
Reference neutron radiations —

Part 2:

**Calibration fundamentals of radiation
protection devices related to the basic
quantities characterizing the radiation field**

Rayonnements neutroniques de référence —

*Partie 2: Concepts d'étalonnage des dispositifs de radioprotection en
relation avec les grandeurs fondamentales caractérisant le champ de
rayonnement*

get full document from standards.iteh.ai



Reference number
ISO 8529-2:2000(E)

© ISO 2000

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

Sample Document

get full document from standards.iteh.ai

© ISO 2000

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

Contents

Page

Foreword.....	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms, definitions and symbols	2
4 Calibration and traceability of the reference radiation field	4
5 Calibration principles for calibrations with radionuclide neutron sources	5
6 Correction for scattering effects for radionuclide sources	8
7 Linearity determination	15
8 Calibrations using accelerators and reactors	15
9 Special considerations for personal dosimeters	18
10 Uncertainties	18
Annex A (informative) List of symbols used in this part of ISO 8529	22
Annex B (informative) Minimum room lengths for 40 % room return (reference [11])	24
Annex C (normative) Air-attenuation correction factors	25
Annex D (informative) Total air-scatter correction	26
Annex E (informative) Criteria for construction and use of shadow cones	27
Annex F (informative) Illustration of the parameters and variables for the reduced-fitting method	29
Bibliography	30

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 3.

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 part of ISO 8529 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 8529-2 was prepared by Technical Committee ISO/TC 85, *Nuclear energy*, Subcommittee SC 2, *Radiation protection*.

ISO 8529 consists of the following parts, under the general title *Reference neutron radiations*:

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

Annex C forms a normative part of this part of ISO 8529.

Annexes A, B, D, E and F are for information only.

Introduction

This part of ISO 8529, and its companion standards ISO 8529-1 and ISO 8529-3, apply to the calibration of personal dosimeters and to area-survey instruments.

Reviews of the physical characteristics of personal dosimeters are given by Griffith *et al.* [1]. Reviews of calibration procedures are given by Eisenhauer *et al.* [2] and by Burger and Schwartz [3].

More details concerning the characteristics of area-survey instruments, and of their calibration requirements and procedures are given in publications [3,4,5] in the bibliography. Complete definitions of radiation quantities and units can be found in ICRP 51, ICRP 74, ICRU 33, ICRU 39, ICRU 43, ICRU 47, ICRU 51, ICRU 57 (see [24] and [28] to [32] in the bibliography) and ISO 8529-1. The actual procedures for calibrating these devices are given in ISO 8529-3.

Sample Document

get full document from standards.iteh.ai

Reference neutron radiations —

Part 2:

Calibration fundamentals of radiation protection devices related to the basic quantities characterizing the radiation field

1 Scope

This part of ISO 8529 takes as its starting point the neutron sources described in ISO 8529-1. It specifies the procedures to be used for realizing the calibration conditions of radiation protection devices in neutron fields produced by these calibration sources, with particular emphasis on the corrections for extraneous effects (e.g., the neutrons scattered from the walls of the calibration room).

In this part of ISO 8529, particular emphasis is placed on calibrations using radionuclide sources (clauses 4 to 6) due to their widespread application, with less details given on the use of accelerator and reactor sources (8.2 and 8.3).

This part of ISO 8529 then leads to ISO 8529-3 which gives conversion coefficients and the general rules and procedures for calibration.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 8529. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 8529 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ICRU Report 33:1980, *Radiation Quantities and Units*.

ICRU Report 60:1998, *Fundamental Quantities and Units for Ionizing Radiation*.

ISO 8529-1:—¹⁾, *Reference neutron radiations — Part 1: Characteristics and methods of production*.

ISO 8529-3:1998, *Reference neutron radiations — Part 3: Calibration of area and personal dosimeters and determination of their response as a function of neutron energy and angle of incidence*.

ISO 12789:—¹⁾, *Reference neutron radiations — Characteristics and methods of production of simulated workplace neutron fields*.

BIPM/IEC/IFCC/ISO/IUPAC/IUPAP/OIML:1993, *International vocabulary of basic and general terms in metrology*.

1) To be published.

3 Terms, definitions and symbols

For the purposes of this part of ISO 8529, the terms and definitions given in ICRU Reports 33 and 60 and the *International vocabulary of basic and general terms in metrology*, and the following apply.

The symbols used in this part of ISO 8529 are listed in annex A.

3.1 reading

M
value of the quantity indicated by an instrument

3.2 conventional true value of a quantity

best estimate of the value of the quantity to be measured

NOTE A conventional true value is, in general, regarded as being sufficiently close to the true value for the difference to be insignificant for the given purpose

3.3 dose equivalent

H
product of Q and D at a point in tissue, where D is the absorbed dose at that point and Q the quality factor: $H = QD$

3.3.1 [ambient dose equivalent

$H^*(d)$
dose equivalent at a point in a radiation field that would be produced by the corresponding expanded and aligned field in the ICRU sphere at a depth, d , on the radius opposing the direction of the aligned field

3.3.2 personal dose equivalent

$H_p(d)$
dose equivalent in soft tissue below a point on the body at an appropriate depth, d

NOTE The unit of the dose equivalent is joule per kilogram ($J \cdot kg^{-1}$) with the special name sievert (Sv).

3.4 fluence

Φ
quotient of dN by da , where dN is the number of neutrons incident on a sphere of cross-sectional area da

$$\Phi = dN/da$$

3.5 response

R
reading divided by the conventional true value of the quantity causing it

NOTE The type of response should be specified, e.g., "fluence response":

$$R_\Phi = \frac{M}{\Phi} \quad (1)$$

or “dose equivalent response”:

$$R_H = \frac{M}{H} \quad (2)$$

or “photon dose equivalent response,”:

$$R_\gamma = \frac{M}{H_\gamma} \quad (3)$$

If M is a measurement of a rate, then the quantities fluence (Φ) and dose equivalent (H) are replaced by fluence rate (ϕ) and dose equivalent rate (\dot{H}), respectively.

3.6 calibration factor

N

reciprocal of the response, when the response is determined under reference conditions

NOTE The calibration factor is the factor by which the reading M is multiplied to obtain the value of the quantity to be measured.

3.7 energy dependence of response

$R_\phi(E)$ or $R_H(E)$

response R , with respect to fluence Φ or dose equivalent H , to monoenergetic neutrons as a function of neutron energy E

3.8 photon sensitivity

change in the neutron reading of a device when photons are added to a neutron field

cf. photon dose equivalent response (3.5)

3.9 free-field quantity

quantity which would exist if irradiations were performed in free space with no scatter or background effects

3.10 point of test

point in the radiation field at which the conventional true value of the quantity to be measured is known

3.11 reference point

point of the instrument which is placed at the point of test for calibration or testing purposes

NOTE The measurement distance is the distance between the centre of the radiation source and the reference point of the instrument.

3.12 effective centre

point within the instrument for which its reading behaves as if it were a point detector; that is, its reading varies with the inverse square of the distance from a point source

EXAMPLE For a spherically symmetric instrument, this will generally be its geometric centre.