International Standard

ISO 11932

Activity measurements of solid materials considered for recycling, re-use or disposal as non-radioactive waste

Mesures d'activité de matériaux solides considérés comme déchets non radioactifs destinés à un recyclage, une réutilisation ou une mise au rebut

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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 document 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 of the voluntary nature of standards, 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 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 5, *Nuclear installations, processes and technologies*.

This second edition cancels and replaces the first edition (ISO 11932:1996), which has been technically revised.

The main changes compared to the previous edition are as follows:

— this document provides overall update of normative references, terms and definitions following the newest international guidance and standards;

— this document provides the generic clearance levels for solid materials using surface contamination and activity concentration, guidance for the radiochemical analysis of difficult-to-measure radionuclides in solid materials, decomposition methods for solid materials samples, and detailed technical requirements of surface contamination measurements.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

During the operation and decommissioning of nuclear facilities, there are significant parts of solid materials that will be considered for recycling, re-use, or disposal as non-radioactive waste. Such solid materials to be cleared from regulatory control are required to satisfy the criteria of clearance specified in IAEA Safety Standards Series No. GSR Part 3[1]. Recommendations on the application of clearance to solid materials are provided in IAEA General Safety Guide No. GSG-18[2]. It is recommended in GSG-18[2] that activity concentration and surface contamination clearance levels are applied for clearance of solid materials.

This document is needed to specify activity measurement of solid materials to show compliance with clearance limits as given in international standards or national standards.

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Activity measurements of solid materials considered for recycling, re-use or disposal as non-radioactive waste

1 Scope

This document specifies the basic guidance and methods for activity measurements of solid materials to be cleared for recycling, re-use or disposal as non-radioactive waste arising from the operation and decommissioning of nuclear facilities, in order to show compliance with required limits for generic clearance or specific clearance. It does not apply to ordinary radioactive waste characterization.

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.

ISO 4037 (all parts), *Radiological protection — X and gamma reference radiation for calibrating dosemeters and doserate meters and for determining their response as a function of photon energy*

ISO 8769, *Measurement of radioactivity — Alpha-, beta- and photon emitting radionuclides — Reference measurement standard specifications for the calibration of surface contamination monitors*

ISO 12749-1, *Nuclear energy — Vocabulary — Part 1: General terminology*

ISO 12749-2, *Nuclear energy, nuclear technologies, and radiological protection — Vocabulary — Part 2: Radiological protection*

IEC 60846-1, *Radiation protection instrumentation — Ambient and/or directional dose equivalent (rate) meters and/or monitors for beta, X and gamma radiation — Part 1: Portable workplace and environmental meters and monitors*

IEC 61017, *Radiation protection instrumentation — Transportable, mobile or installed equipment to measure photon radiation for environmental monitoring*

IEC 60325, *Radiation protection instrumentation — Alpha, beta and alpha/beta (beta energy >60 keV) contamination meters and monitors*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12749-1, ISO 12749-2 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

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3.1
activity
A
quotient of $-dN/dt$, where dN is the change in the number of radioactive nuclei, at a particular energy state and at a given time, due to spontaneous nuclear transformations in the time of interval dt

Note 1 to entry: The special name for the unit of activity in the International Systems of Units is becquerel (Bq), where $1\ Bq = 1\ s^{-1}$.

[SOURCE: ISO 12749-1:2020, 3.1.2]

3.2
activity concentration
activity (3.1) per unit mass or per unit volume

[SOURCE: IAEA Nuclear Safety and Security Glossary:2022(Interim)]

3.3
surface contamination
radioactive substances deposited on defined surfaces

[SOURCE: ISO 7503-1:2016, 3.1.2]

3.4
surface contamination level
ratio between the *activity* (3.1) of the radionuclides present on a surface and the area of that surface

Note 1 to entry: It is expressed in becquerel per square centimetre ($Bq \cdot cm^{-2}$).

3.5
fixed surface contamination
surface contamination (3.3) which cannot be removed or transferred by non-destructive means

[SOURCE: ISO 7503-1:2016, 3.1.3]

3.6
removable surface contamination
radioactive material that can be removed from surfaces by non-destructive means, including casual contact, wiping or washing

Note 1 to entry: It should be noted that under the influence of moisture, chemicals, etc., or as a result of corrosion or diffusion, fixed contamination can become removable or vice versa without any human action. Furthermore, surface contaminations can decrease due to evaporation, volatilization and/or sublimation.

Note 2 to entry: It should be emphasized that the ratio between fixed and removable contamination can vary over time, and that some decisions, such as those related to clearance, should be based on total activity with the potential to become removable over time, not just the amount that is removable at the time of a survey.

[SOURCE: ISO 7503-1:2016, 3.1.4]

3.7
evaluation of surface contamination
evaluation of surface contamination by means of a detector that measure both fixed and removable surface contamination

3.8
indirect evaluation of removable surface contamination
evaluation of the removable activity on a surface by means of a *wipe test* (3.9)

[SOURCE: ISO 12749-2:2022, 3.4.59]

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3.9
wipe test
test to determine if *removable surface contamination* (3.6) is present through wiping the surface with a dry or wet material, followed by evaluation of the wipe material for removable contamination

[SOURCE: ISO 7503-1:2016, 3.1.7]

3.10
instrument efficiency
ε_i
ratio between the instrument net reading (counts per second after background subtraction) and the surface emission rate of the reference measurement standard (particles emitted per second) in a specified geometry relative to a standard

Note 1 to entry: The instrument efficiency depends on the type of emitted particle, the energy of the radiation emitted by the standard, the area of the standard, and the area of the detector entrance window.

[SOURCE: ISO 8769:2020, 3.4]

3.11
generic clearance
clearance on the basis of the clearance levels provided in schedule I of IAEA GSR Part 3[1] or of any set of values defined in the national regulations that are intended for clearance without any restrictions on the material's type, amount, further management, reuse, recycling or final destination

[SOURCE: IAEA GSG-18 Application of the Concept of Clearance:2023, 2.1(a)]

3.12
specific clearance
clearance on the basis of any other clearance levels derived for specific situations, materials and destinations of the cleared material

[SOURCE: IAEA GSG-18 Application of the Concept of Clearance:2023, 2.1(b)]

3.13
clearance level
value established by the competent authority, expressed in terms of *activity* (3.1), *activity concentration* (3.2) or *surface contamination* (3.3) (fixed and non-fixed) at or below which radioactive material or radioactive objects within authorized practice may be removed from any further regulatory control by the regulatory body

[SOURCE: ISO 19461-1:2018, 3.5]

4 Requirements for activity measurements related to generic clearance

4.1 General

Radioactivity measurements related to generic clearance of materials to be treated in this standard deal with

— surface contamination measurements, and

— activity concentration measurements.

Some surface contamination values for generic clearance are given in the Table II-1 of IAEA GSG-18[2], which are derived on the basis of an individual effective dose of 10 $\mu Sv \cdot a^{-1}$.

Surface contamination levels for generic clearance are between 0,1 $Bq \cdot cm^{-2}$ and 10 $Bq \cdot cm^{-2}$ for alpha/gamma emitters. A broader range of surface contamination limits shall be given for weak beta emitters and electron capture emitters, such as ^{3}H, ^{14}C, ^{36}Cl.

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