IEC 61098

Edition 3.0 2023-02

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Radiation protection instrumentation – Installed personnel surface contamination monitors

Instrumentation pour la radioprotection – Moniteurs fixes pour la surveillance de la contamination de surface du personnel

IEC 61098:2023-02(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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RADIATION PROTECTION INSTRUMENTATION – INSTALLED PERSONNEL SURFACE CONTAMINATION MONITORS

FOREWORD

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IEC 61098 has been prepared by subcommittee 45B: Radiation protection instrumentation, of IEC technical committee 45: Nuclear instrumentation. It is an International Standard.

This third edition cancels and replaces the second edition published in 2003. This edition constitutes a technical revision.

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

a) Title is modified.
b) As an alternative of small area sources, area sources are added to be used for methods of test with respect to the variation of response with source position, effective instrument efficiency, detection limit (DL), and variation of response with energy.
c) Detection limit (DL) complies with the ISO 11929 series.
d) Descriptions of influence quantities of type F and type S are added.
e) Consistency with IEC 62706 is promoted for environmental requirements, mechanical requirements, electromagnetic compatibility and methods of test.
f) Descriptions of overhead detectors are added.

g) Descriptions of friskers are added with respect to the hand and foot monitoring.

h) Figures are made easier to understand the relation between the detector position and the response, and the positional relation between the detector surface and the source.

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

Draft	Report on voting
45B/1020/FDIS	45B/1026/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, ISO/IEC Directives and IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/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 in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended

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RADIATION PROTECTION INSTRUMENTATION – INSTALLED PERSONNEL SURFACE CONTAMINATION MONITORS

1 Scope

This document applies to contamination monitors that include warning assembles and meters used for the monitoring of radioactive contamination on the surface of personnel whether they be clothed or not. The document is applicable only to that type of equipment where the user stays at the monitor. It is not applicable to the user passes quickly through the monitor. It is also not applicable to any peripheral equipment which can be associated with a particular type of equipment such as small article monitors. Probes (friskers) for measuring clothes or body by the person under monitoring or someone else are included in this document. The probes (friskers) are always connected to the monitor.

This document is applicable to the monitoring of the whole body (including the head), hands and feet, but parts of this document can be used for monitors designed for the monitoring of radioactive contamination on the hands and/or feet only. This document does not include tritium measurement.

This document is applicable to:

– installed personnel monitor (all clauses applicable);
– transportable personnel monitor (all clauses applicable);
– monitor for monitoring the hands (see the following clauses and subclauses: 2, 3, 4, 5, 6, 7.1.3, 7.2, 7.3.4, 7.4.2.2 b), 7.4.3, 7.4.4.1, 7.4.4.2, 7.4.4.3 b), 7.5, 7.6, 7.7, 8, 9, 10, 11, 12, 13 and 14);
– monitor for monitoring the feet (see the following clauses and subclauses: 2, 3, 4, 5, 6, 7.1.4, 7.2, 7.3.5, 7.4.2.2 c), 7.4.3, 7.4.4.1, 7.4.4.2, 7.4.4.3 c), 7.5, 7.6, 7.7, 8, 9, 10, 11, 12, 13 and 14); and
– monitor for monitoring the hands and feet (including probe (frisker) for whole body measurement) (see the following clauses and subclauses: 2, 3, 4, 5, 6, 7.1.3, 7.1.4, 7.1.5, 7.2, 7.3.4, 7.3.5, 7.3.6, 7.4.2.2 b), 7.4.2.2 c), 7.4.2.2 d), 7.4.3, 7.4.4.1, 7.4.4.2, 7.4.4.3 b), 7.4.4.3 c), 7.4.4.3 d),7.5, 7.6, 7.7, 8, 9, 10, 11, 12, 13 and 14).

The object of this document is to define mechanical and operational characteristics, minimum performance characteristics and general test procedures for personnel monitors.

