



IEC 62484

Edition 2.0 2020-10

# INTERNATIONAL STANDARD

---

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

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 13.280

ISBN 978-2-8322-8873-3

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references .....	8
3 Terms and definitions, abbreviated terms and symbols, quantities and units.....	9
3.1 Terms and definitions.....	9
3.2 Abbreviated terms and symbols .....	10
3.3 Quantities and units .....	11
4 Design requirements.....	11
4.1 General.....	11
4.1.1 Overview .....	11
4.1.2 Pedestrian monitor .....	14
4.1.3 Road vehicle monitor .....	14
4.1.4 Rail vehicle monitor (includes rail transported containers) .....	14
4.1.5 Package (or conveyor) monitor .....	14
4.2 Physical configuration.....	14
4.3 Spectral identification and count rate information .....	15
4.4 Indication features .....	15
4.5 Occupancy and speed sensors .....	16
4.6 Markings .....	16
4.7 Protection of switches.....	16
4.8 Energy and count rate range.....	16
4.9 Data transfer.....	16
4.10 User interface .....	16
4.10.1 Audible (sound) alarm.....	16
4.10.2 Visual indicators .....	16
4.10.3 Warning indicators.....	17
4.10.4 Basic controls and functions .....	17
4.10.5 Advanced indications and functions .....	17
5 General test procedures .....	18
5.1 General test conditions .....	18
5.1.1 Nature of tests.....	18
5.1.2 Standard test conditions .....	18
5.1.3 Statistical fluctuations.....	18
5.2 Reference neutron radiation for alarm testing.....	19
5.3 Alarm categorization .....	19
5.4 General requirements for testing radionuclide identification ability .....	19
5.5 Functionality test.....	20
5.5.1 General .....	20
5.5.2 Pre-test measurements.....	21
5.5.3 Intermediate (during test) measurements.....	21
5.5.4 Post-test measurements .....	21
6 Radiation detection requirements .....	21
6.1 Stability test.....	21
6.1.1 Requirements .....	21
6.1.2 Method of test.....	21

6.2	Neutron radiation detection, if provided	22
6.2.1	Requirements	22
6.2.2	Method of test	22
6.3	Gamma over-range indication	22
6.3.1	Requirements	22
6.3.2	Method of test	22
6.4	Detection of neutron radiation in a high gamma field	23
6.4.1	Requirements	23
6.4.2	Method of test – large road vehicle and multiple-sided rail vehicle monitors	23
6.4.3	Method of test – all other types of monitors	23
6.5	Background effects	23
6.5.1	Requirements	23
6.5.2	Method of test	24
6.6	Radionuclide identification	24
6.6.1	Radionuclide library and identification categorization	24
6.6.2	Radionuclide identification qualification	25
6.6.3	Single radionuclide identification	25
6.6.4	Simultaneous radionuclide identification	26
6.6.5	Alarm without identification	27
7	Climatic requirements	27
7.1	General	27
7.2	Ambient temperature	27
7.2.1	Requirements	27
7.2.2	Method of test	27
7.3	Relative humidity	28
7.3.1	Requirements	28
7.3.2	Method of test	28
7.4	Dust and moisture protection	28
7.4.1	Requirements	28
7.4.2	Method of test – Dust	28
7.4.3	Test method – Moisture	28
7.5	Climatic exposure type test	29
7.5.1	Requirements	29
7.5.2	Method of test	29
8	Mechanical requirements	29
8.1	Vibration	29
8.1.1	Requirements	29
8.1.2	Method of test	29
8.2	Microphonics/Impact	30
8.2.1	Requirements	30
8.2.2	Method of test	30
9	Electric and electromagnetic requirements	30
9.1	Electrostatic discharge (ESD)	30
9.1.1	Requirements	30
9.1.2	Method of test	30
9.2	Radio frequency (RF)	30
9.2.1	Requirements	30
9.2.2	Method of test	30

9.3	Radiated RF emissions .....	31
9.3.1	Requirements .....	31
9.3.2	Method of test.....	31
9.4	Conducted disturbances.....	31
9.4.1	Requirements .....	31
9.4.2	Method of test.....	31
9.5	Surges and oscillatory waves.....	31
9.5.1	Requirements .....	31
9.5.2	Method of test.....	31
9.6	Line voltage and frequency fluctuations .....	32
9.6.1	Requirements .....	32
9.6.2	Method of test.....	32
10	Documentation .....	32
10.1	Operation and maintenance manual.....	32
10.2	Test certificate .....	33
10.3	Declaration of conformity .....	33
Annex A (informative)	Identification of uranium and plutonium .....	36
Bibliography	.....	37
Figure 1	– Example of a two-sided system .....	12
Table 1	– Standards for instrumentation used to detect illicit trafficking of radioactive and nuclear materials .....	7
Table 2	– Speed of moving sources .....	13
Table 3	– Evaluation distances for different applications .....	13
Table 4	– Standard test conditions .....	18
Table 5	– Test radionuclides .....	20
Table 6	– Test materials <sup>1</sup> .....	20
Table 7	– Test result analysis .....	21
Table 8	– Radionuclide library.....	24
Table 9	– Radionuclide categorisation .....	24
Table 10	– Identification acceptance criteria <sup>1,2</sup> .....	25
Table 11	– Summary of performance requirements – Informative.....	33
Table 12	– Environmental requirements – Informative <sup>1</sup> .....	35
Table A.1	– Uranium and plutonium detection and identification guidance.....	36

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

---

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