INTERNATIONAL STANDARD

ISO 18589-1

First edition
2005-05-15

Measurement of radioactivity in the environment — Soil —

Part 1: General guidelines and definitions

Mesurage de la radioactivité dans l'environnement — Sol —
Partie 1: Lignes directrices générales et définitions

Reference number
ISO 18589-1:2005(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

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 18589-1 was prepared by Technical Committee ISO/TC 85, *Nuclear energy*, Subcommittee SC 2, *Radiation protection*.

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

— *Part 1: General guidelines and definitions*

The following parts are under preparation:

— *Part 2: Sampling strategy, sampling, and pre-treatment of samples*

— *Part 3: Measurements of gamma emitting radionuclides*

— *Part 4: Measurement of plutonium by alpha spectroscopy*

— *Part 5: Measurements of strontium 90*

— *Part 6: Measurements of gross alpha and gross beta activities*

Introduction

This document was prepared following discussions during meetings of WG 17 in Tokyo 2000-05-8/10, Recife 2001-09-17/19, Paris 2002-01-15/16, Paris 2002-03-26/27, Ringhals 2002-05-27/29, Paris 2002-10-14/15, Paris 2003-03-03/04, Paris 2003-06-16/17 and Paris 2003-12-08/09.

This part of ISO 18589 has been prepared simultaneously with five other parts concerning the measurements of radioactivity in the soil environment, and is complementary to the latter documents.

ISO 18589 Parts 1 to 6 are addressed to those responsible for determining the radioactivity present in soils. This International Standard is published in several parts to be used jointly or separately according to needs. Parts 1 and 2 are general in nature. Parts 3 to 5 deal with nuclide-specific measurements, Part 6 with non-specific measurements of gross alpha or gross beta activities.

Further parts may be added to this International Standard in the future if the standardization of measurements of other radionuclides becomes necessary.

Measurement of radioactivity in the environment — Soil —

Part 1: General guidelines and definitions

1 Scope

This part of ISO 18589 specifies the general requirements to carry out radionuclides tests on soil sample, including sampling.

This part of ISO 18589 is addressed to people responsible for determining the radioactivity present in soils for the purpose of radiation protection. This may concern soils from gardens and farmland, urban or industrial sites, as well as soil not affected by human activities.

This part of ISO 18589 is applicable to all laboratories regardless of the number of personnel or the extent of the scope of testing activities. When a laboratory does not undertake one or more of the activities covered by this part of ISO 18589, such as planning, sampling or testing, the requirements of those clauses do not apply.

This part of ISO 18589 is to be used in conjunction with other parts of ISO 18589 that outline the setting up of programmes and sampling techniques, methods of general processing of samples in the laboratory and also methods for measuring the radioactivity in soil. Its purpose is the following:

— define the main terms relating to soils, sampling, radioactivity and its measurement;

— describe the origins of the radioactivity in soils;

— define the main objectives of the study of radioactivity in soil samples;

— present the principles of studies of soil radioactivity;

— identify the analytical and procedural requirements when measuring radioactivity in soil.

This part of ISO 18589 is applicable if radionuclide measurements for the purpose of radiation protection are to be made in the following cases:

— initial characterization of radioactivity in the environment;

— routine surveillance of the impact of nuclear installations or of the evolution of the general territory;

— investigations of accident and incident situations;

— planning and surveillance of remedial action;

— decommissioning of installations or clearance of materials.

This part of ISO 18589 is not intended to cover scientific investigations of soil radioactivity and therefore does not apply to aspects of such measurements.

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 11074-1:1996, *Soil quality — Vocabulary — Part 1: Terms and definitions relating to the protection and pollution of the soil*

ISO 11074-2:1998, *Soil quality — Vocabulary — Part 2: Terms and definitions relating to sampling*

ISO 10381-1:2002, *Soil quality — Sampling — Part 1: Guidance on the design of sampling programmes*

ISO 10381-2:2002, *Soil quality — Sampling — Part 2: Guidance on sampling techniques*

ISO 10381-3:2001, *Soil quality — Sampling — Part 3: Guidance on safety*

ISO 11464, *Soil Quality — Pretreatment of samples for physico-chemical analyses*

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

GUM:1995, *Guide to the expression of uncertainty in measurement,* first edition BIPM/IEC/IFCC/ ISO/IUPAC/IUPAP/OIML

3 Terms and definitions

For the purposes of all parts of ISO 18589, the terms and definitions given in ISO 11074 and the following apply.

3.1 General terms

3.1.1
routine surveillance
surveillance carried out periodically and designed to observe the potential changes of the soil's radioactive characteristics

3.1.2
analysis for characterization
set of observations that contribute, at a given time, to the characterization of the radioactive properties of a soil sample with a view to use them later as reference data

NOTE The test report may include other data characterizing the site studied.

3.1.3
vertical distribution of the radioactivity
determination of the radioactivity in the layers of soil sampled at different depths which describe the vertical profile of the distribution by a radionuclide or a group of radionuclides

3.2 Terms relating to soils

3.2.1
soil
upper layer of the Earth's crust composed of mineral particles, organic matter, water, air and living organisms

3.2.2
herbaceous cover
lower stratum of vegetation made up essentially of various herbaceous species found for example in meadows, lawns or fallow fields

3.2.3
soil horizon
basic layer of soil, which is more or less parallel to the surface and is homogeneous in appearance for most morphological characteristics (colour, texture, structure, etc.)

NOTE The succession of soil horizons makes up a soil profile and allows, on the basis of certain analytical criteria, the morphogenetic nature of the soil to be defined.

3.3 Terms relating to sampling

The following definitions are adaptations of the definitions taken from ISO 11074 and ISO 10381.

