Irish Standard
I.S. EN 62387-1:2012

Radiation protection instrumentation - Passive integrating dosimetry systems for environmental and personal monitoring -- Part 1: General characteristics and performance requirements (IEC 62387-1:2007 (MOD))

I.S. EN 62387-1:2012

Incorporating amendments/corrigenda issued since publication:

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English version

Radiation protection instrumentation - Passive integrating dosimetry systems for environmental and personal monitoring - Part 1: General characteristics and performance requirements

(IEC 62387-1:2007, modified)

Instrumentation pour la radioprotection - Systèmes dosimétriques intégrés passifs pour la surveillance de l'environnement et de l'individu - Partie 1: Caractéristiques générales et exigences de fonctionnement (CEI 62387-1:2007, modifiée)

Strahlenschutz-Messgeräte - Passive, integrierende Dosimetriesysteme zur Umwelt- und Personenüberwachung - Teil 1: Allgemeine Eigenschaften und Leistungsanforderungen (IEC 62387-1:2007, modifiziert)

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CENELEC

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

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Foreword

This document (EN 62387-1:2012) consists of the text of IEC 62387-1:2007 prepared by IEC/SC 45B, "Radiation protection instrumentation", of IEC/TC 45, "Nuclear instrumentation", together with the common modifications prepared by CLC/TC 45B, "Radiation protection 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)	2013-01-02
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2015-01-02

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

Clauses, subclauses, notes, tables, figures and annexes which are additional to those in IEC 62387-1:2007 are prefixed “Z”.

In this document, the common modifications to IEC 62387-1:2007 are indicated by a vertical line in the left margin of the text.

The main objectives of EN 62387-1 are to

- specify performance requirements for complete dosimetry systems including detectors, dosemeters, readers, and additional equipment. In addition, the corresponding methods of test to check that these requirements are met are given in detail,
- harmonize requirements for all types of passive dosimetry systems detecting external photon and beta radiation,
- specify the use the operational quantities according to ICRU 51,
- harmonize tests using radiation with relevant ISO standards on reference radiation and calibration: ISO 4037 for photon radiation, ISO 6980 for beta radiation and ISO 8529 for neutron radiation. For this reason, no conversion coefficients from air kerma (or absorbed dose or fluence) to the operational quantities are given in this standard, except in case the necessary conversion coefficients are not included in the respective ISO standard. Those given in the ISO-standards are applicable,
- incorporate basic terms of the concept that a result of a measurement essentially consists of a value and an associated uncertainty, as laid down in the introductions of IEV 311 and EN 60359 and refer the reader to an IEC technical report for complete uncertainty analysis in radiation protection measurements and to the GUM,
- align CENELEC performance requirements on dosimetry systems for measuring personal dose equivalents with the recommendations on accuracy stated in the ICRP Publication 75: *General Principles for the Radiation Protection of Workers*. Further information is given in the informative Annex ZB.

Introduction

A dosimetry system may consist of the following elements:

a) a passive device, referred to here as a *detector*, which, after the presence of radiation, provides and 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;

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.

1 Scope and object

This European Standard applies to all kinds of passive dosimetry systems that are used for measuring

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

– the personal dose equivalent $H_p(0,07)$ (for both whole body and extremity dosimetry),or

– the ambient dose equivalent $H^*(10)$ (for environmental dosimetry).

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

Measuring quantity	Mandatory energy range for photon radiation	Maximum energy range for testing photon radiation	Mandatory energy range for beta-particle radiation	Maximum energy range for testing beta-particle radiation
$H_p(10)$, $H^*(10)$	80 keV to 1,25 MeV	12 keV to 7 MeV	---	---
$H_p(0,07)$	30 keV to 250 keV	8 keV to 7 MeV	0,8 MeV almost equivalent to an E_{max} of 2,27 MeV	0,07 MeV[a] to 1,2 MeV almost equivalent to E_{max} from 0,225 MeV to 3,54 MeV
[a] For beta-particle radiation, an energy of 0,07 MeV is required to penetrate the dead layer of skin of 0,07 mm (almost equivalent to 0,07 mm of ICRU tissue).				

NOTE 1 In this standard, “dose” means personal or ambient dose equivalent, unless otherwise stated.

NOTE 2 For $H_p(10)$ and $H^*(10)$ no beta radiation is considered. Reasons: 1) $H_p(10)$ and $H^*(10)$ are a conservative estimate for the effective dose which is not a suitable quantity for beta radiation. 2) No conversion coefficients are available in ICRU 56, ICRU 57 or ISO 6980.

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

In addition, this standard can be applied for testing neutron dosimetry systems 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). The test utilizing radiation (Clauses 13 to 15) shall be done with neutron reference radiation qualities according to the ISO 8529 series.

