IEC 62706

Edition 2.0 2019-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Radiation protection instrumentation – Recommended climatic, electromagnetic and mechanical performance requirements and methods of tests

Instrumentation pour la radioprotection – Exigences recommandées en matière de performances climatiques, électromagnétiques et mécaniques et méthodes d'essai

IEC 62706:2019-11(en-fr)

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RADIATION PROTECTION INSTRUMENTATION – RECOMMENDED CLIMATIC, ELECTROMAGNETIC AND MECHANICAL PERFORMANCE REQUIREMENTS AND METHODS OF TESTS

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.

This second edition cancels and replaces the first edition, issued in 2012. This edition constitutes a technical revision.

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

a) addition of more details to selected methods of test;
b) revised radio frequency testing requirements based on measurements made at various locations;
c) added equipment and instrument setup guidance and recommendations.

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

FDIS	Report on voting
45B/942/FDIS	45B/947/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document 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- withdrawn,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 detection instrumentation may be worn on the body, handheld, mounted to a vehicle, transported from location to location, or installed. All the conditions associated with these very different uses are considered when developing instrument-specific requirements. To ensure consistency between standards, this climatic, electromagnetic, and mechanical performance requirements standard was established.

RADIATION PROTECTION INSTRUMENTATION – RECOMMENDED CLIMATIC, ELECTROMAGNETIC AND MECHANICAL PERFORMANCE REQUIREMENTS AND METHODS OF TESTS

1 Scope

This document recommends the climatic, mechanical and electromagnetic performance requirements and methods of test for radiation protection instrumentation. This document also provides guidance regarding the setup of test equipment and instruments under test (IUT) for certain tests.

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

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 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-5, *Environmental testing – Part 2-5: Tests – Test S: Simulated solar radiation at ground level and guidance for solar radiation testing and weathering*

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-18, *Environmental testing – Part 2-18: Tests – Test R and guidance: Water*

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

IEC 60068-2-64, *Environmental testing – Part 2-64: Tests – Test Fh: Vibration, broadband random and guidance*

IEC 60068-2-66, *Environmental testing – Part 2-66: Test methods – Test Cx: Damp heat, steady state (unsaturated pressurized vapour)*

IEC 60068-2-68, *Environmental testing – Part 2-68: Tests – Test L: Dust and sand*

IEC 60529, *Degrees of protection provided by enclosures (IP code)*

IEC 60721-2-7, *Classification of environmental conditions – Part 2-7: Environmental conditions appearing in nature. Fauna and flora*

IEC 60721-3-4, *Classification of environmental conditions – Part 3-4: Classification of groups of environmental parameters and their severities – Stationary use at non-weather protected locations*

IEC 60721-3-5, *Classification of environmental conditions – Part 3-5: 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 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 61000-4-5, *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*

IEEE/ANSI C63.4, *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz*

3 Terms and definitions, abbreviated terms and symbols, quantities and units

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-395, as well as the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

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

3.1.2
g_n
standard acceleration due to the earth's gravity, which itself varies with altitude and geographical latitude

3.1.3
handheld or portable instruments
radiation detection instruments that are used while being held

3.1.4
influence quantity
quantity that is not the measurand but that affects the result of the measurement

[SOURCE: ISO/IEC Guide 98-3 (GUM): 2008, B.2.10]

3.1.5
influence quantity of type F
influence quantity whose effect on the indicated value is a change in response

Note 1 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 ^{60}Co radiation is 1,2 times that due to ^{137}Cs radiation).

Note 2 to entry: An example of a type F influence is when an instrument's response changes as a result of the radiation energy or angle of radiation incidence.

3.1.6
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: "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.

Note 2 to entry: An example of a type S influence includes positive or negative changes in an instrument's indication as a result of exposure to an electromagnetic disturbance or microphonic condition.

