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Title: BS EN IEC 63596 Replay Tools for radioactive material detection systems

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



45B/1075/CD

COMMITTEE DRAFT (CD)

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CLOSING DATE FOR COMMENTS:

2025-01-10

SUPERSEDES DOCUMENTS:

45B/1061/NP, 45B/1071A/RVN

IEC SC 45B : RADIATION PROTECTION INSTRUMENTATION

SECRETARIAT:

France

SECRETARY:

Mr Miroslav Voytchev

OF INTEREST TO THE FOLLOWING COMMITTEES:

HORIZONTAL FUNCTION(S):

ASPECTS CONCERNED:

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TITLE:

Replay Tools for radioactive material detection systems

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

Replay tools for radioactive material detection systems

FOREWORD

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- International Standard XXX 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/XX/FDIS	45B/XX/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 maintenance result date¹⁾ 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,

¹⁾ The National Committees are requested to note that for this publication the maintenance result date is ...

- 61 • replaced by a revised edition, or
62 • amended.
63
64

INTRODUCTION

It is important to detect illicit and inadvertent movement of radioactive materials in the form of special nuclear materials, radiation sources used in medical and industrial applications, and contaminated commodities such as metallurgical scrap. 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 problem, concern about a nuclear “black market” has increased 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 have developed and manufactured 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.

To ensure that measurements made at different locations are consistent, it is imperative that radiation instrumentation be designed to specifications based upon agreed performance requirements. IEC standards have been developed to establish performance requirements for personal radiation detectors, radiation portal monitors, highly sensitive gamma and neutron detection systems, spectrometric personal radiation detectors, vehicle mounted mobile systems, and backpack-based radiation detection and identification systems. Table 1 contains a list of those standards. While many of these standards define experimental criteria for evaluating the radiometric performance of radiation detection equipment there is a need to define requirements for supplementary capabilities. One key requirement, defining the data formats for output files associated with radiation detection equipment, is defined in IEC 62755. An emerging need has been identified for software tools capable of replicating the algorithmic elements of radiation detection systems, “replay tools”, to enhance the technical evaluation and ongoing optimisation of radiation detection systems; this standard relates to such tools. This document applies to all types of radiation detection instrumentation.

Table 1 – Overview of IEC Radiation Protection Instrumentation Standards

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 Detector (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 – 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
Mobile system	63121	Radiation protection instrumentation – Vehicle-mounted mobile systems for the detection of illicit trafficking of radioactive materials

Replay tools for radioactive material detection systems

1 Scope

This document describes the requirements for a replay tool for radiological and nuclear material detection systems. The requirements include a central set of requirements that are applicable for a wide range of detection and identification systems, as well as requirements more specifically suited to specific types of radiation detection and identification systems. This standard applies only to systems that use the IEC 62755 (N42) data format.

A replay tool in this context is a stand-alone software package running on a common computing platform. The replay tool executes the algorithm used in a detection and/or identification sensor system on recorded data to generate alarm decisions, indicators, and notifications (in whole or in part) presented to an operator during real time operation. These replay tools can be instrument specific or instrument non-specific. For an instrument specific the replay tool primary function is to replicate the algorithmic processing by the integrated system and therefore reproduce the algorithmic outcomes as closely as possible. An instrument non-specific replay tool incorporates generic algorithms that are not part of the device, not all the requirements are applicable in this case. The replay tool may be used to regression-test algorithms and parameter changes, cross-compare hardware, or be part of an injection framework to investigate system performance over a larger parameter space than is possible through direct experimentation.

Standards for replay tools are driven by use-cases. Details for these use-cases appear in Table 2. Some of these use cases are applicable for system performance testing; others are applicable for internal use by the manufacturer.

