
**Radiological protection — Procedures
for monitoring the dose to the lens of
the eye, the skin and the extremities**

*Radioprotection — Procédures pour la surveillance des doses au
cristallin, à la peau et aux extrémités*

Sample Document

get full document from standards.iteh.ai



Reference number
ISO 15382:2015(E)

© ISO 2015

Sample Document

get full document from standards.iteh.ai



COPYRIGHT PROTECTED DOCUMENT

© ISO 2015, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Individual monitoring	2
4.1 Quantities	2
4.2 Dose limits and monitoring levels	2
4.3 Monitoring period	3
4.4 Extremity, skin and lens of the eye monitoring	3
4.5 Uncertainties	3
4.6 Characteristics of radiation fields	4
5 Assessment of dose levels prior to routine monitoring	4
5.1 General	4
5.2 Indications from workplace measurements	4
5.3 Indications from whole body dosimetry	5
5.4 Indications from literature data	5
5.5 Indications from simulations	5
5.6 Indications from confirmatory measurements	5
6 Personal dosimetry	6
6.1 Extremity and skin dosimetry	6
6.1.1 Locations to monitor	6
6.1.2 Types of dosimeters	6
6.1.3 Technical specifications of dosimeters	7
6.1.4 Application of correction factors	7
6.2 Monitoring of the lens of the eye	7
6.2.1 Locations to monitor	7
6.2.2 Types of dosimeters	8
6.2.3 Technical specifications of dosimeters	8
6.2.4 Application of correction factors	8
7 Interpretation and management of the results	9
7.1 Analyses of results	9
7.2 Optimization	9
7.3 Registration and documentation	9
8 Special cases	9
8.1 Contamination	9
8.1.1 General	9
8.1.2 Estimation of dose to the skin or the lens of the eye from contamination	10
8.1.3 Estimation of dose to the skin or to the eye lens from hot particles	10
8.1.4 Estimation of dose to the skin or to the lens of the eye from contamination on protective clothing	11
8.2 Estimation of dose from exposure to radioactivity in the air	11
8.3 Need to correct estimated doses due to contamination of dosimeters	11
Annex A (normative) Technical specifications of dosimeters	13
Annex B (informative) Monitoring the dose to the lens of the eye	14
Annex C (informative) Special considerations in the medical sector	18
Annex D (informative) Special considerations in nuclear power plants	21
Bibliography	25

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 85, *Nuclear energy, nuclear technologies and radiological protection*, Subcommittee SC 2, *Radiological protection*.

This second edition cancels and replaces the first edition (ISO 15382:2002), which has been technically revised. The main changes are the addition of procedures for monitoring the dose to the lens of the eye.

Introduction

The human body has to be protected from effects of ionizing radiation. The stochastic effects are covered by the limit on the effective dose while tissue reactions (deterministic effects) are covered by the dose limits for specific organs. The human skin has to be protected from tissue reactions, like erythema and ulceration. For the lens of the eye, there is the risk of radiation induced opacities and cataract at elevated exposures. To protect the skin of the whole body, the extremities, and the lens of the eye, separate dose limits are recommended by the International Commission on Radiological Protection (ICRP). These separate dose limits are needed because, in case of localized exposures, the organ doses to the skin and the lens of the eye could exceed these limits even if the effective doses were lower than the limit.

Specific dosimetry is needed to monitor these doses and to assess compliance with applicable limits. There are some situations where the correct assessment of the exposure of the skin, extremities, and lens of the eye can be important. In the nuclear sector, there can be exposure due to weakly penetrating radiation caused by unshielded open radioactive sources, or by work in glove boxes. These types of exposure can occur, in particular, in connection with contamination. Exposure to weakly penetrating radiation from radioactive noble gases in room air also has to be considered. In the medical field, doses to extremities and doses to the lens of the eye can be important during interventional procedures and in nuclear medicine.

Monitoring the extremities and the lens of the eye is not always straightforward, and many practical problems arise for the application of monitoring in the workplace. As a result, monitoring is often not done as it should be, or not done at all. This International Standard provides guidance on how and when this monitoring should be done, for all the different types of workplace fields.

