Udstyr til beskyttelse mod stråling – Dosimetrisystemer med passive integrerede detektorer til person-, arbejdsplads- og miljøovervågning af foton- og beta-stråling

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

DANSK STANDARD
Danish Standards Association

Göteborg Plads 1
DK-2150 Nordhavn

Tel: +45 39 96 61 01
dansk.standard@ds.dk
www.ds.dk

DS projekt: M360417
ICS: 13.280

Første del af denne publikations betegnelse er:
DS/EN IEC, hvilket betyder, at det er en international standard, der har status som europæisk og dansk standard.

Denne publikations overensstemmelse er:
IDT med: IEC 62387:2020 ED2
IDT med: EN IEC 62387:2022

DS-publikationen er på engelsk.

Denne publikation erstatter: DS/EN 62387:2016

DS-publikationstyper
Dansk Standard udgiver forskellige publikationstyper.
Typen på denne publikation fremgår af forsiden.

Der kan være tale om:

Dansk standard
- standard, der er udarbejdet på nationalt niveau, eller som er baseret på et andet lands nationale standard, eller
- standard, der er udarbejdet på internationalt og/eller europæisk niveau, og som har fået status som dansk standard

DS-information
- publikation, der er udarbejdet på nationalt niveau, og som ikke har opnået status som standard, eller
- publikation, der er udarbejdet på internationalt og/eller europæisk niveau, og som ikke har fået status som standard, fx en teknisk rapport, eller
- europæisk præstandard

DS-håndbog
- samling af standarder, eventuelt suppleret med informativt materiale

DS-hæfte
- publikation med informativt materiale

Til disse publikationstyper kan endvidere udgives
- tillæg og rettelsesblade

DS-publikationsform
Publikationstyperne udgives i forskellig form som henholdsvis
- fuldtekstpublikation (publikationen er trykt i sin helhed)
- godkendelsesblad (publikationen leveres i kopi med et trykt DS-omslag)
- elektronisk (publikationen leveres på et elektronisk medie)

DS-betegnelse
Alle DS-publikationers betegnelse begynder med DS efterfulgt af et eller flere præfikser og et nr., fx **DS 383**, **DS/EN 5414** osv. Hvis der efter nr. er angivet et **A** eller **Cor**, betyder det, enten at det er et **tillæg** eller et **rettelsesblad** til hovedstandarden, eller at det er indført i hovedstandarden.
DS-betegnelse angives på forsiden.

Overensstemmelse med anden publikation:
Overensstemmelse kan enten være IDT, EQV, NEQ eller MOD
- **IDT:** Når publikationen er identisk med en given publikation.
- **EQV:** Når publikationen teknisk er i overensstemmelse med en given publikation, men præsentationen er ændret.
- **NEQ:** Når publikationen teknisk eller præsentationsmæssigt ikke er i overensstemmelse med en given standard, men udarbejdet på baggrund af denne.
- **MOD:** Når publikationen er modificeret i forhold til en given publikation.

EUROPEAN STANDARD EN IEC 62387

EUROPÄISCHE NORM

October 2022

ICS 13.280

Supersedes EN 62387:2016

English Version

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

Instrumentation pour la radioprotection - Systèmes dosimétriques avec détecteurs intégrés passifs pour le contrôle radiologique individuel, du lieu de travail et de l'environnement des rayonnements photoniques et bêta (IEC 62387:2020)

Strahlenschutz-Messgeräte - Dosimetriesysteme mit integrierenden passiven Detektoren zur Personen-, Arbeitsplatz- und Umgebungsüberwachung auf Photonen- und Betastrahlung (IEC 62387:2020)

This European Standard was approved by CENELEC on 2022-01-26. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. EN IEC 62387:2022 E

European foreword

This document (EN IEC 62387:2022) consists of the text of IEC 62387:2020 prepared by IEC/SC 45B, Radiation protection instrumentation, of IEC/TC 45, Nuclear instrumentation.

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2023–04–14
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2025–10–14

This document supersedes EN 62387:2016 and all of its amendments and corrigenda (if any).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

This document is read in conjunction with EN IEC 62387:2022/A11:2022.

