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CONSOLIDATED VERSION

Radiation protection instrumentation - Measurement of personal dose equivalents for X, gamma, neutron and beta radiations - Active personal dosemeters

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Radiation protection instrumentation - Measurement of personal dose equivalents for X, gamma, neutron and beta radiations - Active personal dosemeters

FOREWORD

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This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC 61526 edition 4.1 contains the fourth edition (2024-03) [documents 45B/1047/FDIS and 45B/1049/RVD] and its amendment 1 (2026-06) [documents 45B/1113/FDIS and 45B/1121/RVD].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

IEC 61526 has been prepared by subcommittee 45B: Radiation protection instrumentation, of IEC technical committee 45: Nuclear instrumentation. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2010. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) Modification of the title;
b) Inclusion of the measurement quantity for the dose in the lens of the eye, $H_p(3)$;
c) Inclusion of measurement quantity for dose in the skin and extremities, $H_p(0,07)$;
d) Inclusion of dosemeters between active and passive: "hybrid dosemeters";
e) Inclusion of software requirements;
f) Harmonization of requirements for linearity to IEC 62387;
g) Revised neutron energy response requirements.

The text of this International Standard is based on the following documents:

Draft	Report on voting
45B/1047/FDIS	45B/1049/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document and its amendment will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,
– withdrawn, or
– revised.

INTRODUCTION

This document applies to active, (direct reading or hybrid) personal dosemeters and monitors used for measuring personal dose equivalents $H_p(10)$, $H_p(3)$, and $H_p(0,07)$, for X, gamma, neutron, and beta radiations.

For personal dose equivalent $H_p(10)$ and for X and gamma radiation, two minimum rated ranges for the photon energy are given. The first from 20 keV to 150 keV is for workplaces where low energy X-rays are used, e.g., in diagnostic medicine, the second from 80 keV to 1,25 MeV is for workplaces where high energy X-rays and/or gamma sources are used, e.g., in industry. For neutron radiation the minimum rated range of neutron energy is from 0,025 eV (thermal neutrons) to 10 MeV. The rated ranges can be extended to all energies covered by the respective standards for reference radiation fields.

For personal dose equivalent $H_p(3)$ and for X and gamma radiation, a minimum rated range for photon energy from 30 keV to 250 keV is given. For personal dose equivalent $H_p(0,07)$ a range of 30 keV to 1250 keV or, for workplaces where low energy X-rays are used, 20 keV to 150 keV, is given. For beta radiation for both quantities, the minimal rated range is from 0,24 MeV to 0,8 MeV (mean beta particle energy). The rated ranges can be extended to all energies covered by the respective standards for reference radiation fields.

In some applications, for example, at a nuclear reactor installation where 6 MeV photon radiation is present, measurement of personal dose equivalent (rate) $H_p(10)$ for photon energies up to 10 MeV should be required. In some other applications, measurement of $H_p(10)$ down to 10 keV should be required.

For personal dosemeters, requirements for measuring the dose quantities $H_p(10)$, $H_p(3)$, and $H_p(0,07)$, and for monitoring of the respective dose rate quantities are given. The measurement of these dose rate quantities is an option for personal dosemeters.

Establishments in some countries may be permitted to use this type of personal dosemeter as the dosemeter to provide the dose of record by an approved dosimetry service.

1 Scope

This document applies to personal dosemeters with the following characteristics:

a) They are worn on the trunk, close to the eye, or on the extremities.
b) They measure the personal dose equivalents $H_p(10)$, $H_p(3)$, and $H_p(0,07)$, from external X and gamma, neutron (not for $H_p(3)$), and beta radiations, and may measure the respective personal dose equivalent rates for the same radiations (for alarming purposes).
c) They have a digital indication. This indication may or may not be attached.
d) They have alarm functions for the personal dose equivalents or personal dose equivalent rates except for hybrid dosemeters. For hybrid dosemeters an alarm function for the personal dose equivalents shall be implemented in the associated readout system.

NOTE 1 When reference is made in this document to "dose", this is meant to indicate personal dose equivalent, unless otherwise stated.

NOTE 2 When reference is made in this document to "dosemeter", this is meant to include all personal dosemeters, unless otherwise stated.

NOTE 3 This document does not cover neutron dosemeters for the $H_p(3)$ measurements up to now.

This document specifies requirements for the dosemeter and, if supplied, for its associated readout system.

Usually, a dosemeter is not able to measure all quantities given above. Thus, the dosemeter is only tested with regard to those quantities and types of radiation it is intended to be used for. Other types of radiation are considered as influence quantities which also may have requirements.

This document specifies, for the dosemeters described above, general characteristics, general test procedures, radiation characteristics as well as electrical, mechanical, safety and environmental characteristics. The only requirements specified for associated readout systems are those which affect its accuracy of readout of the personal dose equivalent and alarm settings, and those which concern the influence of the reader on the dosemeter.

