *Water quality*, Subcommittee SC 3, *Radiological methods*.

Water quality — Strontium 90 and strontium 89 — Test methods using liquid scintillation counting or proportional counting

WARNING — Persons using this International Standard should be familiar with normal laboratory practice. This document 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 International Standard be carried out by suitably qualified staff.

1 Scope

This International Standard specifies the test methods and their associated principles for the measurement of the activity of ^{90}Sr in equilibrium with ^{90}Y, and ^{89}Sr, pure beta-emitting radionuclides, in water samples. Different chemical separation methods are presented to produce strontium and yttrium sources, the activity of which is determined using a proportional counter (PC) or liquid scintillation counter (LSC). The selection of the test method depends on the origin of the contamination, the characteristics of the water to be analysed, the required accuracy of test results and the available resources of the laboratories.

These test methods are used for water monitoring following, past or present, accidental or routine, liquid or gaseous discharges. It also covers the monitoring of contamination caused by global fallout.

When fallout occurs immediately following a nuclear accident, the contribution of ^{89}Sr to the total amount of strontium activity is not negligible. This International Standard provides the test methods to determine the activity concentration of ^{90}Sr in presence of ^{89}Sr.

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 referenced document (including any amendments) applies.

ISO 11929, *Determination of the characteristic limits (decision threshold, detection limit and limits of the confidence interval) for measurements of ionizing radiation — Fundamentals and application*

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

3 Symbols, definitions, and units

For the purposes of this document, the definitions, symbols, and abbreviated terms defined in ISO 11929 and ISO 80000-10 and the following apply.

A_i	calibration source activity of radionuclide i, at the time of calibration	Bq
$c_{A,i}$	activity concentration of radionuclide i	Bq l^{-1}
$c^*_{A,i}$	decision threshold of radionuclide i	Bq l^{-1}
$c^\#_{A,i}$	detection limit of radionuclide i	Bq l^{-1}
$c^\triangleleft_{A,i}$, $c^\triangleright_{A,i}$	lower and upper limits of the confidence interval of radionuclide i	Bq l^{-1}

$R_{c,i}$	chemical yield of the extraction of radionuclide i	1
r_0	background count rate	s^{-1}
r_{0j}	background count rate for measurement j	s^{-1}
r_g	gross count rate	s^{-1}
r_{gj}	gross count rate for measurement j	s^{-1}
r_j	net count rate for measurement j	s^{-1}
r_s	calibration source count rate	s^{-1}
t	time elapsed between separation of $^{90}Sr/^{90}Y$ ($t = 0$) and counting	s
t_0	background counting time	s
t_d, t_f	start and finish time respectively of the measurement, referred to $t = 0$	s
t_g	sample counting time	s
t_j	start time of the measurement j, referred to $t = 0$	s
t_s	calibration source counting time	s
U	expanded uncertainty, calculated by $U = ku(c_A)$ with $k = 1, 2 ...$	Bq l^{-1}
$u(c_A)$	standard uncertainty associated with the measurement result	Bq l^{-1}
V	volume of the test sample	l
ε_i	counting efficiency for radionuclide i	1
λ_i	decay constant of radionuclide i	1

4 Principle

4.1 General

^{90}Sr, ^{90}Y and ^{89}Sr are pure beta-emitter radionuclides. Their beta-emission energies and half-lives are given in Table 1.

Table 1 — Half-lives, maximum energies, and average energies of ^{90}Sr, ^{90}Y, and ^{89}Sr

Parameter	^{90}Sr	^{90}Y	^{89}Sr
Maximum energy	546,0 keV	2 283,9 keV	1 491,0 keV
Average energy	196,4 keV	935,3 keV	586,3 keV
Half-life	28,79 a	2,67 d	50,5 d

^{90}Sr can be directly measured or estimated through the measurement of its daughter product ^{90}Y. All the test methods are based on a chemical separation step followed by beta-counting of the element using PC or LSC. See Table 2.

4.2 Chemical separation

Strontium is isolated from the water using precipitation, ion chromatography or specific chromatographic separation using crown ether resin. Yttrium can be isolated by precipitation or liquid–liquid extraction.

The separation step should maximize the extraction of the pure element. The method chosen shall be selective with a high chemical yield. When thorium, lead or bismuth radioisotopes are present at high activity levels, they may interfere with ^{90}Sr, ^{90}Y or ^{89}Sr emission during the detection step. Other matrix constituents such as alkaline earth metals and in particular calcium for strontium, or transuranic and lanthanide elements for yttrium, reduce the chemical yield of the extraction.

The radiochemical separation yield is calculated using a carrier such as stable strontium or yttrium, or a radioactive tracer such as ^{85}Sr. Techniques like atomic absorption spectroscopy (AAS), inductively coupled plasma–atomic emission spectroscopy (ICP–AES) or inductively coupled plasma–mass spectrometry (ICP–MS) to measure the carrier, and gamma-spectrometry to measure ^{85}Sr, are recommended. A carrier can also be measured by gravimetric methods, but the presence of inactive elements, essentially alkaline earth elements, in the leaching solutions can lead to an overestimation of the radiochemical separation yields, particularly for the measurement of strontium.

When stable strontium is added as a carrier, the original strontium concentration in the test sample must be known to avoid the overestimation of the radiochemical separation yield.

4.3 Detection

The use of LSC, which provides spectra and permits the detection of interference from unwanted radionuclides, is recommended in preference to PC, which does not distinguish between emissions from different beta-emitters. When PC is used, it is recommended that the purity of the precipitate be checked by following the change over an appropriate time of the ^{90}Y or ^{89}Sr activity, even though this method is time consuming.

Six test methods are presented in Annexes A, B, C, D, E, and F.

5 Chemical reagents and equipment

The necessary chemical reagents and equipment for each strontium measurement method are specified in Annexes A, B, C, D, E, and F.

During the analyses, unless otherwise stated, use only reagents of recognized analytical grade and laboratory water such as distilled or demineralized water or water of equivalent purity as specified in ISO 3696.[1]

6 Procedure

6.1 Test sample preparation

Strontium is determined from the water test sample.

If filtration is required, add the tracer or carrier after this step of the procedure and allow sufficient time to attain chemical equilibrium before starting the test sample preparation.

If stable strontium is added as carrier, the original concentration shall be determined in the test sample in this step of the procedure before the addition of the carrier.

6.2 Chemical separation

6.2.1 General

There are several routine analyses of ^{89}Sr and ^{90}Sr involved in the separation and purification of strontium: precipitation, liquid–liquid extraction or chromatographic techniques (ion exchange or chromatographic extraction). Annexes A, B, C, D, E, and F describe a test method for each of these techniques.