IEC 62244

Edition 2.0 2019-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Radiation protection instrumentation – Installed radiation portal monitors (RPMs) for the detection of illicit trafficking of radioactive and nuclear materials

Instrumentation pour la radioprotection – Portiques de détection des rayonnements (RPM) installés pour la détection du trafic illicite de matières radioactives et nucléaires

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RADIATION PROTECTION INSTRUMENTATION – INSTALLED RADIATION PORTAL MONITORS (RPMS) FOR THE DETECTION OF ILLICIT TRAFFICKING OF RADIOACTIVE AND NUCLEAR MATERIALS

FOREWORD

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International Standard IEC 62244 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 issued in 2006. This edition constitutes a technical revision.

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

a) making the standard consistent with the new standards for detection of illicit trafficking of radioactive material (see the Introduction);
b) creating unformed functionality test for all environmental, electromagnetic and mechanical tests and a requirement for the coefficient of variation of each nominal mean reading;
c) reference to IEC 62706 for the environmental, electromagnetic and mechanical test conditions;

d) adding information regarding climatic exposures.

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

FDIS	Report on voting
45B/929/FDIS	45B/930/RVD

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

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

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

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- withdrawn,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

INTRODUCTION

Illicit and inadvertent movement of radioactive materials has become a problem of increasing importance. Radioactive sources out of regulatory control, so-called “orphan sources”, have frequently caused serious radiation exposures and widespread contamination. Although illicit trafficking of nuclear and other radioactive materials is not a new phenomenon, concern about a nuclear “black market” has increased in the last few years particularly in view of its terrorist potential.

In response to the technical policy of the International Atomic Energy Agency (IAEA), the World Customs Organization (WCO) and the International Criminal Police Organization (Interpol) related to the detection and identification of special nuclear materials and security trends, nuclear instrumentation companies are developing and manufacturing radiation instrumentation to assist in the detection of illicit movement of radioactive and special nuclear materials. This type of instrumentation is widely used for security purposes at nuclear facilities, border control checkpoints, and international seaports and airports.

However, to ensure that measurement results made at different locations are consistent it is imperative that radiation instrumentation be designed to rigorous specifications based upon agreed performance requirements stated in international standards. Several IEC standards have been developed to address body-worn, hand-held and portal instruments, see Table 1.

Table 1 – Standards for instrumentation used to detect illicit trafficking of radioactive and nuclear materials

Type of instrumentation	IEC number	Title of the standard
Body-worn	62401	Radiation protection instrumentation – Alarming Personal Radiation Devices (PRDs) for the detection of illicit trafficking of radioactive material
	62618	Radiation protection instrumentation – Spectroscopy-Based Alarming Personal Radiation Detectors (SPRD) for the detection of illicit trafficking of radioactive material
	62694	Radiation protection instrumentation – Backpack-type radiation detector (BRD) for the detection of illicit trafficking of radioactive material
Portable or hand-held	62327	Radiation protection instrumentation – Hand-held instruments for the detection and identification of radionuclides and for the estimation of ambient dose equivalent rate from photon radiation
	62533	Radiation protection instrumentation – Highly sensitive hand-held instruments for photon detection of radioactive material
	62534	Radiation protection instrumentation – Highly sensitive hand-held instruments for neutron detection of radioactive material
Portal	62244	Radiation protection instrumentation – Installed radiation portal monitors (RPMs) for the detection of illicit trafficking of radioactive and nuclear materials
	62484	Radiation protection instrumentation – Spectroscopy-based portal monitors used for the detection and identification of illicit trafficking of radioactive material
Data format	62755	Radiation protection instrumentation – Data format for radiation instruments used in the detection of illicit trafficking of radioactive materials

RADIATION PROTECTION INSTRUMENTATION – INSTALLED RADIATION PORTAL MONITORS (RPMS) FOR THE DETECTION OF ILLICIT TRAFFICKING OF RADIOACTIVE AND NUCLEAR MATERIALS

1 Scope

This document defines the performance requirements of installed monitors used for the detection of gamma and neutron radiation emitters. These monitors are commonly known as radiation portal monitors or RPMs. They are used to monitor vehicles, cargo containers, people, or packages and are typically located at national and international border crossings. They may be used at any location where there is a need for this type of monitoring.

This document establishes the general, radiological, climatic, mechanical, electric and electromagnetic, and documentation requirements and associated test methods. A summary of the performance requirements is provided as Table 6. An informative listing of environmental requirements from IEC 62706 is provided as Table 7.

This document does not apply to the performance of spectroscopy-based portal monitors covered in IEC 62484.