This document does not cover special requirements for accident or emergency dosimetry, although the dosemeters may be used for this purpose.

This document does not apply to dosemeters used for measurement of pulsed radiation, such as radiation emanating from many medical diagnostic X-ray facilities, linear accelerators or similar equipment.

NOTE 4 Requirements and testing procedure for dosemeters used in pulsed field of ionizing radiation can be found in IEC TS 63050 or IEC TS 62743.

This document does not apply for dosemeters to measure ambient or directional dose equivalent.

NOTE 5 Requirements for ambient or directional dose equivalent meters can be found e.g. in: IEC 60846-1; IEC 62387, IEC 61017 or IEC 60532.

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.

IEC 60050-395:2014, *International Electrotechnical Vocabulary (IEV) – Part 395: Nuclear instrumentation – Physical phenomena, basic concepts, instruments, systems, equipment and detectors*
IEC 60050-395:2014/AMD1:2016
IEC 60050-395:2014/AMD2:2020

IEC 60068-2-31:2008, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60086-1:2021, *Primary batteries – Part 1: General*

IEC 60086-2:2021, *Primary batteries – Part 2: Physical and electrical specifications*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*
IEC 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013

IEC 60904-3, *Photovoltaic devices – Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current up to 16 A per phase*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*

IEC 61187:1993, *Electrical and electronic measuring equipment – Documentation*

IEC 62387:2020, *Radiation protection instrumentation – Dosimetry systems with integrating passive detectors for individual, workplace and environmental monitoring of photon and beta radiation*

IEC TR 62461:2015, *Radiation protection instrumentation – Determination of uncertainty in measurement*

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement* (GUM:1995)

ISO/IEC Guide 98-3:2008/Suppl.1:2008, *Propagation of distributions using a Monte Carlo method and Corr.1 (2009)*

ISO 4037-1:2019, *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*

ISO 4037-2:2019, *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*

ISO 4037-3:2019, *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*

ISO 4037-4:2019, *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 4: Calibration of area and personal dosemeters in low energy X reference radiation fields*

ISO 6980-1:2023, *Nuclear energy – Reference beta-particle radiation – Part 1: Methods of production*

ISO 6980-2:2023, *Nuclear energy – Reference beta-particle radiation – Part 2: Calibration fundamentals related to basic quantities characterizing the radiation field*

ISO 6980-3:2023, *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*

ISO 8529-1:2021, *Reference neutron radiations – Part 1: Characteristics and methods of production*

ISO 8529-2:2000, *Reference neutron radiations – Part 2: Calibration fundamentals of radiation protection devices related to the basic quantities characterizing the radiation field*

ISO 8529-3:2023, *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*

ISO 12789-1, *Reference radiation fields – Simulated workplace neutron fields – Part 1: Characteristics and methods of production*

ISO 12789-2, *Reference radiation fields – Simulated workplace neutron fields – Part 2: Calibration fundamentals related to the basic quantities*

ISO 21909-1:2021, *Passive neutron dosimetry systems – Part 1: Performance and test requirements for personal dosimetry*

ISO 80000-10:2019, *Quantities and units – Part 10: Atomic and nuclear physics*

ICRU Report 51:1993, *Quantities and units in radiation protection dosimetry*

ANSI N42.17A, *American National Standard For Performance Specifications For Health Physics Instrumentation – Portable Instrumentation For Use In Normal Environmental Conditions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-395, IEC 60529 and ICRU Report 51, as well as the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
acceptance test
contractual test to prove to the customer that the device meets certain conditions of its specification

[SOURCE: IEC 60050-151:2001, 151-16-23]

3.2
active personal dosemeter
dosemeter measuring personal dose equivalent using electronic components (e.g. either a direct reading dosemeter or a hybrid personal dosemeter including the associated readout system)

3.3
calibration
quantitative determination of the reference calibration coefficient, N_0, and the correction for non-constant response, r_n, under a controlled set of standard test conditions for which all the m relative response values, r_q, are unity and all the l deviations, D_p, are zero

Note 1 to entry: Methods of calibration are given in ISO 4037 for photons, ISO 6980 for beta and ISO 8529 for neutron radiations. Determinations concerning the build-up and phantom as given in these standards should be taken into account during the calibration of the dosemeter, for the use of phantoms see 7.5.

3.4
calibration coefficient
N
quotient of the conventional quantity value of a quantity, H_r, and the indicated value, G_r, at the point of test for a specified reference radiation under specified reference conditions. It is expressed as

$$N = \frac{H_r}{G_r}$$

Note 1 to entry: The calibration coefficient N is dimensionless when the instrument indicates the quantity to be measured, then N is equal to the calibration factor. A dosemeter indicating the conventional quantity value correctly has the calibration coefficient of one.

[SOURCE: ISO 29661:2012, 3.1.5, modified: replaced notes by new one.]

3.5
coefficient of variation
ratio of the standard deviation s to the arithmetic mean $\bar{x}$ of a set of n measurements x_i given by the following formula: