



SLOVENSKI STANDARD
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Radiološka zaščita - Naprave za industrijsko gama radiografijo - Specifikacije za delovanje, načrtovanje in preskuse

Radiation protection - Apparatus for industrial gamma radiography - Specifications for performance, design and tests

Radioprotection — Appareils pour radiographie gamma industrielle — Spécifications de performance, de conception et d'essais

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Radiation protection — Apparatus for industrial gamma radiography — Specifications for performance, design and tests

*Radioprotection — Appareils pour radiographie gamma industrielle —
Spécifications de performance, de conception et d'essais*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 3999 was prepared by Technical Committee ISO/TC 85, *Nuclear energy*, Subcommittee SC 2, *Radiation protection*.

This second edition cancels and replaces ISO 3999-1:2000, of which it constitutes a minor revision.

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Radiation protection — Apparatus for industrial gamma radiography — Specifications for performance, design and tests

1 Scope

This International Standard specifies the performance, design and test requirements of apparatus for gamma radiography with portable, mobile and fixed exposure containers of the various categories defined in Clause 4.

It applies to apparatus designed to allow the controlled use of gamma radiation emitted by a sealed radioactive source for industrial radiography purposes, in order that persons will be safeguarded when the apparatus is used in conformity with the regulations in force regarding radiation protection.

It is emphasised, however, that so far as transport of apparatus and sealed radioactive source is concerned, compliance with this International Standard is no substitute for satisfying the requirements of relevant international transport regulations (IAEA Regulations for the safe transport of radioactive materials: IAEA-STI-PUB 998, Safety Standards Series No. ST-1 and No. ST-2, and/or the relevant national transport regulations).

The operational use of apparatus for industrial gamma radiography is not covered by this International Standard. Users of this equipment shall comply with national regulations and codes of practice.

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 amendment) applies.

ISO 361, *Basic ionizing radiation symbol*

ISO 2919:1999, *Radiation protection — Sealed radioactive sources — General requirements and classification*

ISO 7503-1, *Evaluation of surface contamination — Part 1: Beta-emitters (maximum beta energy greater than 0,15 MeV) and alpha-emitters*

IAEA-STI-PUB 998 (Safety Standards Series No. ST-1):1996, *Regulations for the safe transport of radioactive material*

IAEA-STI-PUB 998 (Safety Standards Series No. ST-2):1996, *Advisory Material for the IAEA Regulations for the safe Transport of Radioactive Material Safety Guide*

IEC 60068-2-6, *Environmental testing — Part 2: Tests — Test Fc: Vibration (sinusoidal)*

IEC 60068-2-47, *Environmental testing — Part 2-47: Test methods — Mounting of components, equipment and other articles for vibration, impact and similar dynamic tests*

IEC 60846, *Radiation protection instrumentation — Ambient and/or directional dose equivalent (rate) meters and/or monitors for beta, X and gamma radiation*

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IEC 61000-6-1, *Electromagnetic compatibility (EMC) — Part 6: Generic standards — Section 1: Immunity for residential, commercial and light-industrial environments*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) — Part 6: Generic standards — Section 2: Immunity for industrial environments*

IEC 61000-6-4, *Electromagnetic compatibility (EMC) — Part 6: Generic standards — Section 4: Emission standard for industrial environments*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply. Certain terms are illustrated in Figures 1 to 5 which, however, do not purport to illustrate typical or preferred designs.

3.1**ambient equivalent dose rate**

dose rate measured as an average over the sensitive volume of the detector

NOTE 1 Measurements of the ambient equivalent dose rate shall be made at 1 m from the surface and additionally at the surface of the exposure container or at 50 mm from the surface.

NOTE 2 The limits are given in 5.3. The maximum cross-sectional areas of the detectors to be used are given in 6.4.1.2.

cf. ICRU 51.

3.2**apparatus for industrial gamma radiography**

apparatus including an exposure container, a source assembly, and as applicable, a remote control, a projection sheath, an exposure head, and accessories designed to enable radiation emitted by a sealed radioactive source to be used for industrial radiography purposes

NOTE In the following text, an “apparatus for industrial gamma radiography” can be used for any means of non-destructive testing using gamma radiation.

3.3**automatic securing mechanism**

automatically activated mechanical device designed to restrict the source assembly to the secured position

3.4**beam limiter**

shielding device located at the working position designed to reduce the radiation dose rate in directions other than the directions intended for use

NOTE The beam limiter may be designed to be used in conjunction with an exposure head or may incorporate an exposure head as an integral part of the device.

3.5**control cable**

cable or other mechanical means used to project and retract the source assembly out from and into the exposure container by means of remote control

NOTE The control cable includes the means of attachment to the source holder.

3.6**control-cable sheath**

rigid or flexible tube for guiding the control cable from the remote control to the exposure container and for providing physical protection to the control cable

NOTE The control-cable sheath includes the necessary connection(s) for attachment to the exposure container and to the remote control.