3.1.7
installed instruments
radiation detection instruments that are permanently mounted at a location for use

3.1.8
transportable instruments
radiation detection instruments that may be moved to different locations and do not operate while in transit

3.1.9
mobile instruments
radiation detection instruments that are mounted to moving platforms and operate while in motion

3.2 Abbreviated terms and symbols

CISPR	Comité International Spécial des Perturbations Radioélectriques
ESD	electrostatic discharge
IUT	instrument under test
RF	radio frequency
EM	electromagnetic
DC	direct current
AC	alternating current

3.3 Quantities and units

In this document, units of the International System (SI) are used[1]. The definitions of radiation quantities are given in IEC 60050-395.

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

The following units may also be used:

- for energy: electron-volt (symbol: eV), 1 eV = 1,602 x 10^{-19} J;
- for time: years (symbol: y), days (symbol: d), hours (symbol: h), minutes (symbol: min):
- for temperature: degrees Celsius (symbol: ºC), 0 ºC = 273,15 K.
- for acceleration: multiples of g (gravity) with g = 9,81 $m \cdot s^{-2}$

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

4 General characteristics and requirements

This document does not define the general characteristics and requirements for test 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 document recommends the climatic, mechanical and electromagnetic performance requirements and methods of test for radiation protection instrumentation. The tests are based on existing IEC standards for electronic equipment and field-use experience. This document also provides guidance regarding IUT set up for individual tests that have been identified as being complicated to perform.

For a given radiation instrument specific standard, other requirements or those requirements from other instrument types may be used.

5.2 Standard test conditions

Table 1 contains the standard test conditions. Standard test conditions indicate the necessary tolerances in practical testing.

Table 1 – Standard test conditions

Influence quantity	Standard test conditions
Ambient temperature	18 °C to 25 °C
Relative humidity	< 75 %
Atmospheric pressure	86 kPa to 106,6 kPa
Electromagnetic field of external origin	Less than the lowest value that causes interference
Magnetic induction of external origin	Less than twice the induction due to the earth's magnetic field

5.3 Use of this document

5.3.1 General

This document provides the climatic, electromagnetic and mechanical 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., handheld) and its expected use (e.g., indoor or outdoor) as defined in 3.1.

5.3.2 Recommendations 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. In case the type of influence quantity is unknown (S or F), then tests should be performed according to both types (S and F), i.e., according to 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 a dose (rate) that is low enough to ensure that an effect from the test is measurable (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

For these tests, the dose (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 Climatic requirements

Climatic requirements apply to different types of radiation detection instruments based on their design and expected use. The climatic requirements that apply to a specific instrument type are addressed by that instrument-specific standard. As a minimum, ambient temperature and relative humidity tests should be required for all types of radiation detection instruments. Other climatic conditions should be established as appropriate for the expected conditions of use.

The following example text may be used in an individual standard as reference to this document: "The instrument shall undergo the tests specified in IEC 62706, Clause 7, concerning the climatic 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 document will be considered.

5.3.4 Mechanical requirements

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

The following example text may be used in an individual standard as reference to this document: "The instrument shall undergo the tests specified in IEC 62706, Clause 8, 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 document will be considered.

5.3.5 Electromagnetic requirements

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

The following example text may be used in an individual standard as reference to this document: "The instrument shall undergo the tests specified in IEC 62706, Clause 9, 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 document will be considered.

5.3.6 Functionality test

A functionality test verifying that the effects from a climatic, electromagnetic, or mechanical test condition are within the instrument-specific acceptance range shall be defined in the instrument-specific standard. These tests are generally performed before, during and after electromagnetic and climatic testing (e.g., temperature and humidity), and before and after mechanical tests. Appropriate radiation sources specific to the type of IUT 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 as appropriate for the radiation detection instrument and its expected use.

6 Radiation detection requirements

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

7 Climatic 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 climatic 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 for example, temperature changes, may be separated from the overall system.

If the instrument can be powered by batteries and AC power, select the method that represents the manner that the instrument will most likely be powered during use. If the instrument cannot function on a single battery charge for the duration of the test and can be powered by AC, use AC power for the test. If the instrument cannot run on AC power, replace the batteries as needed throughout the test.