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

Sources de référence — Étalonnage des contrôleurs de contamination de surface — Émetteurs alpha, bêta et photoniques

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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*, Subcommittee SC 2, *Radiological protection*.

This third edition cancels and replaces the second edition (ISO 8769:2010), which has been technically revised.

Introduction

Radioactive contamination of surfaces can result from spilling, splashing, or leakage from unsealed sources, or breakage or loss of integrity of sealed sources 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 released 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 International Standard originated from the need for standard calibration sources in those 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 sources that are specified primarily in terms of surface emission rate, as well as activity. The manner in which these sources 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 International Standard. Appropriate guidance on this process is addressed in ISO 7503 series[5][6][7]. However, some estimate of the activity of the calibration source 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 International Standard.

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

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

1 Scope

This International Standard specifies the characteristics of reference sources of radioactive surface contamination, traceable to national measurement standards, for the calibration of surface contamination monitors. This International Standard 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 sources for the calibration of surface contamination monitors. Such procedures are specified in IEC 60325[8], IEC 62363[9], and other documents.

NOTE Since some of the proposed photon sources include filters, the photon sources are to be regarded as sources of photons of a particular energy range and not as sources of a particular radionuclide. For example, a ^{241}Am 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 source that emits photons with an average energy of approximately 60 keV.

This International Standard 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 rates which are traceable to national standards.

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

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

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.

3.1
surface emission rate
<of a source> number of particles or photons of a given type above a given energy emerging from the face of the source or its window per time in a mass-free environment

3.2
face
<of a source> vertical projection of the nominal active area onto the front surface of the source

Note 1 to entry: See Figure 1.