NSAI Standards

Irish Standard
I.S. EN ISO 19581:2020

Measurement of radioactivity - Gamma emitting radionuclides - Rapid screening method using scintillation detector gamma-ray spectrometry (ISO 19581:2017)

I.S. EN ISO 19581:2020

Incorporating amendments/corrigenda/National Annexes issued since publication:

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National Foreword

I.S. EN ISO 19581:2020 is the adopted Irish version of the European Document EN ISO 19581:2020, Measurement of radioactivity - Gamma emitting radionuclides - Rapid screening method using scintillation detector gamma-ray spectrometry (ISO 19581:2017)

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 19581

February 2020

ICS 17.240

English Version

Measurement of radioactivity - Gamma emitting radionuclides - Rapid screening method using scintillation detector gamma-ray spectrometry (ISO 19581:2017)

Mesurage de la radioactivité - Radionucléides émetteurs gamma - Méthode d'essai de dépistage par spectrométrie gamma utilisant des détecteurs par scintillation (ISO 19581:2017)

Bestimmung der Radioaktivität - Gammastrahlung emittierende Radionuklide - Schnellverfahren mit Szintillationsdetektor und Gammaspektrometrie (ISO 19581:2017)

This European Standard was approved by CEN on 6 January 2020.

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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 19581:2017 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 19581:2020 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of an identical text or by endorsement, at the latest by August 2020, and conflicting national standards shall be withdrawn at the latest by August 2020.

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 19581:2017 has been approved by CEN as EN ISO 19581:2020 without any modification.

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INTERNATIONAL STANDARD

ISO 19581

First edition
2017-10

Measurement of radioactivity — Gamma emitting radionuclides — Rapid screening method using scintillation detector gamma-ray spectrometry

Mesurage de la radioactivité — Radionucléides émetteurs gamma — Méthode d'essai de dépistage par spectrométrie gamma utilisant des détecteurs par scintillation

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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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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical committee ISO/TC 85, *Nuclear Energy, nuclear technologies, and radiological protection*, Subcommittee SC 2, *Radiological protection.*

Introduction

Everyone is exposed to natural radiation. The natural sources of radiation are cosmic rays and naturally occurring radioactive substances which exist in the earth and within the human body. Human activities involving the use of radiation and radioactive substances add to the radiation exposure from this natural exposure. Some of those activities, such as the mining and use of ores containing naturally-occurring radioactive materials (NORM) and the production of energy by burning coal that contains such substances, simply enhance the exposure from natural radiation sources. Nuclear power plants and other nuclear installations use radioactive materials and produce radioactive effluent and waste during operation and on their decommissioning. The use of radioactive materials in industry, agriculture and research is expanding around the globe.

All these human activities give rise to radiation exposures that are only a small fraction of the global average level of natural exposure. The medical use of radiation is the largest and a growing man-made source of radiation exposure in developed countries. It includes diagnostic radiology, radiotherapy, nuclear medicine and interventional radiology.

Radiation exposure also occurs as a result of occupational activities. It is incurred by workers in industry, medicine and research using radiation or radioactive substances, as well as by passengers and crew during air travel and for astronauts. The average level of occupational exposures is generally below the global average level of natural radiation exposure[11].

As uses of radiation increase, so do the potential health risk and the public's concerns. Thus, all these exposures are regularly assessed in order to

a) improve the understanding of global levels and temporal trends of public and worker exposure

b) to evaluate the components of exposure so as to provide a measure of their relative importance, and

c) to identify emerging issues that may warrant more attention and study.

While doses to workers are mostly directly measured, doses to the public are usually assessed by indirect methods using radioactivity measurements results performed on various sources: waste, effluent and/or environmental samples.

To ensure that the data obtained from radioactivity monitoring programs support their intended use, it is essential that the stakeholders (for example, nuclear site operators, regulatory and local authorities) agree on appropriate methods and procedures for obtaining representative samples and then handling, storing, preparing and measuring the test samples. A assessment of the overall measurement uncertainty needs also to be carried out systematically. As reliable, comparable and ‘fit for purpose’ data are an essential requirement for any public health decision based on radioactivity measurements, international standards of tested and validated radionuclide test methods are an important tool for the production of such measurement results. The application of standards serves also to guarantee comparability over time of the test results and between different testing laboratories. Laboratories apply them to demonstrate their technical qualifications and to successfully complete proficiency tests during interlaboratory comparison, two prerequisites for obtaining national accreditation. Today, over a hundred international standards, prepared by Technical Committees of the International Standardization Organization, including those produced by ISO/TC85, and the International Electrotechnical Commission (IEC), are available for application by testing laboratories to measure the main radionuclides.

Generic standards help testing laboratories to manage the measurement process by setting out the general requirements and methods to calibrate and validate techniques. These standards underpin specific standards which describe the test methods to be performed by staff, for example, for different types of sample. The specific standards cover test methods for:

— Naturally-occurring radionuclides (including ^{40}K, ^{3}H, ^{14}C and those originating from the thorium and uranium decay series, in particular ^{226}Ra, ^{228}Ra, ^{234}U, ^{238}U, ^{210}Pb) which can be found in materials from natural sources 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, and curium), ^{3}H, ^{14}C, ^{90}Sr and gamma emitting radionuclides found in waste, liquid and gaseous effluent, in environmental matrices (water, air, soil, biota) and food and feed as a result of authorized releases into the environment and of fallout resulting from the explosion in the atmosphere of nuclear devices and accidents, such as those that occurred in Chernobyl and Fukushima.

