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Kärnteknisk mätutrustning – Installerade monitorer för övervakning av dosrat från röntgen- och gammastrålning med energi mellan 50 keV och 7 MeV

*Radiation protection instrumentation –
Installed dose ratemeters, warning assemblies and monitors –
X and gamma radiation of energy between 50 keV and 7 MeV*

Denna svenska standard innehåller den engelska texten i nedan angiven IEC-publikation, utarbetad inom International Electrotechnical Commission, IEC:

- **IEC 60532, Third edition, 2010 - Radiation protection instrumentation - Installed dose ratemeters, warning assemblies and monitors - X and gamma radiation of energy between 50 keV and 7 MeV**

Nationellt förord

Tidigare fastställd svensk standard SS-IEC 60532, utg 2:1993, gäller ej fr o m 2022-11-16.

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SEK Svensk Elstandard

Box 1284
164 29 Kista
Tel 08-444 14 00
www.elstandard.se



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Instrumentation pour la radioprotection – Débitmètres à poste fixe, ensembles d'alarmes et moniteurs – Rayonnements X et gamma d'énergie comprise entre 50 keV et 7 MeV

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RADIATION PROTECTION INSTRUMENTATION –
INSTALLED DOSE RATE METERS, WARNING ASSEMBLIES
AND MONITORS –
X AND GAMMA RADIATION OF ENERGY BETWEEN 50 keV AND 7 MeV**

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 60532 has been prepared by subcommittee 45B: Radiation protection instrumentation, of IEC technical committee 45: Nuclear instrumentation.

This third edition cancels and replaces the second edition, published in 1992, and constitutes a technical revision.

The main technical changes with regard to the previous edition are as follows:

- the document has been updated to take account of the requirements of IEC standards published since 1996.

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

FDIS	Report on voting
45B/655/FDIS	45B/670/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.

INTRODUCTION

a) Technical background, main issues and organization of the standard

This International Standard specifically focuses on radiation monitoring systems used for normal and incident conditions.

This standard is intended for use by purchasers in developing specifications for their plant specific radiation monitoring systems and by manufacturers to identify needed product characteristics when developing systems for normal and incident conditions. Some specific instrument characteristics such as measurement range, required energy response and ambient environment requirements will depend upon the specific application. In such cases, guidance is provided on determining the specific requirements, but specific requirements themselves are not stated except as typical examples given in informative annexes.

This standard is one associated with a series of standards which cover post accident radiation monitors important to safety in nuclear power plants. The full series is comprised of the following standards:

- IEC 60951-1 – *Nuclear power plants – Instrumentation important to safety – Radiation monitoring for accident and post-accident conditions – Part 1: General requirements*
- IEC 60951-2 – *Nuclear power plants – Instrumentation important to safety – Radiation monitoring for accident and post-accident conditions – Part 2: Equipment for continuous off-line monitoring of radioactivity in gaseous effluents and ventilation air*
- IEC 60951-3 – *Nuclear power plants – Instrumentation important to safety – Radiation monitoring for accident and post-accident conditions – Part 3: Equipment for continuous high range area gamma monitoring*
- IEC 60951-4 – *Nuclear power plants – Instrumentation important to safety – Radiation monitoring for accident and post-accident conditions – Part 4: Equipment for continuous in-line or on-line monitoring of radioactivity in process stream*

b) Situation of the current standard in the structure of the IEC SC 45A/SC 45B standard series

IEC 60951 series of standards are at the third level in the hierarchy of SC 45A standards.

They provide guidance on the design and testing of radiation monitoring equipment used for accident and post accident conditions. Other standards developed by SC 45A and SC 45B provide guidance on instruments used for monitoring radiation as part of normal operations.

The IEC 60761 series provides requirements for equipment for continuous off-line monitoring of radioactivity in gaseous effluents in normal conditions. IEC 60861 provides requirements for equipment for continuous off-line monitoring of radioactivity in liquid effluents in normal conditions. IEC 60768 provides requirements for equipment for continuous in-line and on-line monitoring of radioactivity in process stream in normal and incident conditions. Finally, ISO 2889 gives guidance on gas and particulate sampling. The relationship between these various radiation monitoring standards is given in Table 1:

Table 1 – IEC SC 45A/SC 45B standards series

Developer	ISO	SC 45A – Process and safety monitoring		SC 45B – Radiation protection and effluents monitoring
		Accident and post accident conditions	Normal and incident conditions	
Scope	Sampling circuits and methods	Accident and post accident conditions	Normal and incident conditions	
Gas, particulate and iodine with sampling (OFF LINE)	ISO 2889	IEC 60951-1 and IEC 60951-2	IEC 60761 series	
Liquid with sampling (OFF LINE)	N/A	N/A	IEC 60861	
Process stream (gaseous effluents, steam or liquid) without sampling (ON or IN-LINE)	N/A	IEC 60951-1 and IEC 60951-4	IEC 60768	N/A
Area monitoring	N/A	IEC 60951-1 and IEC 60951-3	IEC 60532	
Central system	N/A	IEC 61504		IEC 61559 (all parts)

c) Recommendations and limitations regarding the application of the standard

It is important to note that this standard establishes no additional functional requirements for safety systems.

d) Description of the structure of the IEC SC 45A/SC 45B standard series and relationships with other IEC standards and other bodies' documents (IAEA, ISO)

The IEC 61508 series defines the requirements for an overall safety life-cycle framework and a system life-cycle framework. The IEC 61508 series should be complied with when developing instruments with safety functions for radiation monitoring outside the nuclear power plant sector whilst complying with the requirements defined in this standard.

The top-level standard of the IEC SC 45A standard series is IEC 61513. It provides general requirements for instrumentation and control systems and equipment that are used to perform functions important to safety in nuclear power plants. IEC 61513 structures the IEC SC 45A standard series.

IEC 61513 refers directly to other IEC SC 45A standards for general topics related to the categorization of functions and classification of systems, qualification, separation of systems, defence against common cause failure, software aspects of computer-based systems, hardware aspects of computer-based systems, and control room design. The standards referenced directly at this second level should be considered together with IEC 61513 as a consistent document set.

At a third level, IEC SC 45A/SC 45B standards not directly referenced by IEC 61513 are standards related to specific equipment, technical methods or specific activities. Usually, these documents, which make reference to second-level documents for general topics, can be used on their own.

A fourth level extending the IEC SC 45/SC 45B standard series, corresponds to the technical reports which are not normative.

IEC 61513 has adopted a presentation format similar to the basic safety publication.

The IEC 61508 series, with an overall safety life-cycle framework and a system life-cycle framework, provides an interpretation of the general requirements for the nuclear power plant sector (see IEC 61508-1, IEC 61508-2 and IEC 61508-4). Compliance with IEC 61513 will facilitate consistency with the requirements of the IEC 61508 series as they have been interpreted for the nuclear industry. In this framework, IEC 60880 and IEC 62138 correspond to IEC 61508-3 for the nuclear application sector.

IEC 61513 refers to ISO as well as to IAEA 50-C-QA (now replaced by IAEA 50-C/SG-Q) for topics related to quality assurance (QA).

The IEC SC 45A standard series consistently implement and detail the principles and basic safety aspects provided in the IAEA code on the safety of nuclear power plants (NPPs) and in the IAEA safety series, in particular the requirements of Safety Guide NS-R-1, establishing safety requirements related to the design of nuclear power plants, and Safety Guide NS-G-1.3 dealing with instrumentation and control systems important to safety in nuclear power plants. The terminology and definitions used by SC 45A standards are consistent with those used by the IAEA.

**RADIATION PROTECTION INSTRUMENTATION –
INSTALLED DOSE RATE METERS, WARNING ASSEMBLIES
AND MONITORS –
X AND GAMMA RADIATION OF ENERGY BETWEEN 50 keV AND 7 MeV**

1 Scope and object

This International Standard applies to installed dose rate meters, warning assemblies and monitors that are used to prevent or mitigate a minor radioactive release, or minor degradation of fuel, within the nuclear power plants /nuclear facility design basis, and to warn personnel or to ensure their safety during or following events that involve or result in release of radioactivity in the nuclear power plants (NPP) /nuclear facility (NF), or risk of radiation exposure. This equipment is typically classified as category “A” or “B” or “C” or “not classified” in IEC 61226.

It covers equipment intended to isotropically measure air kerma, ambient dose equivalent or other exposure quantities due to X or gamma radiation of energy between 50 keV and 7 MeV. The equipment is intended primarily for the purpose of radiological protection, and may play an auxiliary or indirect role in the achievement or maintenance of nuclear plant safety.

Instruments measuring over a more limited energy range fall within the scope of this standard provided they cover at least the range of 80 keV to 1,5 MeV.