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

Endorsement notice

The text of the International Standard IEC 62387:2020 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60068-2-31	NOTE Harmonized as EN 60068-2-31
IEC 60359	NOTE Harmonized as EN 60359
IEC 60904-3	NOTE Harmonized as EN IEC 60904-3
IEC/TR 62461	NOTE Harmonized as CLC IEC/TR 62461
ISO 4037-1:2019	NOTE Harmonized as EN ISO 4037-1:2021
ISO 4037-2:2019	NOTE Harmonized as EN ISO 4037-2:2021
ISO 4037-4:2019	NOTE Harmonized as EN ISO 4037-4:2021
ISO 29661:2012/AMD1:2015	NOTE Harmonized as EN ISO 29661:2017

(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 61000-4-2	-	Electromagnetic compatibility (EMC) - Part 4–2: Testing and measurement techniques - Electrostatic discharge immunity test	EN 61000-4-2	-
IEC 61000-4-3	-	Electromagnetic compatibility (EMC) - Part 4–3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	EN IEC 61000-4-3	-
IEC 61000-4-4	-	Electromagnetic compatibility (EMC) - Part 4–4: Testing and measurement techniques - Electrical fast transient/burst immunity test	EN 61000-4-4	-
IEC 61000-4-5	-	Electromagnetic compatibility (EMC) - Part 4–5: Testing and measurement techniques - Surge immunity test	EN 61000-4-5	-
IEC 61000-4-6	-	Electromagnetic compatibility (EMC) - Part 4–6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	EN 61000-4-6	-
IEC 61000-4-8	-	Electromagnetic compatibility (EMC) - Part 4–8: Testing and measurement techniques - Power frequency magnetic field immunity test	EN 61000-4-8	-
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	EN IEC 61000-4-11	-
IEC 61000-6-2	-	Electromagnetic compatibility (EMC) - Part 6–2: Generic standards - Immunity standard for industrial environments	EN IEC 61000-6-2	-

		reference radiation for calibrating dosemeters and doserate meters and for determining their response as a function of photon energy		
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	EN ISO 4037-3	2021
ISO 6980	series	Nuclear energy - Reference beta-particle radiation	-	-
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	-	-
ISO 8529	series	Reference neutron radiations – Part 1: Characteristics and methods of production	-	-
ISO/IEC Guide 98–3	2008	Uncertainty of measurement - Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)	-	-

Edition 2.0 2020-01

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

Instrumentation pour la radioprotection – Systèmes dosimétriques avec détecteurs intégrés passifs pour le contrôle radiologique individuel, du lieu de travail et de l'environnement des rayonnements photoniques et bêta

IEC 62387:2020-01(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

Edition 2.0 2020-01

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

Instrumentation pour la radioprotection – Systèmes dosimétriques avec détecteurs intégrés passifs pour le contrôle radiologique individuel, du lieu de travail et de l'environnement des rayonnements photoniques et bêta

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 13.280

ISBN 978-2-8322-7696-9

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

RADIATION PROTECTION INSTRUMENTATION – DOSIMETRY SYSTEMS WITH INTEGRATING PASSIVE DETECTORS FOR INDIVIDUAL, WORKPLACE AND ENVIRONMENTAL MONITORING OF PHOTON AND BETA RADIATION

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62387 has been prepared by subcommittee 45B: Radiation protection instrumentation, of IEC technical committee 45: Nuclear instrumentation.

This second edition cancels and replaces the first edition of IEC 62387 published in 2012. This edition constitutes a technical revision.

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

- Modification of title.
- Addition of performance requirements for dosemeters to measure $H'(3)$ for both photon and beta radiation.
- Adoption of the cylinder instead of the slab phantom for the quantity $H_p(3)$.
- Correction and clarification of several subclauses to obtain a better applicability.

The text of this standard is based on the following documents:

FDIS	Report on voting
45B/945/FDIS	45B/954/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

A dosimetry system may consist of the following elements:

a) a passive device, referred to herein as a *detector*, which, after the exposure to radiation, stores a signal for use in measuring one or more quantities of the incident radiation field;

b) a “dosemeter”, that incorporates some means of identification and contains one or more detectors and may contain electronic components, e.g. for the readout (e.g., in a direct ion storage (DIS) dosemeter);

c) a “reader” which is used to readout the stored information (signal) from the detector, in order to determine the radiation dose;

d) a “computer” with appropriate “software” to control the reader, store the signals transmitted from the reader, calculate, display and store the evaluated dose in the form of an electronic file or paper copy;

e) “additional equipment” and documented procedures (instruction manual) for performing associated processes such as deleting stored dose information, cleaning dosemeters, or those needed to ensure the effectiveness of the whole system.

