

Measurement of radioactivity in the environment - Soil -
Part 3: Test method of gamma-emitting radionuclides
using gamma-ray spectrometry (ISO 18589-3:2015,
Corrected version 2015-12-01)

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN ISO 18589-3:2017 sisaldab Euroopa standardi EN ISO 18589-3:2017 ingliskeelset teksti.	This Estonian standard EVS-EN ISO 18589-3:2017 consists of the English text of the European standard EN ISO 18589-3:2017.
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.
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English Version

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Part 3: Test method of gamma-emitting radionuclides
using gamma-ray spectrometry (ISO 18589-3:2015,
Corrected version 2015-12-01)

Mesurage de la radioactivité dans l'environnement -
Sol - Partie 3: Méthode d'essai des radionucléides
émetteurs gamma par spectrométrie gamma (ISO
18589-3:2015, Version corrigée 2015-12-01)

Ermittlung der Radioaktivität in der Umwelt -
Erdboden - Teil 3: Messung von Gammastrahlen
emittierenden Radionukliden mittels
Gammaskpektrometrie (ISO 18589-3:2015, korrigierte
Fassung 2015-12-01)

This European Standard was approved by CEN on 13 September 2017.

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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of ISO 18589-3:2015, Corrected version 2015-12-01 has been prepared by Technical Committee ISO/TC 85 “Nuclear energy, nuclear technologies, and radiological protection” of the International Organization for Standardization (ISO) and has been taken over as EN ISO 18589-3:2017 by Technical Committee CEN/TC 430 “Nuclear energy, nuclear technologies, and radiological protection” the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by April 2018, and conflicting national standards shall be withdrawn at the latest by April 2018.

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.

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Endorsement notice

The text of ISO 18589-3:2015, Corrected version 2015-12-01 has been approved by CEN as EN ISO 18589-3:2017 without any modification.

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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).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: [Foreword — Supplementary information](#).

The committee responsible for this document is ISO/TC 85, *Nuclear energy, nuclear technologies, and radiological protection*, Subcommittee SC 2, *Radiological protection*.

This second edition cancels and replaces the first edition (ISO 18589-3:2007), which has been technically revised.

ISO 18589 consists of the following parts, under the general title *Measurement of radioactivity in the environment — Soil*:

- *Part 1: General guidelines and definitions*
- *Part 2: Guidance for the selection of the sampling strategy, sampling and pre-treatment of samples*
- *Part 3: Test method of gamma-emitting radionuclides using gamma-ray spectrometry*
- *Part 4: Measurement of plutonium isotopes (plutonium 238 and plutonium 239 + 240) by alpha spectrometry*
- *Part 5: Measurement of strontium 90*
- *Part 6: Measurement of gross alpha and gross beta activities*
- *Part 7: In situ measurement of gamma-emitting radionuclides*

This corrected version of ISO 18589-3:2015 incorporates a correction to Formula (4).

Introduction

This part of ISO 18589 is published in several parts to be used jointly or separately according to needs. ISO 18589-1 to ISO 18589-6, concerning the measurements of radioactivity in the soil, have been prepared simultaneously. These parts are complementary and are addressed to those responsible for determining the radioactivity present in soils. The first two parts are general in nature. ISO 18589-3 to ISO 18589-5 deal with radionuclide-specific measurements and ISO 18589-6 with non-specific measurements of gross alpha or gross beta activities. ISO 18589-7 deals with the measurement of gamma-emitting radionuclides using *in situ* spectrometry.

Additional parts can be added to ISO 18589 in the future if the standardization of the measurement of other radionuclides becomes necessary.

Measurement of radioactivity in the environment — Soil —

Part 3:

Test method of gamma-emitting radionuclides using gamma-ray spectrometry

1 Scope

This part of ISO 18589 specifies the identification and the measurement of the activity in soils of a large number of gamma-emitting radionuclides using gamma spectrometry. This non-destructive method, applicable to large-volume samples (up to about 3 000 cm³), covers the determination in a single measurement of all the γ -emitters present for which the photon energy is between 5 keV and 3 MeV.

