Water quality - Determination of the activity concentration of radionuclides - Method by high resolution gamma-ray spectrometry (ISO 10703:2007)

EESTI STANDARDIKESKUS
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NATIONAL FOREWORD

See Eesti standard EVS-EN ISO 10703:2015 sisaldab Euroopa standardi EN ISO 10703:2015 ingliskeelset teksti.	This Estonian standard EVS-EN ISO 10703:2015 consists of the English text of the European standard EN ISO 10703:2015.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 14.10.2015.	Date of Availability of the European standard is 14.10.2015.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 10703

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English Version

Water quality - Determination of the activity concentration of radionuclides - Method by high resolution gamma-ray spectrometry (ISO 10703:2007)

Qualité de l'eau - Détermination de l'activité volumique des radionucléides - Méthode par spectrométrie gamma à haute résolution (ISO 10703:2007)

Wasserbeschaffenheit - Bestimmung der Aktivitätskonzentration von Radionukliden - Verfahren mittels hochauflösender Gammaspektrometrie (ISO 10703:2007)

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

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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

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European foreword

The text of ISO 10703:2007 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 10703:2015 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.

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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 10703:2007 has been approved by CEN as EN ISO 10703:2015 without any modification.

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Introduction

This International Standard allows (after proper sampling, sample handling and, when necessary or desirable, sample preparation) the simultaneous determination of the activity concentration of several gamma-ray emitting radionuclides in water samples by gamma-ray spectrometry using high purity germanium [HPGe] detectors. Gamma-ray emitting radionuclides are widespread both as naturally occurring and as man-made radionuclides. Therefore, environmental samples usually contain a multitude of different gamma-ray emitters and high resolution gamma-ray spectrometry provides a useful analytical tool for environmental measurements.

Water quality — Determination of the activity concentration of radionuclides — Method by high resolution gamma-ray spectrometry

WARNING — Persons using this International Standard 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 International Standard be carried out by suitably trained staff.

1 Scope

This International Standard specifies a method for the simultaneous determination of the activity concentration of various radionuclides emitting gamma rays with energies 40 keV < E < 2 MeV in water samples, by gamma-ray spectrometry using germanium detectors with high energy resolution in combination with a multichannel analyser.

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 International Standard, provided both the calibration of the measuring system and the shielding are adapted to this purpose.

This International Standard includes the procedures for energy calibration, determination of the energy dependent sensitivity of the measuring system, the analysis of the spectra and the determination of the activity concentration of the various radionuclides in the sample studied. It is only applicable to homogeneous samples. Samples with activities typically between 1 Bq and 10^4 Bq can be measured as such, i.e. without dilution or concentration of the sample or special (electronic) devices.

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 should be concentrated by evaporation when activities below about 1 Bq have to be measured. Also, when the activity is considerably higher than 10^4 Bq, the sample should be either diluted or an aliquot of the sample should be taken or the source to detector distance should be increased, or a correction for pile-up effects should be applied.

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 31-9, *Quantities and units — Part 9: Atomic and nuclear physics*

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: Guidance on the preservation and handling of water samples*

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

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

Guide to the expression of uncertainty in measurement (GUM), BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML

IEC 60973, *Test procedures for germanium gamma-ray detectors*

IEC 61151, *Nuclear instrumentation — Amplifiers and preamplifiers used with detectors of ionizing radiation — Test procedures*

IEC 61452, *Nuclear instrumentation — Measurement of gamma-ray emission rates of radionuclides — Calibration and use of germanium spectrometers*

3 Terms and definitions

For the purposes of this document, the definitions, symbols and abbreviations given in ISO 31-9 and the following apply.

3.1
blank sample
container of an identical composition to the one used for the water test sample filled with radon free demineralized water

3.2
dead time
time interval which must elapse between the occurrence of two consecutive pulses or ionising events for them to be recognized by the detection system as separate pulses or events

3.3
dead time correction
correction to be applied to the observed number of pulses in order to take into account the number of pulses lost during the dead time

3.4
decay constant
λ
⟨radionuclide in a particular energy state⟩ quotient of dP by dt, where dP is the probability of a given nucleus undergoing a spontaneous nuclear transition from that energy state in the time interval dt

$$\lambda = \frac{\mathrm{d}P}{\mathrm{d}t} = -\frac{1}{N}\frac{\mathrm{d}N}{\mathrm{d}t}$$

where N is the number of nuclei of concern existing at time t

3.5
efficiency
under stated conditions of detection, the ratio of the number of detected gamma-photons to the number of gamma-photons of the same type emitted by the radiation source in the same time interval