

Nuclear energy — Reference beta-particle radiation —

**Part 3: Calibration of area and personal
dosemeters and the determination of
their response as a function of beta
radiation energy and angle of incidence**

ICS 17.240

National foreword

This British Standard was published by BSI. It is the UK implementation of ISO 6980-3:2006. Together with BS ISO 6980-1:2006 and BS ISO 6980-2:2004, it supersedes BS ISO 6980:1996 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee NCE/2, Radiation protection and measurement.

A list of organizations represented on NCE/2 can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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Nuclear energy — Reference beta-particle radiation —

Part 3:

Calibration of area and personal dosemeters and the determination of their response as a function of beta radiation energy and angle of incidence

Énergie nucléaire — Rayonnement bêta de référence —

*Partie 3: Étalonnage des dosimètres individuels et des dosimètres de
zone et détermination de leur réponse en fonction de l'énergie et de
l'angle d'incidence du rayonnement bêta*



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Contents

Page

Foreword.....	iv
Introduction	v
1 Scope	1
2 Normative references	2
3 Terms and definitions.....	2
4 Procedures applicable to all area and personal dosimeters.....	9
4.1 General principles.....	9
4.2 Determination of the calibration factor and of the correction factor	12
5 Particular procedures for area dosimeters	13
5.1 General principles.....	13
5.2 Quantities to be measured.....	13
6 Particular procedures for personal dosimeters	13
6.1 General principles.....	13
6.2 Quantity to be measured.....	13
6.3 Experimental conditions	13
7 Presentation of results	15
7.1 Records and certificates	15
7.2 Statement of uncertainties.....	15
Annex A (normative) Symbols and abbreviated terms	17
Annex B (normative) Reference conditions	19
Annex C (informative) Conversion coefficients for some beta reference radiation fields	21
Bibliography	23

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 6980-3 was prepared by Technical Committee ISO/TC 85, *Nuclear energy*, Subcommittee SC 2, *Radiation protection*.

This first edition of ISO 6980-3, together with ISO 6980-1:2006 and ISO 6980-2:2004, cancels and replaces ISO 6980:1996, which has been technically revised.

ISO 6980 consists of the following parts, under the general title *Nuclear energy — Reference beta-particle radiation*:

- *Part 1: Methods of production*
- *Part 2: Calibration fundamentals related to basic quantities characterizing the radiation field*
- *Part 3: Calibration of area and personal dosimeters and the determination of their response as a function of beta radiation energy and angle of incidence*

Introduction

ISO 6980 covers the production, calibration and use of beta-particle reference radiation fields for the calibration of dosimeters and doserate meters for protection purposes. ISO 6980-1 describes the methods of production and characterization of the reference radiation. ISO 6980-2 describes procedures for the determination of absorbed dose rate to a reference depth of tissue from beta particle reference radiation fields. This part of ISO 6980 describes procedures for the calibration of dosimeters and doserate meters and the determination of their response as a function of beta-particle energy and angle of beta-particle incidence.

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Nuclear energy — Reference beta-particle radiation —

Part 3:

Calibration of area and personal dosimeters and the determination of their response as a function of beta radiation energy and angle of incidence

1 Scope

This part of ISO 6980 describes procedures for calibrating and determining the response of dosimeters and doserate meters in terms of the International Commission on Radiation Units and Measurements (ICRU) operational quantities for radiation protection purposes. However, as noted in ICRU Report 56, the ambient dose equivalent, $H^*(10)$, used for area monitoring of strongly penetrating radiation, is not an appropriate quantity for any beta radiation, even that which penetrates 10 mm of tissue ($E_{\max} > 2$ MeV).

For beta particles, the calibration and the determination of the response of dosimeters and doserate meters is essentially a three-step process. First, the basic field quantity, absorbed dose to tissue at a depth of 0,07 mm in a tissue-equivalent slab geometry is measured at the point of test, using methods described in ISO 6980-2. Then, the appropriate operational quantity is derived by the application of a conversion coefficient that relates the quantity measured (reference absorbed dose) to the selected operational quantity for the selected irradiation geometry. Finally, the reference point of the device under test is placed at the point of test for the calibration and determination of the response of the dosimeter. Depending on the type of dosimeter under test, the irradiation is either carried out on a phantom or free-in-air for personal and area dosimeters respectively. For individual and area monitoring, this part of ISO 6980 describes the methods and the conversion coefficients to be used for the determination of the response of dosimeters and doserate meters in terms of the ICRU operational quantities directional dose equivalent, $H'(0,07; \vec{\Omega})$ and personal dose equivalent, $H_p(0,07)$.

This part of ISO 6980 is a guide for those who calibrate protection-level dosimeters and doserate meters with beta-reference radiation and determine their response as a function of beta-particle energy and angle of incidence. Such measurements can represent part of a type test during the course of which the effect of other influence quantities on the response is examined. This part of ISO 6980 does not cover the *in situ* calibration of fixed, installed area dosimeters. The term “dosimeter” is used as a generic term denoting any dose or doserate meter for individual or area monitoring. In addition to the description of calibration procedures, this part of ISO 6980 includes recommendations for appropriate phantoms and the way to determine appropriate conversion coefficients. Guidance is provided on the statement of measurement uncertainties and the preparation of calibration records and certificates.

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.

International vocabulary of basic and general terms in metrology (VIM), BIPM/IEC/IFCC/ISO/IUPAC/IUPAP/OIML

ISO 6980-2:2004, Nuclear energy — Reference beta-particle radiation — Part 2: Calibration fundamentals related to basic quantities characterizing the radiation field

ICRU Report 51, *Quantities and Units in Radiation Protection Dosimetry*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ICRU Report 51, *VIM* and the following apply.

3.1
ICRU tissue
material with a density of $1 \text{ g}\cdot\text{cm}^{-3}$ and a mass composition of 76,2 % oxygen, 10,1 % hydrogen, 11,1 % carbon, and 2,6 % nitrogen

NOTE See ICRU Report 39.

3.2
maximum beta energy
 E_{max}
highest value of the energy of beta particles emitted by a particular nuclide which can emit one or several continuous spectra of beta particles with different maximum energies

3.3
mean beta energy
 $\bar{E}$
fluence average energy of the beta particle spectrum at the calibration distance

3.4
residual maximum beta energy
 E_{res}
highest value of the energy of a beta particle spectrum at the calibration distance, after having been modified by scatter and absorption

3.5
absorbed dose
 D
quotient of $d\bar{\varepsilon}$ by dm where $d\bar{\varepsilon}$ is the mean energy imparted by ionizing radiation to matter of mass, dm

$$D = \frac{d\bar{\varepsilon}}{dm} \quad (1)$$

NOTE The unit of the absorbed dose is joule per kilogram ($\text{J}\cdot\text{kg}^{-1}$) with the special name, gray (Gy).