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, *International Electrotechnical Vocabulary (IEV) – Part 395: Nuclear instrumentation – Physical phenomena, basic concepts, instruments, systems, equipment and detectors*, available at www.electropedia.org

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

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

IEC 62706, *Radiation protection instrumentation – Recommended climatic, electromagnetic and mechanical performance requirements and methods of tests*

ISO 8769:2020, *Measurement of radioactivity – Alpha-, beta- and photon emitting radionuclides – Reference measurement standard specifications for the calibration of surface contamination monitors*

3 Terms, definitions, units and symbols

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions, as well as those given in IEC 60050-395 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
surface emission rate
<of a source> number of particles or photons of a given type above a given energy emerging from the face of the source or its window per time in a mass-free environment

[SOURCE: ISO 8769:2020, 3.1, modified – Word "second" replaced with "time" in the definition.]

3.1.2
source efficiency
ε_S
ratio between the number of particles of a given type above a given energy emerging from the face of the source or its window per unit time (surface emission rate) and the number of particles of the same type created or released within the source (for a thin source) or its saturation layer thickness (for a thick source) per unit time

3.1.3
small area source
source whose active surface area has a maximum linear dimension not exceeding 2,5 cm

3.1.4
surface emission rate response
<instrument efficiency> under stated conditions specified by the manufacturer (sensitive area of the detector, active area of the source and the distance between source and detector), ratio of the number of detected particles (for instance counts per unit time, corrected for background) to the number of particles of the same type emitted by the radiation source in the same interval of time (conventionally true surface emission rate)

3.1.5
sensitive area of the detector
area of the detector, defined by the manufacturer, where the efficiency for a small area source is greater than 50 % of the maximum efficiency

3.1.6
total equivalent thickness
thickness, generally expressed in mass per unit area, that a particle (alpha or beta) emitted normally from the contaminated surface crosses in order to reach the sensitive volume of the detector

Note 1 to entry: This thickness includes the distance in the air plus the detector window thickness and, sometimes, the thickness of any screen fitted over the detector window which protects it from contamination.

3.1.7
effective range of measurement
absolute value of the difference between the two limits of a nominal range

3.1.8
response
R
ratio of the indicated value of a monitor M_i to the conventional true value M_t

$$R = \frac{M_i}{M_t}$$

3.1.9
relative error of indication
I
quotient of the error of indication of a measured quantity $M_i - M_t$ by the conventional true value M_t of the quantity

Note 1 to entry: It may be expressed as a percentage.

$$I = \frac{M_i - M_t}{M_t} \times 100$$

3.1.10
relative intrinsic error
relative error of indication of an assembly with respect to a quantity when subjected to a specified reference radiation under specified reference conditions

3.1.11
coefficient of variation
V

ratio V of the standard deviation s to the value of the arithmetic mean $\bar{x}$ of a set of n measurements x_i given by the following formula:

$$V = \frac{s}{\bar{x}} = \frac{1}{\bar{x}}\sqrt{\frac{1}{n-1}\sum_{i-1}^{n}(x_i - \bar{x})^2}$$

3.1.12
deviation
D

difference between the indicated values for the same value of the measured quantity, when made under reference conditions and when subject to an influence quantity

$$D = M_{\mathrm{i}} - M_{\mathrm{t}}$$

where

M_{i} is the indicated value of a monitor;

M_{t} is the conventional true value

Note 1 to entry: The deviation can be positive or negative resulting in an increase or a decrease of the indicated value, respectively.

Note 2 to entry: The deviation is of special importance for influence quantities of type S.

3.1.13
lower limit of effective range of measurement
A_0

minimum activity or activity concentration to be measured over which the performance of a monitor meets the requirement of its specifications

3.1.14
decision threshold
y^*

value of the estimator of the measurand, which, when exceeded by the result of an actual measurement using a given measurement procedure of a measurand quantifying a physical effect, is used to decide that the physical effect is present

Note 1 to entry: The decision threshold is defined such that in cases where the measurement result y exceeds the decision threshold y^*, the probability that the true value of the measurand is zero is less or equal to a chosen probability α.