In some countries the presence of beta dose has to be indicated by dosemeters worn on the trunk. Such an indication of the presence of beta dose is not a measurement. For that reason, a specific subclause (11.8) deals with the indication of the presence of beta dose.

This standard 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 4 The correction due to natural background may be made before or after the dose calculation.

Usually, a dosimetry system is not able to measure all quantities given above. Thus, the systems shall only be tested with regards to those quantities and types of radiation it is intended to be used for. Annex D gives further guidelines to define specific usage categories.

Full compliance with this standard is given if the requirements for the mandatory ranges given in Tables 3 to 5 are fulfilled. If the customer or manufacturer requires extended ranges then the test should also be performed as specified in this standard, i.e. the requirements given in Tables 3 to 5 apply, too. The range of any influence quantity stated by the manufacturer is called rated range. Thus, dosimetry systems can be classified by stating a set of ranges (for example, for dose, for energy, for temperature) within which the requirements stated in this standard are met (Capabilities of the system, see Clause 7). In addition, usage categories are given in Annex D with respect to different measuring capabilities.

For the dosimetry systems described above, this standard specifies general characteristics, general test procedures and performance requirements, radiation characteristics as well as environmental, electrical, mechanical, software and safety characteristics.

A dosimetry system may be tested with regards to different quantities at different times. In case the dosimetry system was changed since the previous test, a new test with regards to quantities tests formerly may be necessary.

The absolute calibration of the dosimetry system is not checked during a type test according to this standard as only system properties are of interest. The absolute calibration is checked during a routine test.

2 Normative references

For normative references, see the normative Annex ZA.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

For definitions related to measurements in general, definitions were taken from IEC 60050-300, Part 311, from IEC 60050-393 and from IEC 60050-394. A very limited number of definitions was taken from ISO 4037-3 and the ISO Guide to the Expression of Uncertainty in Measurement (GUM).

The references are given in brackets [ ]. The information following the brackets is specific to this standard and is not originating from the given source.

A word between parentheses ( ) in the title of a definition is a qualifier that may be skipped if there is no danger of confusion with a similar term.

The terms are listed in alphabetical order.

3.1
ambient dose equivalent
***H**(*d*)**
at a point in a radiation field, dose equivalent that would be produced by the corresponding expanded and aligned field, in the ICRU sphere at a depth, *d*, on the radius opposing the direction of the aligned field

[SOURCE: ICRU 51]

Note 1 to entry: The recommended depth, d, for environmental monitoring in terms of $H^*(d)$ is 10 mm, and $H^*(d)$ may be written as $H^*(10)$. [IEV 393-14-95]

3.2
calibration factor
***N*$_0$**
quotient of the conventional true value of a quantity $C_{r,0}$ and the indicated value $G_{r,0}$ at the point of test for a reference radiation under reference conditions. It is expressed as

$$N_0 = \frac{C_{r,0}}{G_{r,0}}$$

Note 1 to entry: The reciprocal of the calibration factor is equal to the response under reference conditions. In contrast to the calibration factor, which refers to the reference conditions only, the response refers to any conditions prevailing at the time of measurement.

[SOURCE: ISO 4037-3, Definition 3.2.12, modified]

Note 2 to entry: This definition is of special importance for non-linear dosemeters.

Note 3 to entry: The reference value $C_{r,0}$ for the dose is given in Table 2.

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

RADIATION PROTECTION INSTRUMENTATION – PASSIVE INTEGRATING DOSIMETRY SYSTEMS FOR ENVIRONMENTAL AND PERSONAL MONITORING –

Part 1: General characteristics and performance requirements

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.
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International Standard IEC 62387-1 has been prepared by subcommittee 45B: Radiation protection instrumentation, of IEC technical committee 45: Nuclear instrumentation.

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

FDIS	Report on voting
45B/544/FDIS	45B/554/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.

A list of all parts of the IEC 62387 series, under the general title: *Radiation protection instrumentation – Passive integrating dosimetry systems for environmental and personal monitoring*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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.

INTRODUCTION

IEC 62387 is published in separate parts according to the following structure:

Part 1: General

General characteristics and performance requirements

Part 2: Thermoluminescence dosimetry systems

Specific characteristics of, and performance requirements for, thermoluminescence dosimetry systems

Up to now, this part is represented by the second edition of IEC 61066.

Parts 3 and following: Other dosimetry systems

The further parts (to be published later) contain specific characteristics of, and performance requirements for, other detectors like direct ion storage, optically stimulated luminescence etc.

A dosimetry system may consist of the following elements:

a) a passive device, referred to here as a *detector*, which, after the presence of radiation, provides and 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;

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.

