Draft for Public Comment

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BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000
Fax: +44 (0)20 8996 7400
www.bsigroup.com

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Interested committees:

Title: Draft BS EN IEC 60325 Draft ED4. Radiation protection instrumentation - Alpha, beta and alpha/beta (beta energy >60 keV) contamination meters and monitors.

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iii) requires additional national guidance or information

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at **https://standardsdevelopment.bsigroup.com/**. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx

1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex **(e.g. 3.1)**	Paragraph/ Figure/Table/Note	**Type of comment**	**Commend (justification for change) by the MB**	**Proposed change by the MB**	**Secretariat observations on each comment submitted**
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

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45B/999/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER: **IEC 60325 ED4**	
DATE OF CIRCULATION: **2022-02-04**	CLOSING DATE FOR COMMENTS: **2022-04-29**
SUPERSEDES DOCUMENTS: **45B/998/RR**	

IEC SC 45B : RADIATION PROTECTION INSTRUMENTATION	
SECRETARIAT: France	SECRETARY: Mr Miroslav Voytchev
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY	

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

TITLE:

Radiation protection instrumentation – Alpha, beta and alpha/beta (beta energy >60 keV) contamination meters and monitors

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

RADIATION PROTECTION INSTRUMENTATION – ALPHA, BETA AND ALPHA/BETA (BETA ENERGY >60 keV) CONTAMINATION METERS AND MONITORS

FOREWORD

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International Standard IEC 60325 has been prepared by subcommittee 45B: Radiation protection instrumentation, of IEC technical committee 45: Nuclear instrumentation.

This fourth edition cancels and replaces the third edition published in 2002. This fourth edition constitutes a technical revision.

a) Measurement traceability to the national standard is required.

b) Uncertainty of measurement according to GUM is introduced.

c) Requirement to light protection is added.

d) Environmental requirements, mechanical requirements and electromagnetic compatibility are up-dated according to IEC 62706.

e) Relative intrinsic error is moved to ANNEX A (informative)

The text of this standard is based on the following documents:

FDIS	Report on voting
45B/***/FDIS	45B/***/RVD

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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 3.

The committee has decided that the contents of this publication will remain unchanged until 2007. At this date, the publication will be

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

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RADIATION PROTECTION INSTRUMENTATION – ALPHA, BETA AND ALPHA/BETA (BETA ENERGY >60 keV) CONTAMINATION METERS AND MONITORS

1 Scope and object

This International Standard is applicable to radiation meters and monitors designed for the direct measurement or the direct detection of surface contamination by alpha and/or beta radiation emitting nuclides and which comprise at least:

– a detection assembly (comprising counter tube, scintillation detector or semiconductor detector, etc), which may be connected either rigidly or by means of a flexible cable or incorporated into a single assembly.

– a measurement assembly.

Some meters and monitors consist of detection assemblies and measurement assemblies where it is possible to separate the detector assembly and use alternative detection assemblies. Conformity with the standard can either be achieved by:

All combinations of the detection assembly and the measurement assembly conforming to the requirements of this standard.

or

The detection assembly and the measurement assembly separately conforming to the relevant parts of this standard in isolation.

Note to entry: The use of the latter criteria verifies conformance with this standard but does not infer that calibration of a particular combination of instruments is interchangeable with any other combination.

The use of the latter criteria could allow a purchaser to use combinations of assemblies from different manufacturers with confidence.

The standard is applicable to:

– alpha surface contamination meters;

– alpha surface contamination monitors;

– beta surface contamination meters;

– beta surface contamination monitors;

– alpha/beta surface contamination meters;

– alpha/beta surface contamination monitors.

The latter two are equipment capable of determining alpha and beta contamination simultaneously and displaying the measurement of either:

– Alpha (beta, alpha/beta) surface contamination meter

– Alpha (beta, alpha/beta) surface contamination monitor.

This standard is also applicable to special purpose assemblies and to assemblies specifically designed for a surface of a particular nature. However, some of the requirements may need to be amended or supplemented according to the particular requirements applicable to such assemblies.