This part of ISO 18589 can be applied by test laboratories performing routine radioactivity measurements as a majority of gamma-emitting radionuclides is characterized by gamma-ray emission between 40 keV and 2 MeV.

The method can be implemented using a germanium or other type of detector with a resolution better than 5 keV.

This part of ISO 18589 is addressed to people responsible for determining gamma-emitting radionuclides activity present in soils for the purpose of radiation protection. It is suitable for the surveillance of the environment and the inspection of a site and allows, in case of accidents, a quick evaluation of gamma activity of soil samples. This might concern soils from gardens, farmland, urban or industrial sites that can contain building materials rubble, as well as soil not affected by human activities.

When the radioactivity characterization of the unsieved material above 200 μm or 250 μm , made of petrographic nature or of anthropogenic origin such as building materials rubble, is required, this material can be crushed in order to obtain a homogeneous sample for testing as described in ISO 18589-2.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 10703, *Water quality — Determination of the activity concentration of radionuclides — Method by high resolution gamma-ray spectrometry*

ISO 11074, *Soil quality — Vocabulary*

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 18589-1, *Measurement of radioactivity in the environment — Soil — Part 1: General guidelines and definitions*

ISO 18589-2, *Measurement of radioactivity in the environment — Soil — Part 2: Guidance for the selection of the sampling strategy, sampling and pre-treatment of samples*

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

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

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

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 10703, ISO 11074, ISO 18589-1 and ISO 80000-10 apply.

3.2 Symbols

m	mass of the test portion, in kilograms
A	activity of each radionuclide in the calibration source, at the calibration time, in becquerel
a, a_c	activity, in becquerel per kilogram, per unit of mass of each radionuclide, without and with corrections
t_g	sample spectrum counting time, in seconds
t_0	ambient background spectrum counting time, in seconds
t_s	calibration spectrum counting time, in seconds
$n_{N,E}, n_{N0,E}, n_{Ns,E}$	number of counts in the net area of the peak, at energy, E , in the sample spectrum, in the background spectrum and in the calibration spectrum, respectively
$n_{g,E}, n_{g0,E}, n_{gs,E}$	number of counts in the gross area of the peak, at energy, E , in the sample spectrum, in the background spectrum and in the calibration spectrum, respectively
$n_{b,E}, n_{b0,E}, n_{bs,E}$	number of counts in the background of the peak, at energy, E , in the sample spectrum, in the background spectrum and in the calibration spectrum, respectively
ε_E	efficiency of the detector at energy, E , with the actual measurement geometry
P_E	probability of the emission of gamma radiation with energy, E , for each radionuclide, per decay
$\mu_1(E), \mu_2(E)$	linear attenuation coefficient at photon energy, E , of the sample and calibration source, respectively, per centimetre
$\mu_{m,i}(E)$	mass attenuation coefficient, in square centimetres per gram, at photon energy, E , of element i
h	height of the sample in the container, in centimetres
w_i	mass fraction of element i (no unit)
ρ	bulk density, in grams per cubic centimetre, of the sample
λ	decay constant of each radionuclide, per second
$u(a), u(a_c)$	standard uncertainty, in becquerel per kilogram, associated with the measurement result, with and without corrections, respectively
U	expanded uncertainty, in becquerel per kilogram, calculated by $U = k \cdot u(a)$ with $k = 1, 2, \dots$
a^*, a_c^*	decision threshold, in becquerel per kilogram, for each radionuclide, without and with corrections, respectively
$a^\#, a_c^\#$	detection limit, in becquerel per kilogram, for each radionuclide, without and with corrections, respectively
$a^<, a^>$	lower and upper limits of the confidence interval, for each radionuclide, in becquerel per kilogram

4 Principle

The activity of gamma-emitting radionuclides present in the soil samples is determined using gamma spectrometry techniques based on the analysis of the energies and the peak areas of the full-energy