RADIATION PROTECTION INSTRUMENTATION – DOSIMETRY SYSTEMS WITH INTEGRATING PASSIVE DETECTORS FOR INDIVIDUAL, WORKPLACE AND ENVIRONMENTAL MONITORING OF PHOTON AND BETA RADIATION

1 Scope

This document applies to all kinds of passive dosimetry systems that are used for measuring:

– the personal dose equivalent $H_p(10)$ (for individual whole body monitoring),

– the personal dose equivalent $H_p(3)$ (for individual eye lens monitoring),

– the personal dose equivalent $H_p(0,07)$ (for both individual whole body skin and local skin for extremity monitoring),

– the ambient dose equivalent $H^*(10)$ (for workplace and environmental monitoring),

– the directional dose equivalent $H'(3)$ (for workplace and environmental monitoring), or

– the directional dose equivalent $H'(0,07)$ (for workplace and environmental monitoring).

This document applies to dosimetry systems that measure external photon and/or beta radiation in the dose range between 0,01 mSv and 10 Sv and in the energy ranges given in Table 1. All the energy values are mean energies with respect to the fluence. The dosimetry systems usually use electronic devices for the data evaluation and thus are often computer controlled.

Table 1 – Mandatory and maximum energy ranges covered by this document

Measuring quantity	Mandatory mean energy range for photon radiation	Maximum mean energy range for testing photon radiation	Mandatory mean energy range for beta-particle radiation[a]	Maximum mean energy range for testing beta-particle radiation[a]
$H_p(10)$, $H^*(10)$	80 keV to 1,25 MeV[b]	12 keV to 7 MeV	–	–
$H_p(3)$, $H'(3)$	30 keV to 250 keV	8 keV to 7 MeV	0,8 MeV[c]	0,7 MeV[c] to 1,2 MeV
$H_p(0,07)$, $H'(0,07)$	30 keV to 250 keV	8 keV to 1,25 MeV[b]	0,24 MeV to 0,8 MeV	0,07 MeV[d] to 1,2 MeV[e]

[a] The following beta radiation sources are suggested for the different mean energies: For 0,06 MeV: ^{147}Pm; for 0,8 MeV: ^{90}Sr/^{90}Y; for 1,2 MeV: ^{106}Ru/^{106}Rh.

[b] 1,25 MeV is the mean energy of photon radiation from ^{60}Co.

[c] For beta-particle radiation, an energy of 0,7 MeV is required to reach the radiation sensitive layers of the eye lens in a depth of about 3 mm (approximately 3 mm of ICRU tissue).

[d] For beta-particle radiation, an energy of 0,07 MeV is required to penetrate the dead layer of skin of 0,07 mm (approximately 0,07 mm of ICRU tissue).

[e] 0,07 MeV, 0,8 MeV and 1,2 MeV beta mean energy are almost equivalent to an E_{max} of 0,225 MeV, 2,27 MeV and 3,54 MeV, respectively.

NOTE 1 In this document, “dose” means dose equivalent, unless otherwise stated.

NOTE 2 For $H_p(10)$ and $H^*(10)$ no beta radiation is considered. Reasons:

a) $H_p(10)$ and $H^*(10)$ are a conservative estimate for the effective dose which is not a suitable quantity for beta radiation.

b) No conversion coefficients are available in ICRU 56, ICRU 57 or ISO 6980-3.

NOTE 3 The maximum energy ranges are the energy limits within which type tests according to this document are possible.

NOTE 4 Direct ion storage (DIS) dosemeters are covered in this document as they are often operated without an online display but a separate reader.

The test methods concerning the design (Clause 8), the instruction manual (Clause 9), the software (Clause 10), environmental influences (Clause 13), electromagnetic influences (Clause 14), mechanical influences (Clause 15), and the documentation (Clause 16) are independent of the type of radiation. Therefore, they can also be applied to other dosimetry systems, e.g. for neutrons, utilizing the corresponding type of radiation for testing.

This document is intended to be applied to dosimetry systems that are capable of evaluating doses in the required quantity and unit (Sv) from readout signals in any quantity and unit. The only correction that may be applied to the evaluated dose (indicated value) is the one resulting from natural background radiation using extra dosemeters.

NOTE 5 The correction due to natural background can be made before or after the dose calculation.

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 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*

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

ISO 4037 (all parts), *Radiological protection – X and gamma reference radiation for calibrating dosemeters and doserate meters and for determining their response as a function of photon energy*

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 6980 (all parts), *Nuclear energy – Reference beta-particle radiation*

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*

ISO 8529 (all parts), *Reference neutron radiations*

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