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Radiological protection — Criteria and performance limits for the periodic evaluation of dosimetry services for external radiation

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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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This document was prepared by Technical Committee ISO/TC 85, *Nuclear energy, nuclear technologies, and radiological protection*, Subcommittee SC 2, *Radiological protection,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 430, *Nuclear energy, nuclear technologies, and radiological protection,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 14146:2018) which has been technically revised.

The main changes are as follows:

— ~~—~~the addition and clarification of several definitions;

— ~~—~~the modification of the requirements to environmental dosemeters ~~and~~;

— ~~—~~the addition of a requirement at reference conditions.

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~~www.iso.org/members.html.

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Radiological protection — Criteria and performance limits for the periodic evaluation of dosimetry services for external radiation

1 Scope

This document specifies the dosimetric and organizational criteria and the test procedures to be used for the periodic verification of the performance of dosimetry services supplying personal and/or area, i.e., workplace and/or environmental, dosemeters used for individual (personal) and/or area, i.e. workplace and/or environmental monitoring.

NOTE The quality of a supplier of a dosimetry service depends on both the characteristics of the approved (type-tested) dosimetry system[1)] and the training and experience of the staff, together with the calibration procedures and quality assurance programmes.

The performance evaluation according to this document can be carried out by a dosimetry service to demonstrate the fulfilment of specified performance requirements. The irradiation qualities used in this document are representative for exposure situations that are expected or mimic workplace fields from the radiological activities being monitored using the dosemeters from the services.

This document applies to personal and area dosemeters for the assessment of external photon radiation with a fluence-weighted mean energy between 8 keV and 10 MeV, beta radiation with a fluence-weighted mean energy between 60 keV and 1,2 MeV, and neutron radiation with a fluence-weighted mean energy between 25,3 meV, i.e., thermal neutrons with a Maxwellian energy distribution with kT = 25,3 meV, and 200 MeV.

It covers all types of personal and area dosemeters needing laboratory processing (e.g. thermoluminescent, optically stimulated luminescence, radiophotoluminescent, track detectors or photographic-film dosemeters) and involving continuous measurements or measurements repeated regularly at fixed time intervals (e.g. several weeks, one month).

Active direct reading as well as semi-passive or hybrid dosemeters, such as direct ion storage (DIS) or silicon photomultiplier (SiPM) dosemeters, (for dose measurement) can also be treated according to this document. Then, they are treated as if they were passive, i.e. the dosimetry service reads their indicated values and reports them to the evaluation organization.

In this document, the corrected indicated (corrected indication) value is the one given by the dosimetry systems as the final result of the evaluation algorithm (for example, display of the software, printout) in units of dose equivalent (Sv).

Environmental dosemeters usually indicate the quantity $H^*(10)$ but they can, in addition or alternatively, indicate the quantity $H'(3)$, $H'(0,07)$, air kerma, K_a, or absorbed dose, D. All these dosemeters can also be

[1] If this document is applied to a dosimetry system for which no approval (pattern or type test) has been provided, then in the following text approval or type test should be read as the technical data sheet provided by the manufacturer or as the data sheet required by the regulatory body.

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treated according to this document. If K_a or D is indicated (in Gy) the dose values in this document stated in Sv shall then be interpreted as equivalent values in Gy.

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.

<std>ISO 4037 ISO 4037-1, Radiological protection — X and gamma reference radiation for calibrating dosemeters and doserate meters and for determining their response as a function of photon energy — Part 1: Radiation characteristics and production methods</std>

<std>ISO 4037 ISO 4037-2, Radiological protection — X and gamma reference radiation for calibrating dosemeters and doserate meters and for determining their response as a function of photon energy — Part 2: Dosimetry for radiation protection over the energy ranges from 8 keV to 1,3 MeV and 4 MeV to 9 MeV</std>

<std>ISO 4037 ISO 4037-3, Radiological protection — X and gamma reference radiation for calibrating dosemeters and doserate meters and for determining their response as a function of photon energy — Part 3: Calibration of area and personal dosemeters and the measurement of their response as a function of energy and angle of incidence</std>

<std>ISO 6980-1, *Nuclear energy — Reference beta-particle radiation — Part 1: Methods of production*</std>

<std>ISO 6980 ISO 6980-1, *Nuclear energy — Reference beta-particle radiation — Part 1: Methods of production*</std>

ISO 6980-2, Nuclear energy — Reference beta-particle radiation — Part 2: Calibration fundamentals related to basic quantities characterizing the radiation field</std>

