
Instrumenti za zaščito pred sevanjem - Nahrbtni detektor sevanja (BRD) za odkrivanje nezakonitega prometa z radioaktivnimi snovmi (IEC 62694:2014)

Radiation protection instrumentation - Backpack-type radiation detector (BRD) for the detection of illicit trafficking of radioactive material (IEC 62694:2014)

Strahlenschutz-Messgeräte - Rucksack-Strahlenschutzdetektor zum Nachweis von unerlaubtem Transport radioaktiver Materialien (IEC 62694:2014)

Instrumentation pour la radioprotection - Détecteur de rayonnement de type sac-à-dos (BRD) pour la détection du trafic illicite des matières radioactives (IEC 62694:2014)

[https://standards.iteh.ai/catalog/standards/sist/9ad9e524-d274-4e44-8f9e-](https://standards.iteh.ai/catalog/standards/sist/9ad9e524-d274-4e44-8f9e-bf1436a8296b/sist-en-62694-2016)

[bf1436a8296b/sist-en-62694-2016](https://standards.iteh.ai/catalog/standards/sist/9ad9e524-d274-4e44-8f9e-bf1436a8296b/sist-en-62694-2016)

Ta slovenski standard je istoveten z: EN 62694:2016

ICS:

13.280 Varstvo pred sevanjem Radiation protection

SIST EN 62694:2016 en

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 62694:2016

<https://standards.iteh.ai/catalog/standards/sist/9ad9e524-d274-4e44-8f9e-bf1436a8296b/sist-en-62694-2016>

EUROPEAN STANDARD

EN 62694

NORME EUROPÉENNE

EUROPÄISCHE NORM

October 2016

ICS 13.280

English Version

Radiation protection instrumentation - Backpack-type radiation detector (BRD) for the detection of illicit trafficking of radioactive material
(IEC 62694:2014)

Instrumentation pour la radioprotection - Détecteur de rayonnement de type sac-à-dos (BRD) pour la détection du trafic illicite des matières radioactives
(IEC 62694:2014)

Strahlenschutz-Messgeräte - Rucksack-Strahlenschutzdetektor zum Nachweis von unerlaubtem Transport radioaktiver Materialien
(IEC 62694:2014)

This European Standard was approved by CENELEC on 2016-09-05. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

EN 62694:2016**European foreword**

This document (EN 62694:2016) consists of the text of IEC 62694:2014 prepared by SC 45B "Radiation protection instrumentation" of IEC/TC 45 "Nuclear instrumentation".

The following dates are fixed:

- latest date by which this document has to be implemented (dop) 2017-09-05
at national level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2019-09-05

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.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 62694:2016

<https://standards.iteh.ai/catalog/standards/sist/9ad9e524-d274-4e44-8f9e-bf1436a8296b/sist-en-62694-2016>

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050	Series	International Electrotechnical Vocabulary -	-	-
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 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	-	-

iTeH STANDARD PREVIEW
(standards.iteh.ai)

<https://standards.iteh.ai/catalog/standards/sist/bad9c527-d274-4e44-8f9e-bf1436a8296b/sist-en-62694-2016>

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 62694:2016

<https://standards.iteh.ai/catalog/standards/sist/9ad9e524-d274-4e44-8f9e-bf1436a8296b/sist-en-62694-2016>



IEC 62694

Edition 1.0 2014-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Radiation protection instrumentation – Backpack-type radiation detector (BRD)
for the detection of illicit trafficking of radioactive material**

**Instrumentation pour la radioprotection – Détecteur de rayonnement de type
sac-à-dos (BRD) pour la détection du trafic illicite des matières radioactives**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE **XB**
CODE PRIX

