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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Radiation protection instrumentation – Environmental, electromagnetic and mechanical performance requirements

Instrumentation pour la radioprotection – Exigences de performances environnementales, électromagnétiques et mécaniques

IEC 62706:2012

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RADIATION PROTECTION INSTRUMENTATION – ENVIRONMENTAL, ELECTROMAGNETIC AND MECHANICAL PERFORMANCE REQUIREMENTS

FOREWORD

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International Standard IEC 62706 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/744/FDIS	45B/753/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- withdrawn,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

Radiation protection instrumentation including those instruments used for the detection and identification of radioactive material and radionuclides are used in many different environments. They are typically exposed to different temperatures, humidity levels, electromagnetic fields, and mechanical stresses such as shock and vibration during normal use. Radiation instrumentation may be worn, hand carried, mounted to a vehicle, transported from location to location, or installed. All of the conditions associated with these very different uses should be considered when developing instrument-specific requirements. In order to ensure consistency between standards, this environmental, electromagnetic, and mechanical performance requirements standard was established.

RADIATION PROTECTION INSTRUMENTATION – ENVIRONMENTAL, ELECTROMAGNETIC AND MECHANICAL PERFORMANCE REQUIREMENTS

1 Scope and object

This International Standard establishes the environmental, mechanical and electromagnetic performance requirements and methods of test for radiation protection instrumentation.

The object of this standard is to define, for design and test purposes, the environments in which radiation protection instrumentation may be exposed. The environments addressed by this standard are applicable to body-worn (e.g., personal radiation detectors, backpack, and dosemeters), hand carried, portable and transportable, mobile, or installed instrumentation.

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 60050-393, *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 60529, *Degrees of protection provided by enclosures (IP code)*

IEC 60721-3-5, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 5: Ground vehicle installations*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and masurement 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 61000-4-5, *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 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

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

3 Terms and definitions, abbreviations, quantities and units

3.1 Terms and definitions

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

3.1.1
body-worn instrument
radiation instruments that are worn on the trunk or the extremities of the body while being used

3.1.2
handheld or portable instrument
radiation instruments that are used while being held

3.1.3
influence quantity
quantity that is not the measurand but that affects the result of the measurement

Note 1 to entry: For example, temperature of a micrometer used to measure length.

[SOURCE: IEC 60050-394:2007, 394-40-27; GUM B.2.10]

3.1.4
influence quantity of type F
influence quantity whose effect on the indicated value is a change in response

Note 1 to entry: Examples are changes in the indicated value due to radiation energy or angle of radiation incidence.

Note 2 to entry: "F" stands for factor: The indication due to radiation is multiplied by a factor due to the influence quantity (e.g., the indication due to Co-60 radiation is 1,2 times that due to Cs-137 radiation).

3.1.5
influence quantity of type S
influence quantity whose effect on the indicated value is a deviation independent of the indicated value

Note 1 to entry: Examples include changes, either positive or negative, in the indicated value from exposure to an electromagnetic disturbance or microphonics.

Note 2 to entry: "S" stands for sum: The indication is the sum of the indication due to radiation and due to the influence quantity, e.g., electromagnetic disturbance.

3.1.6
installed instrument
radiation instruments that are permanently mounted at a location for use

3.1.7
transportable instrument
radiation instruments that may be moved to different locations and do not operate while in transit

3.1.8
mobile instrument
radiation instruments that are mounted to moving platforms and operate while in motion

3.2 Abbreviations

ESD electrostatic discharge
RF radio frequency
EM Electromagnetic
DC direct current
AC alternating current

3.3 Quantities and units

In the present standard, units of the International System (SI) are used[1]. The definitions of radiation quantities are given in IEC 60050-393 and IEC 60050-394. The corresponding old units (non SI) are indicated in brackets.

Nevertheless, the following units may also be used:

– for energy: electron-volt (symbol: eV), 1 eV = 1,602 × 10^{-19} J;
– for time: years (symbol: y), days (symbol: d), hours (symbol: h), minutes (symbol: min).

Multiples and submultiples of SI units will be used, when practicable, according to the SI system.

4 General requirements

This standard does not define the general requirements for systems or devices used to perform individual tests. General requirements are addressed in the instrument-specific standard.

5 General test procedure

5.1 Nature of tests

This standard provides the environmental, mechanical, and electromagnetic performance requirements and methods of tests for radiation detection systems. The tests are based on existing IEC standards for electronic equipment and field-use experience.

For a given instrument type, the project leader may use requirements from other instrument types.

5.2 Reference conditions and standard test conditions

Table 1 contains the reference and standard test conditions. Reference conditions are those conditions to which the performances of the device are valid and standard test conditions indicate the necessary tolerances in practical testing.