<std>ISO 6980 ISO 6980-3, Nuclear energy — Reference beta-particle radiation — Part 3: Calibration of area and personal dosemeters and the determination of their response as a function of beta radiation energy and angle of incidence</std>

<std>ISO 8529-1, *Neutron reference radiations fields — Part 1: Characteristics and methods of production*</std>

<std>ISO 8529 ISO 8529-1, *Neutron reference radiations fields — Part 1: Characteristics and methods of production*</std>

ISO 8529-2, Reference neutron radiations — Part 2: Calibration fundamentals of radiation protection devices related to the basic quantities characterizing the radiation field</std>

<std>ISO 8529 ISO 8529-3, Neutron reference radiation fields — Part 3: Calibration of area and personal dosemeters and determination of their response as a function of neutron energy and angle of incidence</std>

<std>ISO 12749-2, Nuclear energy, nuclear technologies, and radiological protection — Vocabulary — Part 2: Radiological protection</std>

<std>ISO 12789-1, Reference radiation fields — Simulated workplace neutron fields — Part 1: Characteristics and methods of production</std>

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<std>ISO 12789 ISO 12789-2, Reference radiation fields — Simulated workplace neutron fields — Part 2: Calibration fundamentals related to the basic quantities</std>

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

<std>ISO/TS 18090-1, *Radiological protection — Characteristics of reference pulsed radiation — Part 1: Photon radiation*</std>

<std>ISO 29661, *Reference radiation fields for radiation protection — Definitions and fundamental concepts*</std>

<std>ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*</std>

<std>IEC 61267, *Medical diagnostic X-ray equipment — Radiation conditions for use in the determination of characteristics*</std>

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IEC 61267, *Medical diagnostic X-ray equipment — Radiation conditions for use in the determination of characteristics*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12749-2, ISO 29661 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~~https://www.iso.org/obp

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

3.1
approved dosimetry system
dosimetry system that is used by a dosimetry service that has been approved or authorized for use by the qualification body

Note 1 to entry: Several dosemeter designs can be operated using the same associated processing system (dosemeter reader, etc.). Then, they are regarded as separate dosemeters/dosimetry systems.

3.2
area dosemeter
meter designed to measure the ambient dose equivalent (rate) or the directional dose equivalent (rate)

Note 1 to entry: For a general definition of dosemeter, see ~~3.7~~ 3.7.

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Note 2 to entry: Area dosemeters are used for area monitoring which comprises environmental and workplace monitoring, see 3.3.3.3.

[SOURCE: ISO 29661:2012, 3.1.2, modified: Notes 1 and 2 added.]

3.3
area monitoring
monitoring in which a workplace or an area in the environment is monitored by taking dose (rate) measurements

Note 1 to entry: Area monitoring is usually performed in terms of $H'(0,07)$, $H'(3)$ or $H^*(10)$.

Note 2 to entry: Definition orientated at ICRP 103 and ICRP 116.

[SOURCE: IEC 62387:2020, 3.46]

3.4
background dose
radiation dose
dose (or an observed measure related to the dose) attributable to all sources other than the one(s) specified

Note 1 to entry: Strictly, this applies to measurements of dose or counts from a sample, where the background dose or counts must be considered (usually subtracted) from all measurements. However, background is used more generally to refer to the effects of other sources in any situation in which a particular source (or group of sources) is under consideration. It is also applied to quantities other than doses, such as activity concentrations in environmental media.

Note 2 to entry: The background dose can contain dose fractions from transportation and/or other events such as X-ray screening for security checks.

Note 3 to entry: To determine the background dose, usually, a group of control (background) dosemeters is used.

[SOURCE: IAEA Safety Glossary 2022, modified: "dose" and "(radiation dose)" added to the term; "dose rate" removed; second sentence in note 1 rearranged; notes 2 and 3 added]

3.5
control ~~(background)~~ dosemeter
personal, area or environmental dosemeter that provides an estimate of any radiation dose received by the evaluation sample apart from that given by the irradiation laboratory or by a controlled exposure to environmental radiation

Note 1 to entry: The control dosemeter provides a means of estimating and eliminating the contribution to the dose from natural background radiation and that received during the time between zeroing and read out, i.e., the dose during handling, transportation, etc.

Note 2 to entry: The control dosemeters are used to determine the background radiation dose.

3.6
corrected indication
corrected indicated value
G_{corr}
indication of a dosemeter corrected for any differences of the values of the influence quantities from reference conditions

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