IEC 62484

Edition 2.0 2020-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Radiation protection instrumentation – Spectrometric radiation portal monitors (SRPMs) used for the detection and identification of illicit trafficking of radioactive material

Instrumentation pour la radioprotection – Portiques spectrométriques de détection des rayonnements (SRPMs) utilisés pour la détection et l'identification du trafic illicite des matières radioactives

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RADIATION PROTECTION INSTRUMENTATION – SPECTROMETRIC RADIATION PORTAL MONITORS (SRPMS) USED FOR THE DETECTION AND IDENTIFICATION OF ILLICIT TRAFFICKING OF RADIOACTIVE MATERIAL

FOREWORD

International Standard IEC 62484 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 62484 issued in 2010. This edition constitutes a technical revision.

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

a) title modified;

b) making the standard consistent with the new standards for detection of illicit trafficking of radioactive material (see the Introduction);

c) creating unformed functionality test for all environmental, electromagnetic and mechanical tests and a requirement for the coefficient of variation of each nominal mean reading;

d) reference to IEC 62706 for the environmental, electromagnetic and mechanical test conditions;

e) adding information regarding climatic exposures.

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

FDIS	Report on voting
45B/969/FDIS	45B/971/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 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- withdrawn,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

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 (PRD) for detection of illicit trafficking of radioactive material
	62618	Radiation protection instrumentation – Spectroscopy-Based Alarming Personal Radiation Devices (SPRD) for detection of illicit trafficking of radioactive material
	62694	Radiation protection instrumentation – Backpack-type radiation detector (BRD) for 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 – Spectrometric radiation portal monitors (SRPMs) used for the detection and identification of illicit trafficking of radioactive material
Mobile	63121	Radiation protection instrumentation – Vehicle-mounted mobile systems for the detection of illicit trafficking of radioactive materials
Data format	62755	Radiation protection instrumentation – Data format for radiation instruments used in the detection of illicit trafficking of radioactive materials

RADIATION PROTECTION INSTRUMENTATION – SPECTROMETRIC RADIATION PORTAL MONITORS (SRPMS) USED FOR THE DETECTION AND IDENTIFICATION OF ILLICIT TRAFFICKING OF RADIOACTIVE MATERIAL

1 Scope

This document defines the performance requirements of installed monitors used for the detection and identification of gamma emitters and the detection of neutron radiation emitters. These monitors are commonly known as spectrometric radiation portal monitors or SRPMs. They are used to monitor vehicles, cargo containers, people, or packages and are typically used at national and international border crossings and ports of entry. SRPMs 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 in Table 11. An informative listing of environmental requirements from IEC 62706 is provided in Table 12.

This document does not apply to the performance of non-spectroscopic portal monitors covered in IEC 62244.

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 (IEV) – 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 62706, *Radiation protection instrumentation – Recommended climatic, electromagnetic and mechanical performance requirements and methods of tests*

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

IAEA-TECDOC-1311: September 2002, *Prevention of the inadvertent movement and 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
alarm
audible, visual, or other signal activated when the instrument reading exceeds a pre-set value, falls outside of a pre-set range, or when the instrument detects and/or identifies the presence of the source of radiation according to a pre-set condition

3.1.2
coefficient of variation
COV
statistical measure of the dispersion of data points in a data series around the mean of those data points expressed in %

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

where:

s is the standard deviation of the dispersion of the data points;

$\bar{x}$ is the mean of the data points.

3.1.3
confidence indication
indication provided by the monitor on the reliability assigned to the determined identification

3.1.4
detection assembly
component of the SRPM that contains the detectors and associated electronic devices

3.1.5
detection zone
location where radiation emitted by an object or person being monitored may be detected by the detection assembly(s)

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

3.1.6
evaluation distances
distance between an evaluation test source and the exterior surface of the detection assembly(s) that faces the detection zone (see Figure 1)

3.1.7
false alarm
alarm not caused by an increase in radiation level over background conditions

3.1.8
false identification
misinterpretation of data being measured by a system leading to the incorrect identification of radionuclide(s) that are present or the identification of radionuclides that are not present

3.1.9
international protection marking
IP
degrees of protection provided by enclosures

3.1.10
live time
time interval during which a detection assembly is sensitive to the input signal

3.1.11
occupancy
when an object such as a person, vehicle, package, or container is in the detection zone

3.1.12
peripheral device
any device connected to the system other than the detector or detection assembly that is not required for operation

3.1.13
radioactive material
in this document, radioactive material includes special nuclear material and any radioactive source, unless otherwise specifically noted

3.1.14
run time
real time
duration (i.e., elapsed clock time) of the acquisition of the spectrum or other data

3.1.15
static mode
when the object being monitored is stationary within the detection zone for the monitoring period

3.1.16
transient mode
when the object being monitored passes through the detection zone

3.1.17
type test
conformity test of one or more items representative of the production device

3.2 Abbreviated terms and symbols

COV	coefficient of variation
ESD	electrostatic discharge
DU	depleted uranium
HEU	highly enriched uranium
HDPE	high density polyethylene
IAEA	International Atomic Energy Agency
IP	international protection marking
LEU	low enriched uranium

NORM naturally occurring radioactive material
PMMA polymethyl methacrylate
RF radio frequency
RH relative humidity
SNM special nuclear material
SRPM spectrometric radiation portal monitor
WGPu weapons grade plutonium

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 × 10^{-19} J;
- for time: years (symbol: y), days (symbol: d), hours (symbol: h), minutes (symbol: min);
- for temperature: degrees Celsius (symbol: ºC), 0 ºC = 273,15 K.