Note 2 to entry: If the result y is below the decision threshold y^*, the result cannot be attributed to the physical effect; nevertheless, it cannot be concluded that it is absent.

[SOURCE: ISO 11929-1:2019, 3.12, modified – Notes to entry rephrased.]

3.1.15
detection limit
DL
$y^{\#}$
smallest true value of the measurand which ensures a specified probability of being detectable by the measurement procedure

Note 1 to entry: With the decision threshold according to 3.1.15, the detection limit is the smallest true value of the measurand for which the probability of wrongly deciding that the true value of the measurand is zero is equal to a specified value β when, in fact, the true value of the measurand is not zero.

[SOURCE: ISO 11929-1:2019, 3.13, modified – Last sentence of Note 1 to entry removed, and Note 2 to entry deleted.]

3.1.16
conventional true value
best estimate of the value of that quantity

Note 1 to entry: This is usually the value determined by, or traceable to, a secondary or primary standard or by a reference instrument which has been calibrated against a secondary or primary standard.

3.1.17
frisker
probes for whole body monitoring attached to hand and/or foot contamination monitors

3.1.18
influence quantity of type F
influence quantity whose effect on the indicated value is a change in response

Note 1 to entry: An example is radiation energy and 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.

3.1.19
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: An example is the electromagnetic disturbance.

Note 2 to entry: All requirements for influence quantities of type S are given with respect to the value of the deviation D.

Note 3 to entry: "S" stands for sum. The indication is the sum of the indication due to radiation and due to the influence quantity.

3.1.20
ambient background
gamma radiation field in which the monitor is intended to operate which includes natural background and radiation due to radioactive sources and/or plants adjacent to the monitor

3.1.21
reference background
artificial background created to simulate the maximum ambient background for which the monitor is designed

Note 1 to entry: This background includes the naturally occurring background and additional radiation provided by a source of ^{137}Cs (or other radionuclide by agreement between the purchaser and manufacturer) placed at least 3 m from the detector of interest of the monitor under test.

3.1.22
uniformity of surface emission rate of sources
uniformity of a surface in respect to the surface emission rate in relation to the average surface emission rate

Note 1 to entry: For further information on area radioactive sources, refer to ISO 8769.

3.1.23
monitoring channel
system of assemblies or parts of assemblies enabling the signals from one or more detectors to show whether contamination is present or not on specific parts of the body, feet or hands

3.1.24
emission probability
probability of the emission of the particle or photon of interest per disintegration

3.1.25
effective instrument efficiency
E_{ff}
mean value of the instrument efficiency over the whole of the detector, used when the detection limit (DL) is determined

Note 1 to entry: In a case of using the detector for the body surface monitoring, the effective instrument efficiency is the mean value of the instrument efficiency distribution measured using a phantom.

3.1.26
qualification test
sets of tests performed in order to verify that the requirements of a specification are fulfilled

3.1.27
type test
conformity test made on one or more items representative of the production

Note 1 to entry: Type tests are qualification tests which are performed on one assembly or on a small number of assemblies considered to be representative of a standard production assembly, and which, in principle, are not repeated on each assembly.

[SOURCE: IEC 60050-151:2001, 151-16-16, modified – Note to entry added.]

3.1.28
routine test
conformity test made on each individual item during or after manufacture

[SOURCE: IEC 60050-151:2001, 151-16-17]

3.1.29
acceptance test
contractual test to prove to the customer that the item meets certain conditions of its specification

Note 1 to entry: Acceptance tests are, in general, selected from the qualification tests specified, but this selection is a contractual matter and does not form any part of this document.

[SOURCE: IEC 60050-151:2001, 151-16-23, modified – Note to entry added.]