5.3 Use of this standard

5.3.1 General

This standard provides the environmental, mechanical, and electromagnetic performance requirements and methods of tests when developing new or revising existing standards. These requirements should be established based on the type of instrument (e.g., portable) and its expected use (e.g., indoor or outdoor) as defined in Clause 3.

1 International Bureau of Weights and Measures: The International System of Units, 8th edition, 2006.

5.3.2 Requirements for influence quantities

5.3.2.1 General

Unless stated otherwise the functional requirements established in an instrument-specific standard shall be given in terms of change in functionality (e.g., alarm activation, loss of display, etc.) or indicated reading (e.g., ±15 % of the average reading obtained in standard conditions).

The instrument specific standard should indicate whether an influence quantity usually acts as type S or F. The radiation level chosen for each test should be based on the type of influence quantity as described in 5.3.2.2 and 5.3.2.3.

5.3.2.2 Tests for influence quantities of type S

These tests should be performed at an ambient dose equivalent (rate) that is low enough to ensure that an effect from the test is measureable (e.g., 10 times the lower limit of the effective range of measurement but not zero in order to be able to detect a reduction in the indication).

5.3.2.3 Tests for influence quantities of type F

These tests may be performed at any ambient dose equivalent (rate). The ambient dose equivalent (rate) chosen should be high enough to ensure that statistical fluctuations are small enough to demonstrate whether the requirement is met (e.g., at least 10 times above the lower limit of the measuring range).

5.3.3 Environmental requirements

Environmental requirements apply to different types of radiation systems based on their design and expected use. The environmental requirements that apply to a specific instrument are addressed by that instrument-specific standard. As a minimum ambient temperature and relative humidity tests are required for all types of radiation detection systems. Other environmental conditions shall be established as deemed appropriate by the project leader.

The following example text could be used in an individual standard as reference to this standard: "The equipment shall undergo the tests specified in IEC 62706 "Environmental, mechanical, and electromagnetic requirements for radiation protection instrumentation" concerning the ambient temperature, relative humidity, and other metrological requirements for [insert instrument designation here, i.e., body-worn, handheld, installed, etc.] instrumentation." It is advisable not to insert the year of publication in the normative references citing IEC 62706. Thus, the latest edition of this standard will be considered.

5.3.4 Mechanical requirements

Mechanical requirements apply to different types of radiation systems based on their design and expected use. The mechanical requirements that apply to a specific system are addressed by that specific standard. As a minimum, vibration, mechanical shock, and impact are required for all types of radiation detection systems.

The following example text could be used in an individual standard as reference to this standard: "The equipment shall undergo the tests specified in IEC 62706 "Environmental, mechanical, and electromagnetic requirements for radiation protection instrumentation" concerning the mechanical requirements for [insert instrument designation here, i.e., body-worn, handheld, installed, etc.] instrumentation." It is advisable not to insert the year of publication in the normative references citing IEC 62706. Thus, the latest edition of this standard will be considered.

5.3.5 Electromagnetic requirements

Electromagnetic requirements apply to different types of radiation systems based on their design and expected use. The electromagnetic requirements that apply to a specific system are addressed by that specific standard. As a minimum, radio frequency immunity and emissions are required for all types of radiation detection systems.

The following example text could be used in an individual standard as reference to this standard: "The equipment shall undergo the tests specified in IEC 62706 "Environmental, mechanical, and electromagnetic requirements for radiation protection instrumentation" concerning the electromagnetic requirements for [insert instrument designation here, i.e., body-worn, handheld, installed, etc.] instrumentation." It is advisable not to insert the year of publication in the normative references citing IEC 62706. Thus, the latest edition of this standard will be considered.

5.3.6 Functionality test

A functionality test verifying that the effects from an influence are within the instrument-specific acceptance range shall be defined in the instrument-specific standard. These tests are generally performed before, during and after the environmental conditions tests such as temperature, humidity and electromagnetic, and before and after the mechanical disturbances. Appropriate radiation sources specific to the type of instrument under test should be used.

Functionality tests may include the following verifications:

- Instrument readings are within a specific range before and after exposure to an influence quantity (e.g., post-test instrument readings are within ± x % of the pre-test value).
- No alarms, radionuclide identifications, increase or decrease in readings, or spurious indications are observed during exposure to an influence quantity without the presence of a radiation source.
- The instrument radionuclide identification capabilities are not degraded after exposure to an influence quantity.

5.3.7 Additional requirements and test methods

Additional or alternative requirements and methods of test may be established in the specific standard at the discretion of the project leader.

6 Radiation detection requirements

Radiation detection requirements are addressed in the instrument-specific standard.

7 Environmental requirements

7.1 General

Instruments may consist of multiple components that form a system, e.g., a dosimetry system includes the reader and individual dosemeters. Individual components may be exposed to different environments. Selection of environmental requirements shall consider the expected conditions in which each component will be used. During testing, those components that will not be exposed to an influence field (e.g., temperature) may be separated from the overall system.