This International Standard is directed to all who are involved in the dosimetry of the skin, extremities, and the lens of the eye, like for example, radiation protection officers, regulators, workers, dosimetry services, etc.

get full document from standards.iteh.ai

Sample Document

get full document from standards.iteh.ai

Radiological protection — Procedures for monitoring the dose to the lens of the eye, the skin and the extremities

1 Scope

This International Standard provides procedures for monitoring the dose to the skin, the extremities, and the lens of the eye. It gives guidance on how to decide if such dosimeters are needed and to ensure that individual monitoring is appropriate to the nature of the exposure, taking practical considerations into account. National regulations, if they exist, provide requirements that need to be followed.

This International Standard specifies procedures for individual monitoring of radiation exposure of the skin, extremities (hands, fingers, wrists, forearms, feet and ankles), and lens of the eye in planned exposure situations. It covers practices which involve a risk of exposure to photons in the range of 8 keV to 10 MeV and electrons and positrons in the range of 60 keV to 10 MeV.

This International Standard gives guidance for the design of a monitoring program to ensure compliance with legal individual dose limits. It refers to the appropriate operational dose quantities, and it gives guidance on the type and frequency of individual monitoring and the type and positioning of the dosimeter. Finally, different approaches to assess and analyse skin, extremity, and lens of the eye doses are given.

It is not in the scope of this International Standard to consider exposure due to alpha or neutron radiation fields.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/TS 18090-1, *Radiological protection — Characteristics of reference pulsed radiation — Part 1: Photon radiation*.

IEC 62387, *Radiation protection instrumentation — Passive integrating dosimetry systems for personal and environmental monitoring of photon and beta radiation*

IEC 60846-1, *Radiation protection instrumentation — Ambient and/or directional dose equivalent (rate) meters and/or monitors for beta, X and gamma radiation — Part 1: Portable workplace and environmental meters and monitors*

IEC 61526, *Radiation protection instrumentation — Measurement of personal dose equivalents $H_p(10)$ and $H_p(0,07)$ for X, gamma, neutron and beta radiations — Direct reading personal dose equivalent meters*

ICRP, 2007. The 2007 Recommendations of the International Commission on Radiological Protection, ICRP Publication 103. Ann. ICRP 37 (2-4)

ICRP, 2010. Conversion Coefficients for Radiological Protection Quantities for External Radiation Exposures, ICRP Publication 116, Ann. ICRP 40(2-5), 2010

ICRP, 2012. ICRP Statement on Tissue Reactions / Early and Late Effects of Radiation in Normal Tissues and Organs – Threshold Doses for Tissue Reactions in a Radiation Protection Context, ICRP Publication 118. Ann. ICRP 41(1/2)

ICRU, 2011. Fundamental Quantities and Units for Ionizing Radiation, ICRU Publication 85. J. ICRU 11(1)

3 Terms and definitions

For the purposes of this document, the terms, definitions and units given in ICRP 103, ICRP 116, ICRP 118 and ICRU 85 apply.

4 Individual monitoring

4.1 Quantities

Skin and extremity monitoring involves the measurement of $H_p(0,07)$, the estimator of the equivalent dose to the skin.

Lens of the eye monitoring involves the measurement of $H_p(3)$, the estimator of the equivalent dose to the lens of the eye. If the radiation field is well known, $H_p(3)$ can be estimated by the use of dosimeters type tested and calibrated in terms of other quantities, i.e. $H_p(0,07)$ and $H_p(10)$, as in many cases they can provide an adequate estimate of the dose to the lens of the eye (depending on the radiation field). Technical specifications of dosimeters are provided in [Annex A](#). Guidance on which type of dosimeter can be used for the lens of the eye (depending on the radiation field) is provided in [Annex B](#).

4.2 Dose limits and monitoring levels

The dose limits for skin, extremities, and lens of the eye for planned exposure situations are given in national regulations.

ICRP has given more recent recommendations on the dose limits (ICRP 103 and ICRP 118) to avoid tissue reactions. Requirements equivalent to these recommendations are given by the IAEA in the Basic Safety Standards (BSS).^[1] These recommendations from ICRP and IAEA constitute the basis for the recommendations in this International Standard.