Assemblies of this type are commonly defined as area radiation monitors. They are normally employed to determine continuously the radiological situation in working areas in which the radiation field may change with time, for example nuclear power plants, particle accelerators, high active laboratories, fuel reprocessing plants, and to provide alarms when the radiation field goes outside predetermined limits. They are also employed to act in safety related protection systems, such as personnel access control systems which allow access to areas which can be subject to radiation fields.

This standard also gives guidance applicable to equipment for use in pulsed radiation fields, for example, those emanating from pulsed radiation or particle accelerators. This guidance is important, since the operation of the majority of the equipment defined by this standard in pulsed fields will give false readings.

The assemblies considered in this standard comprise at least:

- a detector assembly (e.g. ionization chamber, Geiger-Muller tube, scintillation counters, semiconductors);
- a measuring assembly, which may be fitted into a centralized panel which, in the case of warning assemblies and monitors, provides signal outputs and contacts capable of activating alarm or trip/interlock circuits for the purpose of radiation protection.

This standard is also applicable to installed dose rate measuring assemblies designed for special applications (e.g. very high dose rates). However, some of the requirements may need to be amended or supplemented according to the particular characteristics of such assemblies.

This standard is not applicable to criticality monitors.

Assemblies designed to perform combined functions should comply with the requirements pertaining to each of these functions.

This standard specifies general characteristics, general test procedures, radiation, electrical, safety, and environmental characteristics and the identification certificate for the assemblies defined above.

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 60038, *IEC standard voltages*

IEC 60050-151:2001, *International Electrotechnical Vocabulary – Part 151: Electrical and magnetic devices*

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

IEC 60050-394:2007, *International Electrotechnical Vocabulary – Part 394: Nuclear instrumentation – Instruments, systems, equipment and detectors*

IEC 60068-2-18, *Environmental testing – Part 2-18: Tests – Test R and guidance: Water*

IEC 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-75, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

IEC 60780, *Nuclear power plants – Electrical equipment of the safety system – Qualification*

IEC 60880, *Nuclear power plants – Instrumentation and control systems important to safety – Software aspects for computer-based systems performing category A functions*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measuring techniques – Electrostatic discharge test*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measuring techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4:2004, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measuring techniques – Electrical fast transient (burst immunity) test*

IEC 61000-4-5:2005, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measuring techniques – Surge immunity test*

IEC 61000-4-6:2008, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measuring 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 61000-4-12, *Electromagnetic compatibility (EMC) – Part 4-12: Testing and measurement techniques – Ring wave immunity test*

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

IEC 61000-6-4, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*

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

IEC 61226:2009, *Nuclear power plants – Instrumentation and control important to safety – Classification of instrumentation and control functions*

IEC 61504, *Nuclear power plants – Instrumentation and control systems important to safety – Plant-wide radiation monitoring*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 61513:2001, *Nuclear power plants – Instrumentation and control for systems important to safety – General requirements for systems*

IEC 62138, *Nuclear power plants – Instrumentation and control important for safety – Software aspects for computer-based systems performing category B or C functions*

IEC 62262, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

ISO 2889, *Sampling airborne radioactive materials from the stacks and ducts of nuclear facilities*

ISO 4037-1:1996, *X and gamma reference radiation for calibrating dosimeters and dose rate meters and for determining their response as a function of photon energy – Part 1: Radiation characteristics and production methods*

ISO 4037-2:1997, *X and gamma reference radiation for calibrating dosimeters and dose rate 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 4037-3:1999, *X and gamma reference radiation for calibrating dosimeters and dose rate meters and for determining their response as a function of photon energy – Part 3: Calibration of area and personal dosimeters and the measurement of their response as a function of energy and angle of incidence*

ISO 4037-4:2004, *X and gamma reference radiation for calibrating dosimeters and dose rate meters and for determining their response as a function of photon energy – Part 4: Calibration of area and personal dosimeters in low energy X reference radiation fields*

ISO 6980-1:2006, *Nuclear energy – Reference beta-particle radiation – Part 1: Methods of production*

ISO 6980-2:2004, *Nuclear energy – Reference beta-particle radiation – Part 2: Calibration fundamentals related to basic quantities characterizing the radiation field*

ISO 6980-3:2006, *Nuclear energy – Reference beta-particle radiation – Part 3: Calibration of area and personal dosimeters and the determination of their response as a function of beta radiation energy and angle of incidence*”

ISO 8529-1:2001, *Neutron reference radiations – Part 1: Characteristics and methods of production*

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

ISO 8529-3:1998, *Reference neutron radiations – Part 3: Calibration of area and personal dosimeters and determination of response as a function of energy and angle of incidence*