3.7

exposure container

shield, in the form of a container, designed to allow the controlled use of gamma radiation and employing a source assembly

3.8

exposure head

device which locates the sealed source included in the source assembly, in the selected working position, and prevents the source assembly from projecting out of the projection sheath

3.9

lock

mechanical device with a key used to lock or unlock the exposure container

3.10

locked position

condition of the exposure container and source assembly in the secured and locked position

3.11

maximum rating

maximum activity, expressed as in 7.1.3, of a sealed source specified for a given radionuclide by the manufacturer, marked on the exposure container and not to be exceeded if the apparatus is to conform to this International Standard

3.12

projection sheath

flexible or rigid tube for guiding the source assembly from the exposure container to the working position and having the necessary connections for attachment to the exposure container and to the exposure head, or including the exposure head itself

3.13

remote control

device enabling the source assembly to be moved to and from a working position by operation from a distance away from the exposure container

NOTE

The remote control includes the control mechanism and, where applicable, also the control cable, the control-cable sheath and the necessary connections and attachments.

3.14

reserve sheath

sheath containing the length of the control cable, necessary for the projection of the source assembly

3.15

sealed radioactive source

radioactive source sealed in a capsule or having a bonded cover, the capsule or cover being strong enough to prevent contact with and dispersion of the radioactive material under the conditions of use and wear for which it was designed

NOTE

In the following text, the term "sealed source" is used instead of "sealed radioactive source" for simplification.

(cf. 3.11 of ISO 2919:1999)

3.16

secured position

condition of the exposure container and source assembly, when the sealed source is fully shielded and restricted to this position within the exposure container

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NOTE In the secured position, the exposure container may be unlocked.

3.17**simulated source**

source whose structure is the same as that of the sealed radioactive source but not containing any radioactive material

3.18**source assembly**

source holder with a sealed source attached or included

NOTE In cases where the sealed source is directly attached to the control cable without the use of a source holder, the source assembly is the control cable with the sealed source attached. In cases where the sealed source is not attached to the control cable nor included within the source holder, the sealed source is the source assembly. In the case where a simulated source is attached to or included with a source holder or control cable, this becomes a simulated source assembly.

3.19**source holder**

holder, or attachment device, by means of which a sealed source or simulated source can be directly included in the exposure container (category I apparatus), or fitted at the end of the control cable (category II apparatus)

NOTE Source holders may be an integral part of the source assembly or may be capable of being dismantled for sealed source replacement.

3.20**working position**

condition of the exposure container and source assembly, when in the position intended for performance of industrial gamma radiography

4 Classification**4.1 Classification of exposure containers according to the location of the source assembly when the apparatus is in the working position****4.1.1 Category I**

Exposure container from which the source assembly is not removed for exposure (e.g. see Figure 1).

4.1.2 Category II

Exposure container from which the source assembly is projected out through a projection sheath to the exposure head for exposure. The projection is remotely operated (e.g. see Figure 2).

4.1.3 Category X

Apparatus for gamma radiography designed for special applications where the unique nature of the special application precludes full compliance with this International Standard, for example:

- self propelled intra-tubular gamma radiography apparatus (pipe-line crawler);
- gamma radiography apparatus for underwater use.

The exposure container shall comply with this International Standard to the maximum extent possible. Exceptions and items of non-compliance shall be described in the addenda.

4.2 Classification of exposure containers according to their mobility

4.2.1 Class P

Portable exposure container, designed to be carried by one or more persons. The mass shall be not more than 50 kg.

4.2.2 Class M

Mobile, but not portable, exposure container designed to be moved easily by suitable means provided for the purpose.

4.2.3 Class F

Fixed installed exposure container, or one with mobility restricted to the confines of a defined working location.

5 Specifications

5.1 General design requirements

5.1.1 Apparatus for industrial gamma radiography shall be designed for the conditions likely to be encountered in use.

5.1.2 The design of class P and M apparatus shall ensure that the apparatus withstands the effects of corrosion under the intended conditions of use.

5.1.3 The design of class P and M apparatus shall ensure continued operation under environmental conditions of moisture, mud, sand and other foreign materials.

NOTE If feasible, a test for continued operation under environmental conditions of moisture, mud, sand and other foreign materials, will be developed and will be issued as an addendum.

5.1.4 The design of the apparatus shall ensure satisfactory operation over the temperature range $-10\text{ }^{\circ}\text{C}$ to $45\text{ }^{\circ}\text{C}$.

5.1.5 The operating voltage and the insulation resistance of electric circuits of power-operated apparatus for industrial gamma radiography shall comply with the relevant IEC standards.

5.1.6 The design of the apparatus shall ensure that any non-metallic components (e.g. rubber, plastics, jointing and sealing compounds, lubricants) will not suffer any damage from radiation that will diminish the safety of the apparatus during its design life as specified by the manufacturer.

5.1.7 Putting the exposure container outside or into the secured position shall be possible without bringing parts of the human body into the beam of radiation.

5.1.8 Connecting or disconnecting the projection sheath and/or the remote control from the exposure container shall be possible without bringing parts of the human body into areas where the ambient equivalent dose rate exceeds 2 mSv/h (200 mrem/h).

5.1.9 The design of any replacement component, including the source assembly, shall ensure that its interchange with the original component will not compromise the design safety features of the apparatus.

5.1.10 For class P and M exposure containers, the design of the apparatus shall provide appropriate means for the secure mounting of the remote control and projection sheath (if applicable) to the exposure container in different positions of use.