



IEC 62709

Edition 2.0 2024-09  
REDLINE VERSION

# INTERNATIONAL STANDARD



---

**Radiation protection instrumentation – Security screening of humans –  
Measuring the imaging performance of X-ray systems**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 13.280

ISBN 978-2-8322-9743-8

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

## CONTENTS

FOREWORD.....	5
INTRODUCTION.....	2
1 Scope <del>and object</del> .....	8
2 Normative references.....	8
3 Terms, definitions, abbreviated terms, quantities and units.....	9
3.1 Terms and definitions.....	9
3.2 Abbreviated terms.....	13
3.3 Quantities and units.....	13
4 Imaging performance evaluation procedures.....	13
4.1 General characteristics and test procedures.....	13
4.2 Location of testing.....	13
4.3 Body phantom and test objects.....	15
4.4 <del>Spatial</del> Pentalith resolution test.....	17
4.4.1 Purpose.....	17
4.4.2 Test object description.....	17
4.4.3 Procedure.....	17
4.4.4 Evaluation and record.....	17
4.5 Wire detection test.....	18
4.5.1 Purpose.....	18
4.5.2 Test object description.....	18
4.5.3 Procedure.....	18
4.5.4 Evaluation and record.....	18
4.6 Materials detection on body test.....	19
4.6.1 General.....	19
4.6.2 Purpose.....	19
4.6.3 Test object description.....	19
4.6.4 Procedure.....	19
4.6.5 Evaluation and record.....	19
4.7 Materials detection in air test.....	20
4.7.1 General.....	20
4.7.2 Purpose.....	20
4.7.3 Test object description.....	20
4.7.4 Procedure.....	20
4.7.5 Evaluation and record.....	20
4.8 Penetration test.....	20
4.8.1 General.....	20
4.8.2 Purpose.....	21
4.8.3 Test object description.....	21
4.8.4 Procedure.....	21
4.8.5 Evaluation and record.....	21
5 Minimum acceptable imaging performance.....	21
6 Environmental requirements.....	22
Annex A (normative) Mechanical drawings of the test objects.....	23
Annex B (informative) Example of reporting form.....	36
Annex C (informative) Image resolution measurement using the pentalith.....	39
C.1 General.....	39

C.2	Strategy .....	39
C.3	Pentalith description .....	39
C.4	Pass/fail criterion .....	42
C.5	Repeatability .....	43
Annex D (informative)	Comparison of whole body imaging systems .....	45
Bibliography	.....	46

Figure 1	– Generic illustration of the testing configuration showing a HDPE body phantom with a test object on one end supported 1 m off the ground .....	15
Figure 2	– Body phantom and test objects .....	16
Figure A.1	– Components of the test phantom .....	23
Figure A.2	– Material detection in air phantom .....	24
Figure A.3	– Subassembly of the material detection in air phantom (Figure A.2), metal comb, three teeth .....	24
Figure A.4	– Subassembly of the material detection in air phantom (Figure A.2), metal comb, two teeth .....	25
Figure A.5	– Subassembly of the material detection in air phantom (Figure A.2), metal comb, one tooth .....	25
Figure A.6	– Subassembly of the material detection in air phantom (Figure A.2), plastic comb .....	26
Figure A.7	– Subassembly of the material detection in air phantom (Figure A.2), mounting sheet .....	26
Figure A.8	– Material detection on body 1 .....	27
Figure A.9	– Material detection on body 2 .....	27
Figure A.10	– Wire detection phantom .....	28
Figure A.11	– Subassembly of the wire detection phantom (Figure A.10), mounting base .....	28
Figure A.12	– Subassembly of the wire detection phantom (Figure A.10), cover .....	29
Figure A.13	– Pentalith resolution phantom .....	30
Figure A.14	– Subassembly of the <del>spatial</del> pentalith resolution phantom (Figure A.13), mounting base .....	31
Figure A.15	– Subassembly of the <del>spatial</del> pentalith resolution phantom (Figure A.13); hole placement in mounting base .....	32
Figure A.16	– Subassembly of the <del>spatial</del> pentalith resolution phantom (Figure A.13), cover .....	33
Figure A.17	– Body phantom, 55 mm thick .....	33
Figure A.18	– Body phantom, 75 mm thick .....	34
Figure A.19	– Body phantom, 50 mm thick .....	34
Figure A.20	– Storing space .....	35
Figure C.1	– Dimensional design of the pentalith pattern .....	40
Figure C.2	– Example of a pentalith overlying a pixel grid .....	41
Figure C.3	– Example of a pentalith test phantom suitable for optical measurements .....	41
Figure C.4	– Example of a pentalith test phantom suitable for X-ray imaging .....	42
Figure C.5	– Example of using image thresholding as an objective pass/fail criterion .....	43
Table 1	– Wire sizes for the wire detection test .....	18
Table 2	– Minimum acceptable imaging performance at the reference location .....	21

