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Measurement of radioactivity - Measurement and evaluation of surface contamination —

Part 2: Test method using wipe-test samples

Mesurage de la radioactivité — Mesurage et évaluation de la contamination de surface —
Partie 2: Méthode d'essai utilisant des échantillons d'essai de frottis

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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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 Technical Committee 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 7503-2:1988), 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*

Introduction

ISO 7503 gives guidance on the measurement of surface contamination. This International Standard 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 radiochemicals;

— 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 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 has to 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 the evaluation of surface contamination by indirect measurement using a wipe test.

Measurement of radioactivity - Measurement and evaluation of surface contamination —

Part 2:
Test method using wipe-test samples

1 Scope

ISO 7503 (all parts) and ISO 8769 are addressed to the people responsible for measuring 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 an indirect method of measurement.

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 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 calibration of instruments for the evaluation of radioactive surface contaminations is dealt with in ISO 7503-3.

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

ISO 9698, *Water quality — Determination of tritium activity concentration — Liquid scintillation counting method*

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

ISO/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 and definitions, symbols and abbreviations

3.1 Terms and definitions

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

3.1.1
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 may become removable or vice versa without any human action. Furthermore, surface contaminations may decrease due to evaporation and volatilization.

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.

3.1.2
wipe test
test to determine if removable contamination is present through wiping the surface with a dry or wet material, followed by evaluation of the wipe material for removable contamination

Note 1 to entry: The type of wipe test, wet or dry, needs to be assessed by a competent person. In some instances (e.g. tritium contamination) a wet wipe may be preferred. In others, it may be more practical or advisable to use a dry wipe.

3.1.3
wiping efficiency
ratio of the activity of the radionuclides removed from the surface by one wipe sample to the activity of the radionuclides of the removable surface contamination prior to this sampling

Note 1 to entry: The wiping efficiency is defined by the following relationship:

$$\varepsilon_w = \frac{a_R}{a_T}$$

where

a_R is the activity of the radionuclides removed by wipe test;

a_T is the total removable activity of the radionuclides present on the wiped area.

Note 2 to entry: In practice, it is almost impossible to measure the total amount of removable activity on the surface; and in most cases, a value for "wiping efficiency" cannot be assessed but can only be estimated.

Note 3 to entry: For important combinations of contaminant and surface material, the wiping efficiency can be determined experimentally using the method of "exhaustive removal by repetitive wipe tests". The step-by-step addition of the removed activities results in an approximation of the total removable activity (a_T), to which the activity removed by the first wipe test (a_R) can then be related to yield the wiping efficiency.

Note 4 to entry: The method of "exhaustive removal by repetitive wipe tests" is only applicable if it can be guaranteed that exactly the same area is wiped on each occasion and exactly the same pressure is maintained uniformly over the area wiped. Moreover, results of this method are only valid for a specific nature and structure of a surface and are not transferable to other surface structures.

3.1.4
tritium surface contamination
total activity of tritium adsorbed upon and absorbed into the surface

3.1.5
removable tritium surface contamination
fraction of surface contamination which is removable or transferable under normal working conditions

Note 1 to entry: It should be noted that

a) under external influences of a chemical nature (e.g. moisture, corrosion) or of a physical nature (e.g. ambient pressure or temperature changes, vibration, impact, expansion and contraction), and also as a result of diffusion, the total tritium activity may be transformed into removable contamination or non-removable. The state is reversible multiple times,

b) tritium surface contamination may be volatile or contain volatile fractions which may volatilize under normal working conditions - this also contributes to the removable contamination and should be evaluated appropriately (see also Clause 7), and

c) as a result of diffusion of tritium into the surface structure, removal of the tritium surface contamination by exhaustive wipes may be without effect as the removed tritium contamination may be replaced in short time (see also Clause 7).

3.1.6
indirect evaluation of removable tritium surface contamination
evaluation of the removable tritium activity by means of a wipe test

Note 1 to entry: Any wipe used for tritium can only be analysed reliably using liquid scintillation counting. Direct measurements of tritium contaminated wipes may have large uncertainties or are not possible.

3.2 Symbols and abbreviated terms

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

ε_W wiping efficiency

a_R activity of the radionuclides removed by wipe test in Bq

a_T total removable activity of the radionuclides present on the wiped area in Bq

a_r activity per unit area of the removable contamination of the wiped surface in $Bq \cdot cm^{-2}$

a_W activity of the wipe sample in Bq

S_W wiped surface area in cm^2

$C(A)^{ind}$ activity calibration factor for wipe sample in $(Bq \cdot cm^{-2})/s^{-1}$

4 Sources of surface contamination

A surface can be contaminated with naturally occurring or man-made radionuclides.

The main natural radionuclides are ^{40}K and radionuclides originating from ^{238}U and ^{232}Th decay series. Natural radioactivity may vary considerably from one type of natural material to another (e.g. building materials).

Laboratories that intentionally handle naturally occurring radioactive material, such as radium or thorium, should anticipate surface contamination from these radionuclides.

The sources of surface contamination by man-made radionuclides can arise from a number of activities such as the following:

— routine laboratory use of radio chemicals;

— medical treatments;