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If an assembly has been designed to carry out combined functions, it must comply with the requirements pertaining to these different functions. If, on the other hand, it has been designed to perform one function, and, in addition, it is also capable of carrying out other functions, then it must comply with the requirements for the first function, and it would be desirable for it to comply with requirements pertaining to the others.

This standard is not applicable to radiation monitors or meters designed to measure or detect beta particles with E_{max} < 60 keV.

The object of this standard is to lay down standard requirements and to give examples of acceptable methods, and also to specify general characteristics, general test conditions, radiation characteristics, electrical safety, environmental characteristics, and the requirements of the identification certificate for alpha, beta and alpha-beta contamination meters and monitors.

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 amendments) applies.

IEC 60038, *IEC standard voltages*

IEC 60050-151, *International Electrotechnical Vocabulary – Part 151: Electrical and magnetic devices*

IEC 60050(393):1996, *International Electrotechnical Vocabulary (IEV) – Chapter 393: Nuclear instrumentation: Physical phenomena and basic concepts*

IEC 60050(394):1995, *International Electrotechnical Vocabulary (IEV) – Chapter 394: Nuclear instrumentation: Instruments*

IEC 60068 (all parts): *Environmental testing*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4: Testing and measuring techniques – Section 2: Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 3: Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 4: Electrical fast transient/burst immunity test*

IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 6: Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 11: Voltage dips, short interruptions and voltage variations immunity tests*

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IEC 61187, *Electrical and electronic measuring equipment – Documentation*

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

ISO 7503 (all parts), *Evaluation of surface contamination*

ISO 8769, *Reference sources for the calibration or surface contamination monitors – Beta-emitters (maximum beta energy greater than 0,15 MeV) and alpha-emitters*

ISO 11929 (all parts): *Determination of the characteristic limits (decision threshold, detection limit and limits of the coverage interval) for measurements of ionizing radiation - Fundamentals and application-*

3 Terms and definitions

The general terminology concerning the detection and measurement of ionizing radiation and nuclear instrumentation is given in IEC 60050(393) and IEC 60050(394).

For the purposes of this International Standard, the following definitions apply:

3.1
effective range of measurement
range of values of the quantity to be measured over which the performance of a meter or monitor meets the requirements of this standard

3.2
surface emission rate (of a source), $q/2\pi$
number of particles of a given type above a given energy emerging from the front face of the source per unit time.

3.3
source efficiency, ε_s
ratio between the number of particles of a given type above a given energy emerging from the front face of a 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

3.4
high efficiency source
source in which the efficiency for particles with an energy greater than 5,9 keV is greater than 0,25, including backscattered particles. (This definition applies to beta emitters with a maximum energy >150 keV).

3.5
small area source
source whose active surface area has a maximum linear dimension not exceeding 1 cm

3.6
surface emission rate response (instrument efficiency)
under stated conditions specified by the manufacturer (sensitive area of the detector, active surface area of the source and the distance between source and detector), the surface emission rate response (efficiency) of the detector used in conjunction with the assemblies is the 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)

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3.7
response time (of a measuring assembly)
the time required after a step variation in the measured quantity for the output signal variation to reach a given percentage, usually 90 %, of its final value for the first time

[IEV 394-19-09]

Note to entry: For integrating measuring assemblies the response time is 90 % of the equilibrium value of the first derivative or slope of the indication.

3.8
sensitive area of the detector:
the area of the detector, defined by the manufacturer, where the efficiency for a small area source is greater than 50 % of the maximum efficiency

3.9
total equivalent thickness
the 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 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.