Table 3 – Standard test conditions ..... 22

Table D.1 – Comparison of whole body imaging systems for security screening ..... 45

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

---

**RADIATION PROTECTION INSTRUMENTATION –  
SECURITY SCREENING OF HUMANS –  
MEASURING THE IMAGING PERFORMANCE OF X-RAY SYSTEMS****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) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

**This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 62709:2014. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.**

IEC 62709 has been prepared by subcommittee 45B: Radiation protection instrumentation, of IEC technical committee 45: Nuclear instrumentation. It is an International Standard.

This second edition cancels and replaces the first edition published in 2014. This edition constitutes a technical revision.

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

- a) Clarified the test procedures to maintain consistency with IEC 62463.
- b) Changed the term "spatial resolution" to "pentolith resolution".
- c) Modified some standard test conditions.
- d) Modified some terms and definitions.
- e) Changed the imaging requirements for transmission general-use systems.

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

Draft	Report on voting
45B/1059/FDIS	45B/1069/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under [webstore.iec.ch](http://webstore.iec.ch) in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

**IMPORTANT – The "colour inside" logo on the cover page of this document 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.**

## INTRODUCTION

This document establishes standard test methods and test objects for measuring the imaging performance of X-ray systems for security screening of humans. For each image quality test, this document also sets minimum acceptable levels of performance. These procedures and minimum acceptable requirements should not be construed as an all-inclusive measure of performance for any situation. Depending on the circumstances and detection needs, user institutions will continue to generate their own requirements and are encouraged to do so. Rather, it is hoped that this document will provide a starting point for evaluating systems, provide a uniform set of readily available information to compare equipment, and offer a standard procedure for periodic quality control testing.

Four annexes are included. Annex A (normative) provides mechanical drawings of the imaging test objects. Sample test report forms are given in Annex B (informative). Annex C (informative) provides a generic description of the pentolith, ~~the spatial~~ resolution test object. Annex D (informative) seeks to describe the different types of security systems presently being used for whole-body imaging.

# RADIATION PROTECTION INSTRUMENTATION – SECURITY SCREENING OF HUMANS – MEASURING THE IMAGING PERFORMANCE OF X-RAY SYSTEMS

## 1 ~~Scope and object~~

This document applies to security screening systems that utilize X-ray radiation and are used to inspect people who are not inside vehicles, containers, or enclosures. Specifically, this document applies to systems used to detect objects carried on or within the body of the individual being inspected. ~~This standard does not include requirements related to electromagnetic compatibility, radiological, electrical and mechanical safety. These requirements are covered in IEC 62463:2010.~~

The following types of systems are included in the scope of this document:

- Systems designated as ~~fixed, portal, transportable,~~ mobile or ~~gantry fixed.~~
- Systems employing detection of primary radiation, backscattered radiation, forward-scattered radiation, (see Annex D) or some combination of these modalities to form two-dimensional X-ray images.
- Systems that are primarily imaging but that also may have complementary features such as material discrimination, automatic active or passive detection alerts. This document does not address how to test these complementary features.

The objective is to provide standard methods of measuring and reporting imaging quality characteristics that enable system manufacturers, potential system users and other interested parties to:

- a) Establish a consistent indicator of the expected technical performance of screening systems used for the inspection of individuals. Such technical performance testing complements explicit detection testing and evaluation. In this document "detection" refers to items in an image.
- b) Provide repeatable and verifiable imaging performance data that can be used to compare systems from different vendors.
- c) Establish a baseline that can be used over time to calibrate the system or detect any performance degradation. (It is not intended that the entire test method be employed for daily quality assurance testing.)
- d) Establish minimum acceptable performance requirements for the systems described above.