ICS 13.280

ISBN 978-2-8322-1486-2

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	6
1 Scope.....	8
2 Normative references	8
3 Terms and definitions, abbreviations, quantities and units	8
3.1 Terms and definitions.....	8
3.2 Abbreviations.....	10
3.3 Quantities and units	11
4 General test procedure	11
4.1 Nature of test.....	11
4.2 Standard test conditions	11
4.3 Tests performed under standard test conditions	11
4.4 Test performed with variation of influence quantities	11
4.5 Statistical fluctuations	11
4.6 Uncertainties in the measurements	12
4.7 Background radiation during testing	12
4.8 BRD set up	12
4.9 Speed of moving sources and integration time for radionuclide identification	13
4.10 Radiation sources	13
4.11 Functionality tests	14
5 General requirements	15
5.1 Mass	15
5.1.1 Requirements	15
5.1.2 Method of test.....	16
5.2 Design requirements	16
5.2.1 Requirements	16
5.2.2 Method of test.....	16
5.3 Marking.....	16
5.3.1 Requirements	16
5.3.2 Method of test.....	16
5.4 Switches	16
5.4.1 Requirements	16
5.4.2 Method of test.....	16
5.5 Effective range of measurement – Energy.....	17
5.5.1 Requirements	17
5.5.2 Method of test.....	17
5.6 Effective range of measurement – Count rate	17
5.6.1 Requirements	17
5.6.2 Method of test.....	17
5.7 Operating parameters	17
5.7.1 Requirements	17
5.7.2 Method of test.....	17
5.8 Explosive atmospheres	17
5.8.1 Requirements	17
5.8.2 Method of test.....	18
5.9 Diagnostics	18
5.9.1 Requirements	18

	5.9.2	Method of test.....	18
5.10		Power supply	18
	5.10.1	Requirements	18
	5.10.2	Method of test.....	18
5.11		Data format.....	19
	5.11.1	Requirements	19
	5.11.2	Method of test.....	20
5.12		Data storage	21
	5.12.1	Requirements	21
	5.12.2	Method of test.....	21
5.13		Communication interface.....	21
	5.13.1	Requirements	21
	5.13.2	Method of test.....	21
5.14		User interface	21
	5.14.1	Display	21
	5.14.2	Basic indications.....	22
	5.14.3	Additional indications.....	22
	5.14.4	Indications for BRDs with radionuclide identification capabilities	23
	5.14.5	Indications for BRDs with radionuclide directionality capabilities	23
	5.14.6	Basic functions and controls	23
	5.14.7	Restricted functions and controls	24
6		Radiation detection requirements	24
6.1		False alarm test.....	24
	6.1.1	Requirements	24
	6.1.2	Method of test.....	24
6.2		Alarm response to photon radiation.....	25
	6.2.1	Requirements	25
	6.2.2	Method of test.....	25
6.3		Alarm response to neutron radiation	26
	6.3.1	Requirements	26
	6.3.2	Method of test.....	26
6.4		Personal radiation protection alarm and response time	27
	6.4.1	Requirements	27
	6.4.2	Method of test.....	27
6.5		Gamma-ray ambient dose equivalent rate indication	28
	6.5.1	Requirements	28
	6.5.2	Method of test.....	28
6.6		Angular dependence and verification of directional indication.....	28
	6.6.1	Requirements	28
	6.6.2	Method of test.....	28
6.7		Over range test.....	29
	6.7.1	Requirements	29
	6.7.2	Method of test.....	29
6.8		Neutron indication in the presence of photons.....	30
	6.8.1	Requirements	30
	6.8.2	Method of test.....	30
6.9		Detection of gradually increasing radiation levels.....	31

6.9.1	Requirements	31
6.9.2	Method of test.....	31
6.10	Networked area monitors	31
6.10.1	Requirements	31
6.10.2	Method of test.....	32
6.11	Radionuclide identification, when provided.....	32
6.11.1	General Requirements	32
6.11.2	Radionuclide identification library	33
6.11.3	Single radionuclide identification	33
6.11.4	Identification of shielded radionuclides	35
6.11.5	Simultaneous and masked radionuclide identification	35
6.11.6	Radionuclide not in library	36
6.11.7	Low-exposure rate identification	37
6.11.8	Over range characteristics for identification	37
6.11.9	Rejection of natural background variations	38
7	Environmental requirements	39
8	Mechanical requirements.....	39
9	Electromagnetic requirements	40
10	Documentation	40
10.1	Type test report	40
10.2	Certificate	40
10.3	Operation and maintenance manual	40
Annex A (informative)	Statistical considerations	46
A.1	Poisson distribution.....	46
A.2	Confidence intervals for Poisson distribution.....	46
A.3	False alarm testing	46
A.4	Binomial distribution.....	48
Annex B (informative)	List of expected progeny and expected impurities	50
Annex C (informative)	Summary of fluence rate calculations	52
Annex D (normative)	Calculation ambient dose equivalent rate	54
Bibliography.....		59
Figure 1	– Diagram of testing angles when source passes at an angle of 0° in the horizontal plane (top view). The displayed source movement represents the test configuration at an angle of 0°	44
Figure 2	– Diagram of the two orthogonal planes (horizontal and vertical planes), the BRD reference point and testing angles	45
Figure 3	– BRD setup and testing source positions for network area monitoring.....	45
Table 1	– Standard test conditions	42
Table 2	– Occurrence of functionality tests for environmental testing	42
Table 3	– Occurrence of functionality tests for mechanical testing	43
Table 4	– Emission frequency range	43
Table 5	– Occurrence of functionality tests for electromagnetic testing	44
Table A.1	– One-sided 95 % upper confidence bounds for the false alarm rate for a given number of false alarms observed over a given time period	47

