IEC 62463

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Radiation protection instrumentation – X-ray systems for the screening of persons for security and the carrying of illicit items

Instrumentation pour la radioprotection – Systèmes radiographiques aux rayons X pour le contrôle des individus dans le cadre de la sécurité et du transport d'objets illicites

IEC 62463:2010

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

RADIATION PROTECTION INSTRUMENTATION – X-RAY SYSTEMS FOR THE SCREENING OF PERSONS FOR SECURITY AND THE CARRYING OF ILLICIT ITEMS

FOREWORD

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International Standard IEC 62463 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/642/FDIS	45B/658/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- withdrawn,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.

INTRODUCTION

The existence of this standard does not indicate approval of the use of the relevant equipments. However these equipments exist and are used in some countries and are likely to be used to scan persons of all nationalities including nationals of those countries which ban their use. If other international organisations ban their use, this standard could be withdrawn. Meanwhile it is considered valuable to have this standard to reduce the radiation doses to members of the public and others likely to have to use the equipments. Personnel X-ray screening assemblies are used to examine persons in order to detect objects such as: weapons, explosives, smuggled or stolen items such as drugs or diamonds. The screening devices can be divided into three types: one type using the Compton backscattered X-rays (Backscatter system) for the image creation, one using the transmitted X-rays (Transmission system) for the image creation, and a third type as a combination of the two types (Backscatter + Transmission).

All three types consist of an X-ray unit and a detector unit, and take about 10 s to perform a scan.

The systems are operated by and the image is viewed on an external computer. Sophisticated software is used to evaluate the complex images and to enable the detection of hidden objects.

The main difference between the system types is the position of the detectors. Usually, they also differ in the tube voltage range used.

Backscatter X-ray systems, (B), use a narrow pencil shaped beam that scans the subject at high speed in a horizontal and vertical direction. Large detectors are installed on the same side of the subject as the X-ray source. The person stands in front of the enclosure and is scanned by the X-ray beam having a typical cross-sectional area of approximately 25 mm^2; this of course is the quantity limiting the spatial resolution of the system. Usually the person is scanned twice, once from the front and then from the back. Sometimes lateral scans are also performed. Typical systems use fixed peak voltage (kV) and current (mA) settings for the X-ray source. These are typically 50 kV and 5 mA. The total aluminium equivalent filtration is in the range of 1 mm to 7 mm.

Transmission X-ray systems, (T), often use a vertical fan–shaped beam of X-rays and a linear array of detectors. The person stands between the X-ray tube and the detector array and is scanned by the X-ray beam having a typical width of approximately 2 mm. The limiting quantity for the spatial resolution is the size of the detector elements. Typical systems use a fixed peak voltage (kV) and current (mA). Settings are in the range of about 140 kV to 220 kV and 0,1 mA to about 4 mA. The total aluminium equivalent thickness is in the range of about 1 mm to about 16 mm. The systems are capable of detecting objects within the body.

Backscatter plus transmission X-ray systems, (BT), are systems that use both backscattered and transmitted X-rays, during the same scan procedure.

RADIATION PROTECTION INSTRUMENTATION – X-RAY SYSTEMS FOR THE SCREENING OF PERSONS FOR SECURITY AND THE CARRYING OF ILLICIT ITEMS

1 Scope and object

This International Standard is applicable to X-ray systems designed for screening people to detect if they are carrying objects that could be used for criminal purposes, e.g., terrorist use, drug smuggling and theft. These objects include weapons, explosives, chemical and biological agents and other concealed items.

Three types of X-ray screening systems are currently in use. These are backscatter systems, transmission systems and combination backscatter/transmission systems. With backscatter systems the X-rays are used to detect objects hidden under or within the person's clothing. With transmission systems objects swallowed or hidden in body cavities may be detected. Combined devices can be used to get both pieces of information simultaneously.

The object of this standard is to lay down standard requirements and also to specify general characteristics, general test procedures, radiation characteristics, electrical characteristics, environmental influences, mechanical characteristics, safety requirements and to provide examples of acceptable methods in terms of dose to the whole or part of the body for each screening procedure and the time taken for each screening procedure.

In particular the standard addresses the design requirements as they relate to the radiation protection of the people being screened, people who are in the vicinity of the equipment and the operators. The standard does not address the performance requirements for the quality of the object detection.

2 Normative references

The following referenced documents are indispensable for the application 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 60038:2009, *IEC standard voltages*

IEC 60050-393:2003, *International Electrotechnical Vocabulary (IEV) – Part 393: Nuclear instrumentation – Physical phenomena and basic concepts*

IEC 60050-394:2007, *International Electrotechnical Vocabulary (IEV) – Part 394: Nuclear instrumentation – Instruments, systems, equipments and detectors*

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-75:1997*, Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electric fast transient/burst immunity test*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-12, *Electromagnetic compatibility (EMC) – Part 4-12: Testing and measurement techniques – Ring wave immunity test*

IEC 61187, *Electrical and electronic equipment – Documentation*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety related systems*

ISO 4037 (all parts), *X and gamma reference radiation for calibrating dosemeters and doserate meters and for determining their response as a function of photon energy*

ISO 4037-1:1996, *X and gamma reference radiation for calibrating dosemeters and doserate meters and for determining their response as a function of photon energy – Part 1: Radiation characteristics and production method*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply. The general terminology concerning X-ray screening systems is given in IEC 60050-393:2003 and IEC 60050-394:2007.

3.1
ambient dose equivalent, Hx(d)
the ambient dose equivalent at a point in a radiation field, is the dose equivalent that would be produced by the corresponding expanded and aligned field, in the ICRU sphere at a depth, d, on the radius opposing the direction of the aligned field

[ICRU 51]

NOTE 1 The recommended depth, d, for strongly penetrating radiation is 10 mm, and ambient dose equivalent at this depth may be written as $H_x^*(10)$.

NOTE 2 Soft tissue means ICRU 4-element, see ICRU 39.

3.2
constant potential X-ray unit
unit in which the ripple of the high voltage does not exceed ±10 %

3.3
exposure beam location
that part of the external surface of the system enclosure through which the collimated X-ray beam passes

3.4
half value layer (air kerma), HVL or HVLx
the thickness of the specified material which attenuates the beam of radiation to an extent such that the air kerma rate is reduced to one half of its original value. In this definition, the contribution of all scattered radiation, other than any which might be present initially in the beam concerned, is deemed to be excluded.