

INTERNATIONAL
STANDARD

ISO
8769

Fourth edition
2020-06

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

*Mesurage de la radioactivité — Radionucléides émetteurs alpha,
bêta et photoniques — Spécifications des étalons de référence pour
l'étalonnage des contrôleurs de contamination de surface*



Reference number
ISO 8769:2020(E)

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Published in Switzerland

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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](#).

This document was prepared by Technical Committee ISO/TC 85, *Nuclear energy*, Subcommittee SC 2, *Radiological protection*.

This fourth edition cancels and replaces the third edition (ISO 8769:2016), which has been technically revised. The changes compared to the previous edition are as follows:

- In order to maintain consistency with terms described in the International Vocabulary of Metrology or ISO/IEC 17025^[16], “reference measurement standard”, “working measurement standard” and “transfer measurement device” were adopted respectively instead of a “reference source”, “working source” and “reference transfer instrument”.
- [5.1 b\)](#): “a surface layer of thickness equal to the saturation layer thickness” was modified to “a surface layer of thickness equal to or less than the saturation layer thickness”.
- [5.2.3](#) and [5.3.3](#): The statement of “minus its relative standard uncertainty” was removed.
- [5.4.3](#): Requirement for the re-measurement of uniformity was added as follows; “In case that significant change not due to half-life is found on the re-calibration of surface emission rate, re-measurement of uniformity is required.”

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.

Introduction

Radioactive contamination of surfaces can result from spilling, splashing, or leakage from unsealed sources, or breakage or loss of integrity of sealed sources. It can lead to the spread of contamination, loss of quality control and can give rise to the following health hazards:

- a) external exposure to parts of the body in proximity to the contaminated surface;
- b) internal exposure through incorporation of radioactive material emanating from the surface.

The need for effective monitoring of surface contamination has long been recognized, see Reference [1]. Surface contamination is quantified in terms of activity per unit area, the quantity which is normally used to specify “derived limits”, i.e. maximum limits of surface contamination. These limits are based on radiological protection considerations and have been derived from the dose equivalent or intake limits recommended by the International Commission on Radiological Protection (ICRP), see References [2] and [3]. Derived limits are incorporated into numerous national and international regulatory documents which relate specifically to surface contamination monitoring.

The requirement for this document originated from the need for calibration measurement standards in International Standards dealing with the calibration of surface contamination monitors.

While regulatory documents refer to surface contamination in terms of activity per unit area, the response of monitoring instruments is related directly to the radiation emitted from the surface rather than to the activity contained upon or within the surface. Due to variations in the absorptive and scattering properties of real surfaces, it cannot be assumed, in general, that there is a simple, known relationship between surface emission rate and activity. Thus, there emerges a clear need for calibration measurement standards that are specified primarily in terms of surface emission rate, as well as activity. The manner in which these standards are used and the associated calibration protocols vary from country to country^[4].

Calibration of an instrument in terms of activity for the types of surfaces that are usually encountered in monitoring situations depends on the following considerations:

- mixture and ratios of radionuclides being monitored;
- their types and abundances of emissions;
- nature of the surface;
- depths and distribution profiles within the surface;
- spectral attenuation dependence of the instrument entrance window;
- distance between the instrument entrance window and the surface.

The derivation of appropriate calibration factors in terms of activity is therefore a highly complex process which is outside the scope of this document. Appropriate guidance on this process is addressed in ISO 7503 (all parts)^[5]. However, some estimate of the activity of the calibration measurement standard is required for general radiological safety purposes such as handling, leak testing, shielding, packaging, and transport. This is a generic issue for all radioactive sources regardless of their intended use and is not therefore addressed specifically in this document.

Traceability of calibration measurement standards to International Standards or national standards is established by a system of reference transfer instruments.

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

1 Scope

This document specifies the characteristics of reference measurement standards of radioactive surface contamination, traceable to national measurement standards, for the calibration of surface contamination monitors. This document relates to alpha-emitters, beta-emitters, and photon emitters of maximum photon energy not greater than 1,5 MeV.

It does not describe the procedures involved in the use of these reference measurement standards for the calibration of surface contamination monitors. Such procedures are specified in IEC 60325^[6], IEC 62363^[2], and other documents.

NOTE Since some of the proposed photon standards include filters, the photon standards are to be regarded as reference measurement standards of photons of a particular energy range and not as reference measurement standards of a particular radionuclide. For example, a ²⁴¹Am source with the recommended filtration does not emit from the surface the alpha particles or characteristic low-energy L X-ray photons associated with the decay of the nuclide. It is designed to be a reference measurement standard that emits photons with an average energy of approximately 60 keV.

This document also specifies preferred reference radiations for the calibration of surface contamination monitors. These reference radiations are realized in the form of adequately characterized large area sources specified, without exception, in terms of surface emission rate and activity which are traceable to national standards.

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

IEC 60050-395, *International Electrotechnical Vocabulary — Part 395: Nuclear instrumentation: Physical phenomena, basic concepts, instruments, systems, equipment and detectors*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12749-2, IEC 60050-395, and the following apply.

ISO and IEC maintain terminological 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/>