
X and gamma reference radiation for calibrating dosimeters and dose rate meters and for determining their response as a function of photon energy —

Part 4:

Calibration of area and personal dosimeters in low energy X reference radiation fields

*Rayonnements X et gamma de référence pour l'étalonnage des
dosimètres et des débitmètres et pour la détermination de leur réponse
en fonction de l'énergie des photons —*

*Partie 4: Étalonnage des dosimètres de zone (ou d'ambiance) et
individuels dans des champs de référence X de faible énergie*



This is a preview of "ISO 4037-4:2004". [Click here to purchase the full version from the ANSI store.](#)

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.

© ISO 2004

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.org
Web www.iso.org

Published in Switzerland

This is a preview of "ISO 4037-4:2004". Click here to purchase the full version from the ANSI store.

Contents

Page

Foreword.....	iv
Introduction	v
1 Scope.....	1
2 Normative references	1
3 Terms and definitions.....	2
4 Symbols (and abbreviated terms)	2
5 General procedures for calibrating and determining response.....	4
6 Characterisation and production of low energy X-ray reference radiations	4
6.1 General	4
6.2 Tube potential.....	4
6.3 Field uniformity and scattered radiation	5
6.4 Spectral fluence and conversion coefficients	5
7 Dosimetry of low energy reference radiations.....	6
7.1 General	6
7.2 Operation of the standard instruments	6
7.2.1 Instruments for the measurement of air kerma	6
7.2.2 Instruments for the measurement of the dose-equivalent quantities defined in ICRU 51	6
8 Calibration and determination of the response as a function of photon energy and angle of radiation incidence	6
8.1 General	6
8.2 Selection of calibration method	7
8.3 Calibration by using reference instruments for K_a	7
8.3.1 General	7
8.3.2 Conventionally true value of the measurand air kerma	7
8.3.3 Conventionally true value of the measurands dose-equivalent quantities $H_p(0,07)$ and $H'(0,07)$	8
8.3.4 Conventionally true value of the measurands dose-equivalent quantities $H_p(10)$ and $H^*(10)$	8
8.3.5 Performing the calibration	10
8.4 Calibration by using reference instruments which measure the ICRU dose-equivalent quantities	10
8.4.1 General	10
8.4.2 Conventionally true value of the measurands dose-equivalent quantities $H_p(10)$ and $H^*(10)$	10
8.4.3 Performing the calibration	12
8.5 Statement of uncertainty	12
Annex A (normative) Correction for air density	13
Annex B (informative) Measurement of pulse height spectra.....	17
Bibliography	19

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies

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 4037-4 was prepared by Technical Committee ISO/TC 85, *Nuclear energy*, Subcommittee SC 2, *Radiation protection*.

ISO 4037 consists of the following parts, under the general title *X and gamma reference radiation for calibrating dosimeters and dose rate meters and for determining their response as a function of photon energy*:

- *Part 1: Radiation characteristics and production methods*
- *Part 2: Dosimetry for radiation protection over the energy ranges from 8 keV to 1,3 MeV and 4 MeV to 9 MeV*
- *Part 3: Calibration of area and personal dosimeters and the measurement of their response as a function of energy and angle of incidence*
- *Part 4: Calibration of area and personal dosimeters in low energy X reference radiation fields*

This is a preview of "ISO 4037-4:2004". [Click here to purchase the full version from the ANSI store.](#)

Introduction

This part of ISO 4037 is closely related to the three other parts of ISO 4037. The first, ISO 4037-1, describes the methods of production and characterisation of the photon reference radiations. The second, ISO 4037-2, describes the dosimetry of the reference radiations and the third, ISO 4037-3, 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 [1, 2, 3] for radiation protection purposes.

This part of ISO 4037 is the fourth part of the series, and it describes special procedures for low energy X reference radiation fields. In ISO 4037-3, all the dose quantities used are based on the air kerma K_a free in air. Either K_a is the selected measuring quantity, or one of the dose-equivalent quantities $H'(0,07)$, $H_p(0,07)$, $H_p(10)$ and $H^*(10)$ is determined using conversion coefficients from air kerma K_a to the appropriate dose-equivalent quantity. For the dose-equivalent quantities $H'(0,07)$ and $H_p(0,07)$, this procedure is associated with only a small additional uncertainty, because the conversion coefficients depend only slightly on the photon energy and angle of radiation incidence for the ranges given in ISO 4037-3. Therefore, for these dose-equivalent quantities, no special attention is given for the low energy X reference radiation fields. For the two other dose-equivalent quantities $H_p(10)$, and $H^*(10)$, this is different. For them, the use of conversion coefficients can be associated with large additional uncertainties if low energy X reference radiation fields are considered; see the remark already given in these cases in ISO 4037-3. This is because the conversion coefficients depend strongly on the photon energy and the angle of radiation incidence. For nominally the same radiation quality as defined in ISO 4037-1, the conversion coefficients can differ by several tens of percent. A detailed description of all the measurements and methods necessary to avoid these additional uncertainties is given by Ankerhold *et al.* [4, 5] and by Behrens [6].

NOTE For irradiation of the whole body, $H_p(10)$ and $H^*(10)$ are relevant for radiation protection, as long as they are closer to their limit than $H'(0,07)$ and $H_p(0,07)$. This is the case down to about 15 keV.