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

4 Design requirements

4.1 General

4.1.1 Overview

The equipment addressed by this document shall detect the presence of gamma-ray emitting sources, identify gamma-emitting radionuclide(s), and may detect neutron sources.

An indication shall be provided when the measurement results from the detection system exceed an alarm criterion or pre-set condition (user selectable for radiation level or identification result). Measurement occurs when the object passes through the detection zone (transient mode) or with the object static within the detection zone where the user performs controlled analyses of the object (i.e., enters collection time and/or activates the count to obtain a spectrum).

Passage speeds for transient mode testing are stated in each applicable clause and summarized in Table 2. Testing at different speeds may be performed as a special test upon agreement between the manufacturer and user.

Monitors shall be capable of operating independently of any peripheral device or remote station and shall be unaffected by any malfunction of a peripheral device.

According to its use, an SRPM can be classified as a:

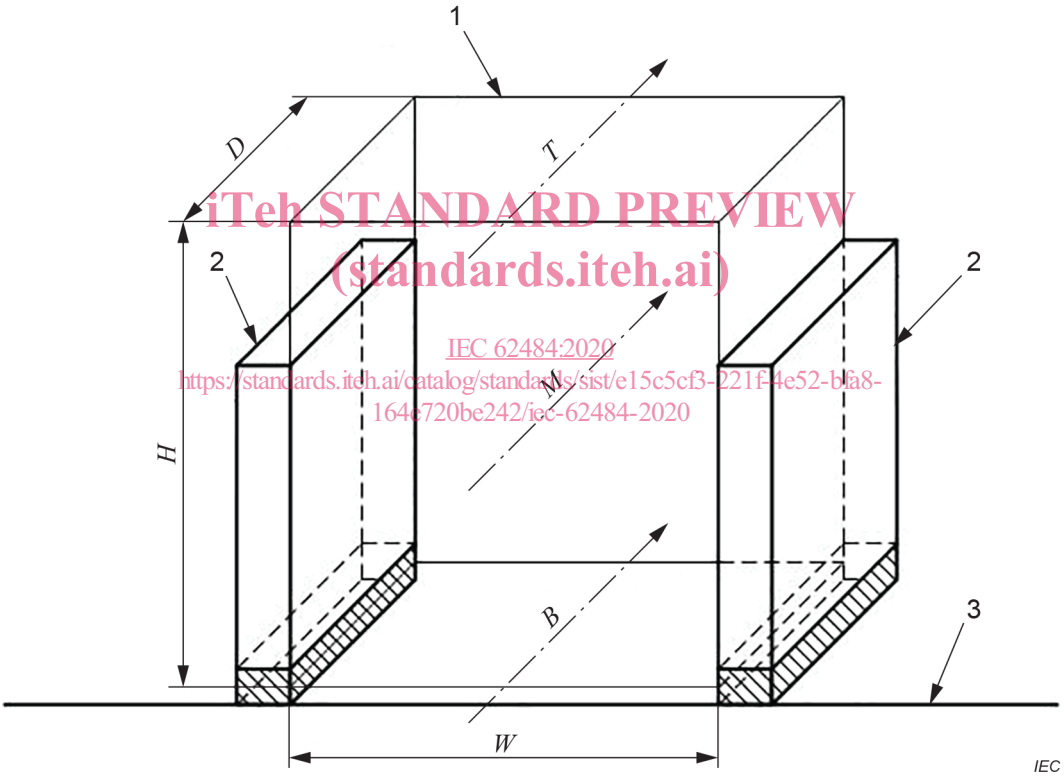
– pedestrian monitor,
– small vehicle monitor,
– large road vehicle and rail monitors, or
– package or conveyor monitor.

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

The detection zone is the area located adjacent to a single-sided detection assembly or between two or more detection assemblies where the measurement of radiation takes place (Figure 1). The size of the detection zone is based on the classification of use. If a monitor is used in two or more classifications, its detection zone shall be appropriate for each classification. The detection zone shall be of a size that ensures that all objects which could move through the detection zone are monitored. The manufacturer shall state the SRPM classification(s) for which the requirements stated in this document are met.

Operational conditions such as separation distance (distance between opposing detection assemblies), object speed, and background radiation should be considered when installing the monitor.

It is important to be able to identify the object that caused an alarm. The alarm should be generated within a period of time to ensure that the object that caused an alarm can be identified. This is important if complex algorithms are in place that need a finite process time. It becomes more important if a constant stream of traffic is being monitored (e.g., pedestrians).



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

The source movement speed and evaluation test distance for each monitor type in 4.1.2 through 4.1.5 are described in Table 2 and Table 3, respectively.

Table 2 – Speed of moving sources

Monitor classification	Source speed m/s
Pedestrian monitors	1,2 ± 0,12
Small vehicle	2,2 ± 0,22
Large road vehicle and rail monitors	1,2 ± 0,12
Package or conveyor monitor	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 m	Detection zone middle from the ground or floor surface m	Detection zone top from the ground or floor surface m
Single-sided pedestrian monitors	N/A	Source (1,0 ± 0,02) m from detector	0,05	1	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	1	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	1,25	2,5
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	2,25	4,5
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	3	6
Multiple-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