## 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.

~~NOTE—Users of this standard should note that standards referenced herein may not fulfil the legal requirements and practices in all countries, or jurisdictions. Care should be taken to ensure regulatory compliance.~~

~~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, equipment and detectors~~



IEC 60050-395:2014, *International Electrotechnical Vocabulary (IEV) – Part 395: Nuclear instrumentation – Physical phenomena, basic concepts, instruments, systems, equipment and detectors*

IEC 60050-395:2014/AMD1:2016

IEC 60050-395:2014/AMD2:2020

IEC 60050-881:1983, *International Electrotechnical Vocabulary (IEV) – Part 881: Radiology and radiological physics*

IEC 60050-881:1983/AMD1:2014

IEC 60050-881:1983/AMD2:2019

IEC 60050-881:1983/AMD3:2020

IEC 62463:20102024, *Radiation protection instrumentation – X-ray systems for the security screening of persons ~~for security and the carrying of illicit items~~*

ISO 683-17:19992023, *Heat-~~treated~~treatable steels, alloy steels and free-cutting steels – Part 17: Ball and roller bearing steels*

# INTERNATIONAL STANDARD



---

**Radiation protection instrumentation – Security screening of humans –  
Measuring the imaging performance of X-ray systems**

## CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references.....	8
3 Terms, definitions, abbreviated terms, quantities and units.....	9
3.1 Terms and definitions.....	9
3.2 Abbreviated terms.....	12
3.3 Quantities and units.....	12
4 Imaging performance evaluation procedures.....	12
4.1 General characteristics and test procedures.....	12
4.2 Location of testing.....	13
4.3 Body phantom and test objects.....	14
4.4 Pentalith resolution test.....	15
4.4.1 Purpose.....	15
4.4.2 Test object description.....	16
4.4.3 Procedure.....	16
4.4.4 Evaluation and record.....	16
4.5 Wire detection test.....	16
4.5.1 Purpose.....	16
4.5.2 Test object description.....	17
4.5.3 Procedure.....	17
4.5.4 Evaluation and record.....	17
4.6 Materials detection on body test.....	18
4.6.1 General.....	18
4.6.2 Purpose.....	18
4.6.3 Test object description.....	18
4.6.4 Procedure.....	18
4.6.5 Evaluation and record.....	18
4.7 Materials detection in air test.....	18
4.7.1 General.....	18
4.7.2 Purpose.....	19
4.7.3 Test object description.....	19
4.7.4 Procedure.....	19
4.7.5 Evaluation and record.....	19
4.8 Penetration test.....	19
4.8.1 General.....	19
4.8.2 Purpose.....	19
4.8.3 Test object description.....	20
4.8.4 Procedure.....	20
4.8.5 Evaluation and record.....	20
5 Minimum acceptable imaging performance.....	20
6 Environmental requirements.....	21
Annex A (normative) Mechanical drawings of the test objects.....	22
Annex B (informative) Example of reporting form.....	35
Annex C (informative) Image resolution measurement using the pentalith.....	37
C.1 General.....	37

C.2	Strategy .....	37
C.3	Pentalith description .....	37
C.4	Pass/fail criterion .....	40
C.5	Repeatability .....	41
Annex D (informative)	Comparison of whole body imaging systems .....	42
Bibliography	.....	43

Figure 1	– Generic illustration of the testing configuration showing a HDPE body phantom with a test object on one end supported 1 m off the ground .....	13
Figure 2	– Body phantom and test objects .....	15
Figure A.1	– Components of the test phantom .....	22
Figure A.2	– Material detection in air phantom .....	23
Figure A.3	– Subassembly of the material detection in air phantom (Figure A.2), metal comb, three teeth .....	23
Figure A.4	– Subassembly of the material detection in air phantom (Figure A.2), metal comb, two teeth .....	24
Figure A.5	– Subassembly of the material detection in air phantom (Figure A.2), metal comb, one tooth .....	24
Figure A.6	– Subassembly of the material detection in air phantom (Figure A.2), plastic comb .....	25
Figure A.7	– Subassembly of the material detection in air phantom (Figure A.2), mounting sheet .....	25
Figure A.8	– Material detection on body 1 .....	26
Figure A.9	– Material detection on body 2 .....	26
Figure A.10	– Wire detection phantom .....	27
Figure A.11	– Subassembly of the wire detection phantom (Figure A.10), mounting base .....	27
Figure A.12	– Subassembly of the wire detection phantom (Figure A.10), cover .....	28
Figure A.13	– Pentalith resolution phantom .....	29
Figure A.14	– Subassembly of the pentalith resolution phantom (Figure A.13), mounting base .....	30
Figure A.15	– Subassembly of the pentalith resolution phantom (Figure A.13); hole placement in mounting base .....	31
Figure A.16	– Subassembly of the pentalith resolution phantom (Figure A.13), cover .....	32
Figure A.17	– Body phantom, 55 mm thick .....	32
Figure A.18	– Body phantom, 75 mm thick .....	33
Figure A.19	– Body phantom, 50 mm thick .....	33
Figure A.20	– Storing space .....	34
Figure C.1	– Dimensional design of the pentalith pattern .....	38
Figure C.2	– Example of a pentalith overlying a pixel grid .....	38
Figure C.3	– Example of a pentalith test phantom suitable for optical measurements .....	39
Figure C.4	– Example of a pentalith test phantom suitable for X-ray imaging .....	39
Figure C.5	– Example of using image thresholding as an objective pass/fail criterion .....	41
Table 1	– Wire sizes for the wire detection test .....	17
Table 2	– Minimum acceptable imaging performance at the reference location .....	20