3.10
response *R*
the ratio of the indicated value of a monitor or meter, M_{i}, to the conventional true value, M_{t}.

$$R = \frac{M_{\mathrm{i}}}{M_{\mathrm{t}}}$$

3.11
relative error of indication *I*
the quotient of the error of indication of a measured quantity by the conventionally true value of the quantity. It may be expressed as a percentage

$$I = \frac{M_{\mathrm{i}} - M_{\mathrm{t}}}{M_{\mathrm{t}}} \times 100 \ \ [\%]$$

3.12
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

3.13
coefficient of variation *V*
the 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:

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

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3.14
detection limit of the surface emission rate per unit area
surface emission rate per unit area derived according to the procedure given in ISO 11929-1

Note to entry: With values of counting rates and counting times of an adequate size, a simplified formula for the counting rate at the lower limit of detection should be used. In the case of time preselection and known background counting rate, the following simplified formula applies:

$$R_{\mathrm{n}} = \left(k_{1-\alpha} + k_{1-\beta}\right)\sqrt{R_o\left(\frac{1}{t_{\mathrm{o}}} + \frac{1}{t_{\mathrm{b}}}\right)}$$

where

R_{n} is the net counting rate at the lower limit of detection;

R_0 is the background counting rate;

t_0 is the preselected time for background counting;

t_b is the preselected time for measurement;

$k_{1-\alpha}$ is the quantile of the normal law for a risk of errors of the first kind;

$k_{1-\beta}$ is the quantile of the normal law for a risk of errors of the second kind.

For instance, for $\alpha = \beta = 0{,}05$ $(k_{1-\alpha}) = (k_{1-\beta}) = 1{,}645$

$$R_{\mathrm{n}} = (1{,}645 + 1{,}645)\sqrt{R_0\left(\frac{1}{t_0} + \frac{1}{t_{\mathrm{b}}}\right)}$$

The detection limit of the surface emission rate for a specified radionuclide becomes

$$DL = \frac{R_{\mathrm{n}}}{S_{(\mathrm{nuclide})}A}$$

where

$S_{(\mathrm{nuclide})}$ is the surface emission rate response (see 3.6);

A is the sensitive area of the detection assembly.

The surface emission rate per unit area shall be expressed in $\mathrm{s}^{-1}\cdot\mathrm{cm}^{-2}$.

3.15
conventionally true value of a quantity
the best estimate of the value of that quantity

Note to entry: This will usually be 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.

3.16
detection assembly
assembly containing at least the detector

3.17
measurement assembly
an assembly displaying the level of contamination detected

3.18
alpha, beta or alpha/beta surface contamination meter
an assembly including one or more radiation detectors and associated assemblies or basic function units that is designed to measure respectively alpha (beta, alpha/beta) surface emission rate associated with the contamination of the surface under examination

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3.19
alpha beta or alpha/beta surface contamination monitor
respectively an alpha (beta, alpha/beta) activity meter provided with means for giving perceptible warning (generally visual and/or audible) that the indicated surface emission rate per unit surface area associated with the contamination of the surface under examination exceeds some adjustable predetermined value.

3.20
uncertainty of measurement
parameter, associated with the result of a measurement, that characterises the dispersion of the values that could reasonably be attributed to the measurand.

Note 1 to entry: This formal definition of the term "uncertainty of measurement" was developed for use in ISO/IEC Guide 98-3:2008, Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM 1995), and ISO/IEC Guide 99:2007, International vocabulary of metrology – Basic and general concepts and associated terms (VIM).

[SOURCE: IEV 815-17-19]

4 Units

In this standard, the units are the multiples and sub multiples of units of the International System of Units (SI)[1]. The following non-SI units are also used:

Time: years, days, hours (h), minutes (min)

For energy: electron-volt (eV) (1 eV = 1,602 × 10^{-19} J)

Note to entry: Definitions of the radiation quantities and dosimetric terms are given in IEC 60050(395).

5 Classification of assemblies

Assemblies are classified according to their status as:

- detection assemblies;
- measurement assemblies;
- complete contamination meters or monitors.

For measurement assemblies and complete contamination meters or monitors, according to their use as:

- transportable assemblies;
- handheld and portable assemblies.

For measurement assemblies and complete contamination meters or monitors, according to their power supplies as:

- mains;
- primary or secondary batteries.

For detection assemblies and complete contamination meters or monitors, according to the type of radiation as:

- alpha contamination meters or monitors,
- beta contamination meters or monitors,
- alpha/beta contamination meters or monitors.

[1] International Bureau of Weights and Measures: The International System of Units (SI), 9th edition 2019.

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