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, *International Electrotechnical Vocabulary – Part 395: Nuclear instrumentation: Physical phenomena, basic concepts, instruments, systems, equipment and detectors*

IEC 60068-2-5, *Environmental testing – Part 2-5: Tests – Test S: Simulated solar radiation at ground level and guidance for solar radiation testing and weathering*

IEC 60068-2-11, *Basic environmental testing procedures – Part 2-11: Tests – Test Ka: Salt mist*

IEC 61187, *Electrical and electronic equipment – Documentation*

IEC 62706, *Radiation protection instrumentation – Environmental, electromagnetic and mechanical performance requirements*

IEC 62755, *Radiation protection instrumentation – Data format for radiation instruments used in the detection of illicit trafficking of radioactive materials*

3 Terms and definitions, abbreviated terms and symbols, quantities and units

3.1 Terms and definitions

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

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

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

3.1.1
coefficient of variation
COV
statistical measure of the dispersion of data points in a data series around the mean of those data points

$$\text{COV } \% = \frac{s}{\bar{x}} \times 100$$

Where:

s is the standard deviation;

$\bar{x}$ is the mean.

3.1.2
detection assembly
component of the RPM that contains the detectors and associated electronic devices

3.1.3
detection zone
location from which radiation emitted by an object or person being monitored may be detected by the detection assembly(ies)

Note 1 to entry: For two sided RPMs, the detection zone is located between detection assemblies; for single-sided RPMs, the detection zone is adjacent to the front face of the detection assembly.

3.1.4
nuclear material
plutonium except that with isotopic concentration exceeding 80 % in plutonium-238; uranium-233; uranium enriched in the isotope 235 or 233; uranium containing the mixture of isotopes as occurring in nature other than in the form of ore or ore-residue; any material containing one or more of the foregoing

[SOURCE: IAEA-TECDOC-1311, September 2002]

3.1.5
occupancy
when an object such as a person, vehicle, package, or container is in the detection zone

3.1.6
reference point <of an assembly>
physical mark on a piece of equipment or assembly to be used in order to position a source at a point where the conventionally true value of the quantity to be measured is known

Note 1 to entry: For this document, the physical mark can be used to identify where a source is positioned.

Note 2 to entry: Two different physical marks could be used to identify positions for neutron and gamma radiation.

3.1.7
type test
conformity test of one or more items representative of the production

3.2 Abbreviated terms and symbols

COV coefficient of variation

ESD electrostatic discharge

DU depleted uranium

HDPE high density polyethylene

IP international protection marking – degrees of protection provided by enclosures

NORM naturally occurring radioactive material

PVT polyvinyl toluene

RF radio frequency

RH relative humidity

RPM radiation portal monitor

3.3 Quantities and units

In the present document, units of the International System (SI) are used[1]. The definitions of radiation quantities are given in IEC 60050-395.

The following units may also be used:

- for energy: electron-volt (symbol: eV), 1 eV = 1,602 x 10^{-19} J;
- for time: years (symbol: y), days (symbol: d), hours (symbol: h), minutes (symbol: min);

Multiples and submultiples of SI units will be used, when practicable, according to the SI system.

4 General characteristics and requirements

4.1 General

4.1.1 Overview

RPMs are designed to detect radiation from gamma and/or neutron emitters transported by vehicle, carried by a person, or concealed in a cargo container or in a package moved by a conveyor belt.

RPMs issue a visual and/or audible alarm when the measured gamma or neutron radiation level exceeds an alarm threshold. Measurement occurs when an object passes through the detection zone.

According to their use, RPMs are classified as:

– pedestrian,

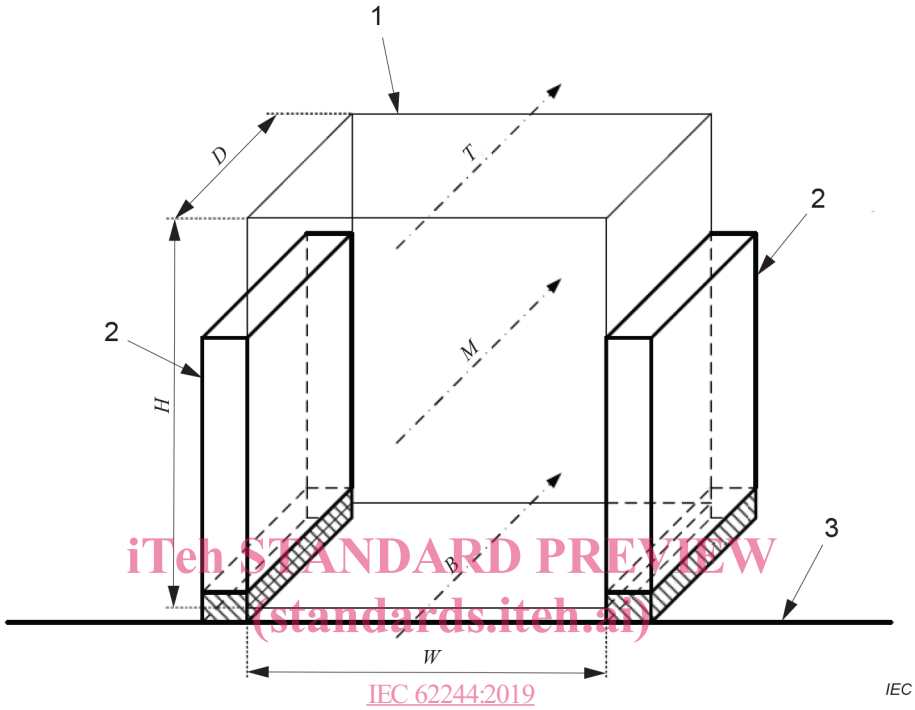
– road vehicle,

[1] International Bureau of Weights and Measures: The International System of Units, 8th edition, 2006.