Table 3 – Standard test conditions ..... 21

Table D.1 – Comparison of whole body imaging systems for security screening ..... 42

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

---

**RADIATION PROTECTION INSTRUMENTATION –  
SECURITY SCREENING OF HUMANS –  
MEASURING THE IMAGING PERFORMANCE OF X-RAY SYSTEMS****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) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 62709 has been prepared by subcommittee 45B: Radiation protection instrumentation, of IEC technical committee 45: Nuclear instrumentation. It is an International Standard.

This second edition cancels and replaces the first edition published in 2014. This edition constitutes a technical revision.

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

- a) Clarified the test procedures to maintain consistency with IEC 62463.
- b) Changed the term "spatial resolution" to "pentalith resolution".
- c) Modified some standard test conditions.
- d) Modified some terms and definitions.
- e) Changed the imaging requirements for transmission general-use systems.

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

Draft	Report on voting
45B/1059/FDIS	45B/1069/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under [webstore.iec.ch](http://webstore.iec.ch) in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

**IMPORTANT – The "colour inside" logo on the cover page of this document 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.**

## INTRODUCTION

This document establishes standard test methods and test objects for measuring the imaging performance of X-ray systems for security screening of humans. For each image quality test, this document also sets minimum acceptable levels of performance. These procedures and minimum acceptable requirements should not be construed as an all-inclusive measure of performance for any situation. Depending on the circumstances and detection needs, user institutions will continue to generate their own requirements and are encouraged to do so. Rather, it is hoped that this document will provide a starting point for evaluating systems, provide a uniform set of readily available information to compare equipment, and offer a standard procedure for periodic quality control testing.

Four annexes are included. Annex A (normative) provides mechanical drawings of the imaging test objects. Sample test report forms are given in Annex B (informative). Annex C (informative) provides a generic description of the pentolith resolution test object. Annex D (informative) seeks to describe the different types of security systems presently being used for whole-body imaging.



# **RADIATION PROTECTION INSTRUMENTATION – SECURITY SCREENING OF HUMANS – MEASURING THE IMAGING PERFORMANCE OF X-RAY SYSTEMS**

## **1 Scope**

This document applies to security screening systems that utilize X-ray radiation and are used to inspect people who are not inside vehicles, containers, or enclosures. Specifically, this document applies to systems used to detect objects carried on or within the body of the individual being inspected.

The following types of systems are included in the scope of this document:

- Systems designated as mobile or fixed.
- Systems employing detection of primary radiation, backscattered radiation, forward-scattered radiation, (see Annex D) or some combination of these modalities to form two-dimensional X-ray images.
- Systems that are primarily imaging but that also may have complementary features such as material discrimination, automatic active or passive detection alerts. This document does not address how to test these complementary features.

The objective is to provide standard methods of measuring and reporting imaging quality characteristics that enable system manufacturers, potential system users and other interested parties to:

- a) Establish a consistent indicator of the expected technical performance of screening systems used for the inspection of individuals. Such technical performance testing complements explicit detection testing and evaluation. In this document "detection" refers to items in an image.
- b) Provide repeatable and verifiable imaging performance data that can be used to compare systems from different vendors.
- c) Establish a baseline that can be used over time to calibrate the system or detect any performance degradation. (It is not intended that the entire test method be employed for daily quality assurance testing.)
- d) Establish minimum acceptable performance requirements for the systems described above.

## **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 60050-395:2014, *International Electrotechnical Vocabulary (IEV) – Part 395: Nuclear instrumentation – Physical phenomena, basic concepts, instruments, systems, equipment and detectors*

IEC 60050-395:2014/AMD1:2016

IEC 60050-395:2014/AMD2:2020

IEC 60050-881:1983, *International Electrotechnical Vocabulary (IEV) – Part 881: Radiology and radiological physics*

IEC 60050-881:1983/AMD1:2014

IEC 60050-881:1983/AMD2:2019

IEC 60050-881:1983/AMD3:2020

IEC 62463:2024, *Radiation protection instrumentation – X-ray systems for the security screening of persons*

ISO 683-17:2023, *Heat-treatable steels, alloy steels and free-cutting steels – Part 17: Ball and roller bearing steels*