3.3.1
sample
portion of material selected from a larger quantity of material, collected and taken away for testing

3.3.2
sampling
defined procedure whereby a part of the soil is taken for testing

NOTE 1 In certain cases, the sample might not be representative but is determined by availability.

NOTE 2 Sampling procedures shall describe all the processes necessary to provide the laboratory with the samples required to reach the objectives of the study of the soil radioactivity. This will include the selection, sampling plan, withdrawal and preparation of the samples from the soil.

3.3.3
sampling strategy
set of technical principles that aim to resolve, depending on the objectives and site considered, the two main issues which are the sampling density and the spatial distribution of the sampling areas

NOTE The sampling strategy provides the set of technical options that will be required in the sampling plan.

3.3.4
sampling area
area from which the different samples are collected

NOTE A site can be divided into several sampling areas.

3.3.5
sampling plan
precise protocol that, depending on the application of the principles of the strategy adopted, defines the spatial and temporal dimensions of sampling, the frequency, the sample number, the quantities sampled, etc., and the human resources to be used for the sampling operation

3.3.6
random sampling
collecting samples at random in space and time from the sampling area

3.3.7
systematic sampling
collecting samples by some systematic method in space and time from the sampling area

3.3.8
random systematic sampling
collecting samples at random from each sampling unit from a set of systematically defined sampling units

3.3.9
sampling unit
section of the sampling area whose limits can be physical or hypothetical

NOTE Sampling units are obtained by dividing the sampling area into grid box units according to the sampling pattern.

3.3.10
sampling pattern
system of sampling locations based on the results of statistical procedures

NOTE This leads to a set of predetermined sampling points designed to monitor one or more specified sites. The sampling area is divided into several sampling units or basic grid box units, which are usually square or rectangular (but circular or linear grid boxes are not excluded depending upon the characteristics of the pollution source).

3.3.11
increment
portion of material collected in a single operation using a sampling device

NOTE Increments can be grouped to form a composite sample.

3.3.12
sub-sample
sample in which the material of interest is randomly distributed in parts of equal or unequal size

3.3.13
single sample
representative quantity of the material, presumed to be homogeneous, taken from a sampling unit, kept and treated separately from the other samples

3.3.14
composite sample
two or more increments mixed together in appropriate proportions, either discretely or continuously (blended composite sample), from which the average value representative of a desired characteristic may be obtained

3.3.15
sorted sample
single sample or composite sample taken from the same sampling unit, obtained after the elimination of coarse elements that are larger than 2 cm and before drying

3.3.16
laboratory sample
sorted sample intended for laboratory inspection or testing

NOTE 1 When the laboratory sample is further prepared (reduced) by subdividing, mixing, grinding or combinations of these operations, the result is the test sample. When no preparation is required, the initial laboratory sample is considered as the test sample. Depending on the number of analyses to be performed, test portions are isolated from the test sample for analysis.

NOTE 2 The laboratory sample is the final sample from the point of view of the sample collection step, but it is the initial sample from the point of view of the test step.

3.3.17
test sample
sample treated in accordance with ISO 18589-2, prepared for testing

NOTE The test sample is prepared from the laboratory sample. It is a fine dry homogeneous soil in a powder state.

3.3.18
test portion
part of the test sample prepared for specific testing

4 Symbols

Table 1 — Definitions and symbols

Quantity	Common notation	Unit	Definition
Activity	A	becquerel Bq	number of decays per second of a radionuclide
Activity concentration	A_m	becquerel per kilogram $Bq \cdot kg^{-1}$	radionuclide activity per unit dry mass of material
Activity per unit area	A_s	becquerel per square metre $Bq \cdot m^{-2}$	radionuclide activity per unit area used to characterize the activity at the soil surface, at a depth or integrated activity over a soil column
Gross α activity	$A'(\alpha)$	Becquerel Bq	number of α decays per second of a mixture of radionuclides determined by non-nuclide-specific measurement techniques whose efficiency is calibrated using a specific radionuclide such as ^{239}Pu, ^{241}Am, …
Gross β activity	$A'(\beta)$	Becquerel Bq	number of β decays per second of a mixture of radionuclides determined by non-nuclide-specific measurement techniques whose efficiency is calibrated using a specific radionuclide such as ^{36}Cl, ^{40}K, $^{90}Sr+^{90}Y$, …

5 Origins of the radioactivity in soils

5.1 Natural radioactivity

Soils are naturally radioactive, primarily because of their mineral content. The main natural radionuclides are potassium 40 (^{40}K) and the radioactive nuclides of the uranium 238 (^{238}U) and thorium 232 (^{232}Th) decay series. The natural radioactivity may vary considerably from one type of soil to another. Table 2 gives the order of magnitude of the activity concentrations of these elements in soils of some large regions of the world [3].

Table 2 — Activity concentrations of natural radionuclides in soils [3]

Region/Country	Activity concentration $Bq \cdot kg^{-1}$					
	^{40}K		^{238}U		^{232}Th	
	Mean	Range	Mean	Range	Mean	Range
North America (USA)	370	100 to 700	35	4 to 140	35	4 to 130
South America (Argentina)	650	540 to 750	—	—	—	—
East Asia (China R.P.)	440	9 to 1 800	33	2 to 690	41	1 to 360
West Asia (Armenia)	360	310 to 420	46	20 to 78	30	29 to 60
North Europe (Lithuania)	600	350 to 850	16	3 to 30	25	9 to 46
West Europe (Ireland)	350	40 to 800	37	8 to 120	26	3 to 60
East Europe (Russian Federation)	520	100 to 1 400	19	0 to 67	30	2 to 79
South Europe (Greece)	360	12 to 1 570	25	1 to 240	21	1 to 190