Table 2 Use-Cases for Replay Tools

Use-Case	Details
Injection - testing capabilities of the detection system	Synthetic signals are added to background signals, either measured or synthetic, and then replayed. The synthetic signals include signatures that test the capabilities of the detection system and might include obscure signatures or signatures that can be mis-identified. The background can also be varied.
Investigation of instrument-to-instrument variation	Detection system files obtained from the same scenarios and from various copies of the detection system are replayed to investigate the variations in the results across the individual detection systems.
Optimization of parameter settings (minimization of nuisance alarms while maintaining detection standards)	A large number of synthetic or modelled signals are added to various background signals replayed along with background files and files from alarming but benign scenarios, using a sweep of replay parameters in order to investigate the parameter settings that maximize the ability to alarm on files that should be alarming and not alarm on benign or background files.
Determination of parameter settings for initial deployment	A large number of files, including some files with threats injected onto backgrounds, are replayed with a sweep of parameter settings. This allows determination of reasonable parameter settings in advance of a detection system's deployment.
Adjustment of parameter settings for different backgrounds/locations	A large number of files, including some files with modelled or synthetic signals injected onto backgrounds, are replayed with parameter settings from previous testing, and with a sweep of parameter settings. Results are examined to determine if parameter adjustments are necessary due to differing local conditions.

Testing capabilities of a new algorithm version	Files from the detection system using the old algorithm version are replayed with the new version and the results compared to discern the improvement in performance vs. the old algorithm version.
Testing device firmware revisions	Files collected from detection systems with the old firmware are replayed with the updated replay tool, and files from the detection system with the new firmware are replayed with the replay tool from the non-updated detection system to compare performance based on the updated firmware.

125
126

127 2 Normative references

128 The following referenced documents are indispensable for the application of this document. For
129 dated references, only the edition cited applies. For undated references, the latest edition of
130 the referenced document (including any amendments) applies.

131 IEC 60050-151, *International Electrotechnical Vocabulary (IEV) – Part 151: Electrical and*
132 *magnetic devices*

133 IEC 62706, *Radiation protection instrumentation - Environmental, electromagnetic and*
134 *mechanical requirements*

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

137 3 Terms and definitions, abbreviations and symbols, quantities and units

138 3.1 Terms and definitions

139 For the purposes of this document, the following terms and definitions, as well as those given
140 in IEC 60050-393 and IEC 60050-394 (replaced by IEC 60050-395 after its publication in 2011)
141 apply.

142 3.1.1

143 alarm

144 an audible, visual, or other signal activated when the instrument reading exceeds a pre-set
145 value, falls outside of a pre-set range, or when the instrument detects the presence of the
146 source of radiation according to a pre-set condition.

147 [IEV 393-18-03, modified]

148 3.1.2

149 analysis parameters

150 default or user-supplied information used by the radiation recognition algorithm that governs
151 the algorithm's processing of sensor data and ancillary data.

152 3.1.3

153 ancillary data

154 (digital) data provided by the detection system that do not include the sensor's foreground
155 radiation measurements but is required for execution of the radiation recognition algorithm.

156 Note to entry: Ancillary data include calibration, background measurements and other data necessary for
157 processing with the algorithm but do not include analysis parameters.

158 3.1.4

159 background data

160

sensor data deemed by the system to be solely due to the ambient radiation emissions present at the sensor location, free from the influence of real, or potential, transient sources of radiation.

3.1.5

batch processing

a facility for processing multiple input files with a single launch statement or action; in this context refers to either a batch processing mode or a command line interface.

3.1.6

detector

the component of a detection system that uses a sensor or sensors to measure gamma or neutron radiation and provides the sensor data to the radiation recognition algorithm.

3.1.7

detection system

gamma and/or neutron detector(s) coupled with the radiation recognition algorithm and user interface. The detection system provides alarm decisions and/or identification notifications to the operator.

3.1.8

device type

in this document: a personal radiation detector, a handheld detection and identification device, a mobile radiation detection and identification device, a spectroscopic portal monitor, a radiation portal monitor, or a backpack detection and identification device.

3.1.9

foreground data

sensor data from an inspection, to be differentiated from background/ambient data.

3.1.10

injection

the process by which synthetic data (from existing data and/or models) is used to alter an existing input file or to fabricate an entire new synthetic input file, for processing by the replay tool.

3.1.11

inspection

the set of radiological measurements collected and assessed by the detection system.

Note to entry: In the case of a radiation portal, the measurements are of a vehicle. Inspections by PRDs, handheld or mobile radiation and identification instruments, and backpack systems may be of the local radiation environment or of a targeted object.

3.1.12

input data

data produced by the detector and associated ancillary systems i.e., cameras, occupancy sensors etc., which are required inputs for the in-situ (i.e., in-device) algorithm or to the replay tool.

3.1.13

input file

a file that contains input data.

3.1.14

instrument specific