The main objectives of this international standard IEC 62387-1 are to:

- specify performance requirements for complete dosimetry systems including detectors, dosemeters, readers, and additional equipment. In addition, the corresponding methods of test to check that these requirements are met are given in detail;
- harmonize requirements for all types of passive dosimetry systems detecting external photon and beta radiation;
- specify the use the operational quantities according to ICRU 51;
- harmonize tests using radiation with relevant ISO standards on reference radiation and calibration: ISO 4037 for photon radiation, ISO 6980 for beta radiation and ISO 8529 for neutron radiation. For this reason, no conversion coefficients from air kerma (or absorbed dose or fluence) to the operational quantities are given in this standard. Those given in the ISO-standards are applicable;
- incorporate basic terms of the concept that a result of a measurement essentially consists of a value and an associated uncertainty, as expounded in the introductions of IEV 311 and IEC 60359 and refer the reader to an IEC technical report for complete uncertainty analysis in radiation protection measurements and to the GUM;

- align IEC uncertainty requirements on dosimetry systems for measuring personal dose equivalents with those stated in ICRP Publication 75: *General Principles for the Radiation Protection of Workers*.

RADIATION PROTECTION INSTRUMENTATION – PASSIVE INTEGRATING DOSIMETRY SYSTEMS FOR ENVIRONMENTAL AND PERSONAL MONITORING –

Part 1: General characteristics and performance requirements

1 Scope and object

This part of IEC 62387 applies to all kinds of passive dosimetry systems that are used for measuring the personal dose equivalents $H_p(10)$ or $H_p(0,07)$ or the ambient dose equivalent $H^*(10)$. It applies to dosimetry systems that measure external photon or beta radiation in the dose range between 0,01 mSv and 10 Sv and in the energy ranges given in the following Table. All the energy values are mean energies with respect to the prevailing dose quantity. The dosimetry systems usually use electronic devices for the data evaluation and thus are often computer controlled.

Measuring quantity	Energy range for photon radiation	Energy range for beta-particle radiation
$H_p(10)$, $H^*(10)$	12 keV to 7 MeV	---
$H_p(0,07)$	8 keV to 250 keV	0,07 MeV[a] to 1,2 MeV almost equivalent to E_{max} from 225 keV to 3,54 MeV
[a] For beta-particle radiation, an energy of 0,07 MeV is required to penetrate the dead layer of skin of 0,07 mm (almost equivalent to 0,07 mm of ICRU tissue) nominal depth.		

NOTE 1 In this standard, “dose” means personal or ambient dose equivalent, unless otherwise stated.

NOTE 2 For $H_p(10)$ and $H^*(10)$ no beta radiation is considered. Reasons: 1) $H_p(10)$ and $H^*(10)$ are a conservative estimate for the effective dose which is not a suitable quantity for beta radiation. 2) No conversion coefficients are available in ICRU 56, ICRU 57 or ISO 6980.

This standard 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 The correction due to natural background may be made before or after the dose calculation.

In this standard, requirements are stated for minimal ranges of influence quantities, for example 80 keV to 1,25 MeV for photon energy (see Tables 3 to 5). A dosimetry system shall at least fulfil the requirements stated for these *minimal* ranges. However, the manufacturer may state larger ranges for the different influence quantities, for example 60 keV to 7 MeV. These larger ranges are called *rated* ranges. In such cases, the dosimetry systems must fulfil the requirements stated for these rated ranges. Thus, dosimetry systems can be classified by stating a set of ranges (for dose, energy, temperature etc.) within which the requirements stated in this standard are met (Capabilities of the system, see Clause 7). In addition, usage categories are given in Annex D with respect to different measuring capabilities.

For the dosimetry systems described above, this standard specifies general characteristics, general test procedures and performance requirements, radiation characteristics as well as environmental, electrical, mechanical, software and safety characteristics.

The absolute calibration of the dosimetry system is not checked during a type test according to this standard as only system properties are of interest. The absolute calibration is checked during a routine test.

2 Normative references

The following referenced documents are indispensable for the application 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 60050-300:2001, *International Electrotechnical Vocabulary (IEV) – Electrical and electronic measurements and measuring instruments – Part 311: General terms relating to measurements – Part 312: General terms relating to electrical measurements – Part 313: Types of electrical measuring instruments – Part 314: Specific terms according to the type of instrument*

IEC 60050-393:2003, *International Electrotechnical Vocabulary (IEV) – Part 393: Nuclear instrumentation: Physical phenomena and basic concepts*

IEC 60050-394:1995, *International Electrotechnical Vocabulary (IEV) – Chapter 394: Nuclear instrumentation: Instruments*
Amendment 1 (1996)
Amendment 2 (2000)

IEC 60068-2-32, *Environmental testing – Part 2: Tests. Test Ed: Free fall*

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 61000-4-11, *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 4037-1:1996, *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*