– rail vehicle,

– conveyor.

If an RPM is designed for use in two or more classifications, its associated detection zone shall be appropriate for each classification. Figure 1 shows an example of the detection zone dimensions for an RPM that uses two detection assemblies.



Key

1	Detection zone
2	Detection assembly
3	Ground surface
W	Width of detection zone
H	Height of detection zone
D	Depth of detection zone
T	Top
M	Middle
B	Bottom
–·–►	source movement

Figure 1 – Example of a two-sided system

Some RPMs may have the ability to reduce alarms caused by NORM using for example, energy-based discrimination analysis. Such analysis provides a categorisation of the radiation source. Performance requirements are established by agreement between the manufacturer and the user.

The source movement speed and evaluation test distance for each monitor type in 4.1.2 through 4.1.4 are described in Table 2 and Table 3, respectively.

4.1.2 Pedestrian

Pedestrian RPMs shall provide a detection zone to ensure that people are monitored. Pedestrian RPMs may use a single detection assembly (single-sided) or multiple directly opposing detection assemblies (two-sided).

4.1.3 Road vehicles

Large road vehicle RPMs monitor vehicles that are typically more than 2,5 m high. Small road vehicle RPMs monitor vehicles that are typically less than or equal to 2,5 m high. Road vehicle RPMs shall be two-sided.

4.1.4 Rail vehicles (includes rail transported containers)

Rail vehicle RPMs shall be two-sided. Rail vehicle RPMs should have the ability to identify the individual car that caused an alarm to occur while monitoring an entire multi-car train.

4.1.5 Conveyor

Conveyor RPMs shall provide a detection zone to ensure that items moving through the detection zone are monitored. They may use a single detection assembly or multiple detection assemblies with detectors across the top, bottom, and/or side(s) of the detection zone. The detection zone is located adjacent to a detection assembly for single detector conveyor RPMs. For multiple detectors conveyor RPMs, the detection zone is located between the detection assemblies.

Table 2 – Speed of moving sources

Monitor type	Source speed, m/s
Pedestrian	1,2 ± 0,12
Small vehicle	2,2 ± 0,22
Large road vehicle and rail	1,2 ± 0,12
Package or conveyor	1,0 ± 0,1

Table 3 – Evaluation distances for different applications

Monitor type	Distance between detection assemblies for testing	Evaluation distance	Detection zone bottom from the ground or floor surface	Detection zone middle from the ground or floor surface	Detection zone top from the ground or floor surface
Single-sided pedestrian monitors	N/A	Source (1,0 ± 0,02) m from detector	0,05 m	1 m	2 m or less in case of height restriction
Multiple-sided pedestrian monitors	(1,0 ± 0,02) m apart measured from the surface of each detection assembly, or as stated by the manufacturer	Centred between detection assemblies	0,05 m	1 m	2 m or less in case of height restriction
Small vehicle monitors	(3,0 ± 0,1) m apart measured from the surface of each detection assembly, or as stated by the manufacturer	Centred between detection assemblies	0,2 m	1,25 m	2,5 m
Large road vehicle monitors	(5,0 ± 0,1) m apart measured from the surface of each detection assembly, or as stated by the manufacturer	Centred between detection assemblies	0,2 m	2,25 m	4,5 m
Multiple-sided rail vehicle monitors	(6,0 ± 0,1) m apart measured from the surface of each detection assembly, or as stated by the manufacturer	Centred between detection assemblies	1 m	3 m	6 m
Single-sided package (or conveyor) monitor	As stated by the manufacturer	Centred between detection assemblies	As stated by the manufacturer	As stated by the manufacturer	As stated by the manufacturer
Double-sided package (or conveyor) monitor	N/A	Source (1,0 ± 0,02) m from detector	As stated by the manufacturer	As stated by the manufacturer	As stated by the manufacturer

4.2 Configuration

An RPM may be designed as one or several detection assemblies that are contiguous to a system controller or placed at a distance from it. A detection assembly may consist of a single detector or multiple detectors contained within a protective enclosure. An RPM may consist of a single detection assembly or multiple detection assemblies depending on the classification.

The detection assemblies shall be designed to operate under all weather conditions expected at the installation location including conditions such as temperature, humidity, rain, lightning, wind, sunlight, mould and vegetation growth (flora), and invasive insects or rodents (fauna). Enclosure(s) provided for assemblies intended for outdoor use should be designed to not deteriorate during prolonged use under these conditions. Enclosure vents may be used on the detection assemblies to allow air flow. If used, the venting techniques should not allow