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Measurement of radioactivity — Measurement and evaluation of surface contamination —

Part 3: Apparatus calibration

Mesurage de la radioactivité — Mesurage et évaluation de la contamination de surface —

Partie 3: Étalonnage de l'appareillage

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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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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 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 7503-3:1996), which has been technically revised.

ISO 7503 consists of the following parts, under the general title *Measurement of radioactivity — Measurement and evaluation of surface contamination*:

— *Part 1: General principles*

— *Part 2: Test method using wipe-test samples*

— *Part 3: Apparatus calibration*

This corrected version of ISO 7503-3:2016 incorporates the following corrections:

— In E.5, Formulae (E.12) and (E.13) have been modified.

Introduction

ISO 7503 gives guidance on the measurement of surface contamination. ISO 7503 is applicable to many situations where radioactive contamination can occur. Contamination arises from the release of radioactivity into the local environment. In most circumstances, the release is inadvertent but, on occasion, may be deliberate. Although the purpose and scope of the investigation may differ, the approaches taken to measure the levels and extent of the contamination are essentially similar.

Radioactive contamination can arise from a number of activities or events such as the following:

— routine laboratory use of radio-chemicals;

— medical treatments;

— industrial applications;

— transport accidents;

— equipment malfunctions;

— malevolent incidents;

— nuclear accidents.

Without process knowledge or documentation, it is not always possible to identify or distinguish the different radionuclides constituting a surface contamination, and the evaluation of such a contamination cannot be made on a quantitative basis. Instead of using instruments with nuclide specific calibrations, it may be necessary to use other instruments which are fit for such a purpose.

However, there may be cases (e.g. a contaminated fuel material transport container) where the radionuclide or the radionuclide mixture can be clearly characterized. A surface contamination evaluation exceeding a pure qualitative assessment of fixed and removable surface contamination may then be needed. Moreover, following requirements laid down in national regulations and in international conventions, a measured surface contamination activity per unit area should be compared with surface contamination guideline values or surface contamination limits.

Surface contamination guideline values are radionuclide-specific and thus require complex radionuclide-specific calibrations of measurement equipment. Calibration quality assurance is crucial in order to avoid non-detection (i.e. type II decision errors) leading to incorrectly assuming compliance with given surface contamination guideline values or limits. Evaluation of surfaces contaminated by a mixture of radionuclides with known ratios requires respectively proportionated calibration factors.

ISO 7503 is concerned with the measurement and estimation of radioactivity levels. It does not provide advice on decommissioning, planning and surveillance techniques.

Surface contamination is specified in terms of activity per unit area and the limits are based on the recommendations by the International Commission on Radiological Protection (ICRP 103).

This part of ISO 7503 deals with a nuclide specific calibration methodology that incorporates summation corrections. Annex A provides calibration methods which are simplified in respect of radionuclide emission data treatment.

Measurement of radioactivity — Measurement and evaluation of surface contamination —

Part 3:
Apparatus calibration

1 Scope

ISO 7503 and ISO 8769 are addressed to the people responsible for determining the radioactivity present on solid surfaces.

This part of ISO 7503 applies to the evaluation of contamination on surfaces in terms of activity per unit area by direct and indirect methods of measurement and deals with the complex aspects of instrument calibration.

This part of ISO 7503 is applicable to well-defined surfaces, such as those of equipment and facilities, containers of radioactive materials, sealed sources, and buildings or land.

This part of ISO 7503 can be used for laboratory and equipment/installation control and for remediation and monitoring activities to comply with release criteria.

This part of ISO 7503 also refers to the following:

— calibration laboratories or institutions dealing with radionuclides with complex emission characteristics or radionuclides for which no reference calibration sources are available;

— institutions confronted with the task to evaluate surface contaminations consisting of a radionuclide mixture;

— institutions/authorities controlling nuclear material transports or material/equipment clearance according to national legislation guideline values or international convention limits.

This part of ISO 7503 does not apply to contamination of the skin, clothing, or loose material, such as gravel.

NOTE Direct evaluation of surface contamination from alpha-emitters, beta-emitters and photon emitters is dealt with in ISO 7503-1. The test method using wipe-test samples for the evaluation of radioactive surface contaminations is dealt with in ISO 7503-2.

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 7503-1, *Measurement of radioactivity — Measurement and evaluation of surface contamination — Part 1: General principles*

ISO 7503-2, *Measurement of radioactivity — Measurement and evaluation of surface contamination — Part 2: Test method using wipe test samples*

ISO 8769, *Reference sources — Calibration of surface contamination monitors — Alpha-, beta- and photon emitters*

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

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

3 Terms, definitions, symbols, and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7503-1 and ISO 7503-2 and the following apply.

3.1.1
emission probability of a radionuclide
ratio of the number of particles of a given type above a given energy or of photons created per unit time by a given radionuclide to the number of decays of this radionuclide per unit time

3.1.2
emergence factor of a source
ratio of the number of particles of a given type or of photons created or released within the source (for a thin source) or its saturation layer thickness (for a thick source) per unit time and the number of particles of the same type above a given energy or of photons emerging from the front face of a source or its window per unit time (surface emission rate)

3.1.3
source efficiency
ratio of the number of particles of a given type above a given energy or of photons emerging from the front face of a source or its window per unit time (surface emission rate) and the number of particles of the same type or of photons created or released within the source (for a thin source) or its saturation layer thickness (for a thick source) per unit time

3.2 Symbols and abbreviated terms

For the purposes of this part of ISO 7503, the symbols given in ISO 7503-1 and ISO 7503-2 and the following apply.

p_e	probability of a particle emerging from the surface
p_c	probability of a particle emerging from the surface of a calibration source
P	inverse of probability of a particle emerging from the surface
$E_{i,j}$	emergence factor of a source for a given energy or energy region i and for the radiation type j (alpha or beta or photon radiation)
a_i	component i of radionuclide decay path
$\varepsilon_{i,j}$	instrument efficiency for a given energy or energy region i and for the radiation type j (alpha or beta or photon radiation) in s^{-1}/s^{-1}
k_i	abundance of radionuclide decay path i
$C(A)_n$	direct method activity calibration factor for the radionuclide n in $(Bq \cdot cm^{-2})/s^{-1}$
S_G	active calibration source area equal to the averaging area for the surface contamination guideline value in cm^2