Table A.2 – Necessary sample sizes (n) for different levels (p_0) and number of failures (k).....	49
Table B.1 – List of expected progeny and expected impurities	51
Table C.1 – Examples of fluence rate calculations	53
Table D.1 – Conversion coefficient $h^*_K(10)$ from air kerma, K, to ambient dose equivalent, $H^*(10)$, for mono-energetic and parallel photon beams.....	55
Table D.2 – Probabilities per disintegration for ^{232}Th and ^{226}Ra (in equilibrium) as a function of photon energy	56
Table D.3 – Values of the mass energy-transfer, mass energy-absorption, and mass attenuation coefficients for air	58

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 62694:2016

<https://standards.iteh.ai/catalog/standards/sist/9ad9e524-d274-4e44-8f9e-bf1436a8296b/sist-en-62694-2016>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RADIATION PROTECTION INSTRUMENTATION – BACKPACK-TYPE
RADIATION DETECTOR (BRD) FOR THE DETECTION 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 62694 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/781/FDIS	45B/790/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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

iTeh STANDARD PREVIEW (standards.iteh.ai)

SIST EN 62694:2016

<https://standards.iteh.ai/catalog/standards/sist/9ad9e524-d274-4e44-8f9e-bf1436a8296b/sist-en-62694-2016>

RADIATION PROTECTION INSTRUMENTATION – BACKPACK-TYPE RADIATION DETECTOR (BRD) FOR THE DETECTION OF ILLICIT TRAFFICKING OF RADIOACTIVE MATERIAL

1 Scope

This International Standard applies to backpack-type radiation detectors (BRDs) that are used for the detection of illicit trafficking of radioactive material. This standard establishes the operational and performance requirements for BRDs. BRDs are portable instruments designed to be worn during use. They may also be used as temporary area monitors in a stand-alone mode.

BRDs detect gamma radiation and may include neutron detection and/or the identification of gamma-ray emitting radionuclides. This standard establishes performance and testing requirements associated with radiation measurements and the expected electrical, mechanical, and environmental conditions while in use.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050 (all parts): *International Electrotechnical Vocabulary* (available at <http://www.electropedia.org>)

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 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, abbreviations, quantities and units

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-393 and IEC 60050-394 apply, as well as the following.

3.1.1

accuracy

closeness of the agreement between the result of a measurement and the conventionally true value of the measurand

3.1.2 alarm

audible, visual, or other signal activated when the instrument reading exceeds a preset value, falls outside of a preset range, or when the instrument detects the presence of the source of radiation according to a preset condition

[SOURCE: IEC 60050-393:2003, 393-18-03, modified]

3.1.3 background level

radiation field in which there are no external sources present other than those in the natural background at the location of the measurements

3.1.4 backpack-type radiation detector

instrument composed of several radiation detection components that are placed inside a backpack or other similar enclosure with an external user interface or control device

3.1.5 centre line

horizontal or vertical line that describes the geometrical centre of an object

3.1.6 coefficient of variation

ratio of the standard deviation s to the arithmetic mean \bar{x} of a set of n measurements x_i given by the following formula:

$$v = \frac{s}{\bar{x}} = \frac{1}{\bar{x}} \sqrt{\frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2}$$

SIST EN 62694:2016
<https://standards.iteh.ai/catalog/standards/sis/9ad9e534-d274-4e44-8f9e-bf1436a8236b/sist-en-62694-2016>

[SOURCE: IEC 60050-394:2007, 394-40-14]

3.1.7 energy window

part of the energy spectrum within an upper and lower energy limit

[SOURCE: IEC 60050-394:2007, 394-38-70]

3.1.8 keyhole markup language

KML

is a file format used to display geographic data

Note 1 to entry: For example, see <http://www.opengeospatial.org/standards/kml/>.

3.1.9 fluence

Φ

the quotient of dN by da , where dN is the number of particles incident on a sphere of cross-sectional area da : $\Phi = dN/da$

[SOURCE: IEC 60050-881:1983, 881-04-18]