Environmental materials, including foodstuffs, thus may contain radionuclides at activity concentrations which could present a risk to human health. In order to assess the potential human exposure to radioactivity and to provide guidance on reducing health risks by taking measures to decrease radionuclide activity concentrations, the environment and foodstuffs are routinely monitored for radioactivity content as recommended by the World Health Organization (WHO). Gamma-emitting radionuclides are usually quantified in environmental and food samples by gamma-ray spectrometry using High Purity Germanium (HPGe) gamma-ray spectrometry. Following a nuclear accident, a screening approach based on rapid test methods is recommended to help the decision makers to decide whether activity concentrations in environmental samples, feed and food samples are above or below operational intervention levels (OILs)[12] that are specifically set up to manage nuclear and radiological emergency. During nuclear emergency response, these default radionuclide specific OILs for food, milk and water concentrations from laboratory analysis would be used to measure the effectiveness of protective actions and contribute to determining any further actions required[12][13].

In 1989, following the Chernobyl accident, the first version of the Codex Guideline Levels (GLs) for Radionuclides in Foods Contaminated Following a Nuclear or Radiological Emergency (in the following referred to as “Codex GLs”) was adopted. The Codex GLs were reviewed in 2006 and are included in the General Standard for Contaminants and Toxins in Food and Feeds[14][15]. During a nuclear emergency situation, the Codex GLs for gamma-emitting radionuclides such as $^{106}Ru/^{106}Rh$ and ^{131}I is 100 $Bq \cdot kg^{-1}$; the GL for ^{60}Co, ^{103}Ru, ^{137}Cs and ^{134}Cs, ^{144}Ce is higher at 1000 $Bq \cdot kg^{-1}$ but a lower limit of 100 $Bq \cdot kg^{-1}$ still applies for foods for infants. Default radionuclide specific OILs for food, milk and water concentrations from laboratory analysis set up by FAO, IAEA, ILO, OECD/NEA, PAHO, OCHA, WHO were recently revised[16].

NOTE The Codex GLs are the activity concentration in foods that would result in an effective dose of 1 mSv/year for members of the Public (infant and adult) in accordance with the most recent recommendations of the International Commission on Radiological Protection (ICRP) considering that 550 kg of food is consumed per year by an adult and 200 kg of food and milk is consumed per year by an infant, with 10 % of the diet is of imported food, all of which is contaminated giving an import to production factor of 0,1. For convenience the GL values were rounded, and radionuclides with ingestion dose coefficients of similar magnitudes grouped and given similar GLs values. However, separate GLs were derived for infants and adults due to differences in radionuclide absorption, metabolism and sensitivity to radiation.

Emergency preparedness should include planning for the implementation of optimized test methods that can provide rapid estimates of activity concentration to be checked against OILs. Thus, an international standard on a screening method using Gamma-Ray Spectrometry is justified for use by testing laboratories carrying out measurements of gamma-emitting radionuclides during an emergency situation. Such laboratories are intended to obtain a specific accreditation for radionuclide measurement in environmental and/or food samples.

This document describes, after proper sampling, sample handling and preparation, a screening method to quantify rapidly the activity concentration of iodine and caesium in environmental, feedstuffs and foodstuffs samples using scintillation spectrometer during an emergency situation.

This document is one of a set of generic international standards on measurement of radioactivity.

Measurement of radioactivity — Gamma emitting radionuclides — Rapid screening method using scintillation detector gamma-ray spectrometry

WARNING — Persons using this document should be familiar with normal testing laboratory practice. This 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 according to this document be carried out by suitably trained staff.

1 Scope

This document specifies a screening test method to quantify rapidly the activity concentration of gamma-emitting radionuclides, such as ^{131}I, ^{132}Te, ^{134}Cs and ^{137}Cs, in solid or liquid test samples using gamma-ray spectrometry with lower resolution scintillation detectors as compared with the HPGe detectors (see IEC 61563).

This test method can be used for the measurement of any potentially contaminated environmental matrices (including soil), food and feed samples as well as industrial materials or products that have been properly conditioned. Sample preparation techniques used in the screening method are not specified in this document, since special sample preparation techniques other than simple machining (cutting, grinding, etc.) should not be required. Although the sampling procedure is of utmost importance in the case of the measurement of radioactivity in samples, it is out of scope of this document; other international standards for sampling procedures that can be used in combination with this document are available (see References [1],[2],[3],[4],[5],[6]).

The test method applies to the measurement of gamma-emitting radionuclides such as ^{131}I, ^{134}Cs and ^{137}Cs. Using sample sizes of 0,5 l to 1,0 l in a Marinelli beaker and a counting time of 5 min to 20 min, decision threshold of 10 Bq·kg^{-1} can be achievable using a commercially available scintillation spectrometer [e.g. thallium activated sodium iodine (NaI(Tl)) spectrometer 2” ϕ × 2” detector size, 7 % resolution (FWHM) at 662 keV, 30 mm lead shield thickness].

This test method also can be performed in a “makeshift” laboratory or even outside a testing laboratory on samples directly measured in the field where they were collected.

During a nuclear or radiological emergency, this test method enables a rapid measurement of the sample activity concentration of potentially contaminated samples to check against operational intervention levels (OILs) set up by decision makers that would trigger a predetermined emergency response to reduce existing radiation risks[12].

Due to the uncertainty associated with the results obtained with this test method, test samples requiring more accurate test results can be measured using high-purity germanium (HPGe) detectors gamma-ray spectrometry in a testing laboratory, following appropriate preparation of the test samples[7][8].

This document does not contain criteria to establish the activity concentration of OILs.

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.