The ICRP recommended dose limits are the following:

- a) an equivalent dose limit to the extremities (hands and feet) or the skin of 500 mSv in a year. The equivalent dose limits for the skin apply to the average dose over 1 cm² of the most highly irradiated area of the skin. In practice, an estimate of equivalent dose to the skin is a conservative estimate of equivalent dose to the extremities;
- b) an equivalent dose limit to the lens of the eye of 20 mSv per year averaged over 5 consecutive years (100 mSv in 5 years) and of 50 mSv in any single year.

Individual monitoring is required to verify compliance with dose limits as they are described in the national legislation. Extremity, skin, and lens of the eye monitoring should be undertaken for workers who have a reasonable probability of receiving per year an equivalent dose higher than 3/10th of one of the above mentioned yearly limits. National regulations can require monitoring from different values, in that case they replace the following values.

The following monitoring levels are recommended:

- a) for the extremities or the skin, this means monitoring should be undertaken if there is a reasonable probability to receive a dose greater than 150 mSv per year;
- b) for the lens of the eye, monitoring should be undertaken if there is a reasonable probability to receive a dose in a single year greater than 15 mSv or in consecutive years greater than 6 mSv per year.

For dose levels expected to be lower than the recommended monitoring levels given above, a survey demonstrating that the levels are not exceeded, should be sufficient.

The expected annual dose can be estimated via one or more of the methods given in [Clause 5](#).

4.3 Monitoring period

The choice of the length of the monitoring period is related to the levels of the expected doses and to the relevant dose limit.

For doses above the monitoring level, a monitoring period of one month is recommended. For workers whose doses are likely to stay below the monitoring level, providing monitoring can be considered. The monitoring period in the latter case can be longer, e.g. three months. Shorter monitoring periods can be chosen (weekly monitoring or even monitoring per procedure), when setting up new procedures, when optimizing working conditions or when there is a risk of potential high exposure.

Regulatory bodies and/or expert committees also can provide appropriate recommendations for monitoring periods.

4.4 Extremity, skin and lens of the eye monitoring

The dose to the extremities, skin, and the lens of the eye needs to be monitored in situations with non-homogeneous exposure conditions for which the whole-body monitoring does not provide an adequate estimate of the dose to the skin, the dose to the extremities, or the dose to the lens of the eye. Exposures can be significant when weakly penetrating radiation such as low energy photons or beta radiation is present.

Hand or finger monitoring shall be considered for workplaces where extremities are particularly close to the radiation emitter or radiation beam, such as situations where radioactive sources are handled in, for example, research, nuclear medicine, and dismantling applications. Other important examples where extremity monitoring can be necessary are interventional radiology and nuclear medicine workplaces. Skin monitoring shall be considered for workplaces where skin is close to the radiation emitter or the beam. Also when there is a risk for skin contamination, monitoring should be considered. Examples of such situations are handling of contaminated components or unsealed radioactive sources.

Monitoring of the lens of the eye shall be specifically considered for workplaces where the eyes are particularly close to the radiation emitter (which can also be a source of scattered radiation) or the radiation beam (for example in interventional radiology) while the rest of the body can be protected by, e.g. a lead apron. Workers exposed in high energy beta fields can receive significant doses to the lens of the eye.

4.5 Uncertainties

An essential aspect of quality assurance in individual monitoring is assessing the quality of the measurement results. In the evaluation of the uncertainty, all knowledge of the dosimeter and evaluating system should be used, possibly in combination with information from the client/customer such as local exposure and storage conditions. The amount of effort put into the uncertainty should be realistic in view of its purpose in radiation protection.

ICRU makes recommendations on the acceptable levels for total uncertainty in Report 47^[2] which are broadly consistent with the ICRP recommendation (ICRP 75).^[3] ICRU recommends for single measurements of the operational quantities that “....in most cases, an overall uncertainty of one standard deviation of 30 % should be acceptable.”

The expanded uncertainty (95 % coverage probability) for values of assessed annual dose values at or near the dose limit should not exceed 0,67 to 1,5 (factor 1,5) after all corrections have been made (ICRP 75).^[3] This applies to values of effective dose, equivalent dose to a small area of skin, equivalent dose to lens of the eye or extremities, summed for all radiation types of the radiation field.

It shall be recognized that different requirements on accuracy may be needed for an estimate of the equivalent dose at another part of the body than the position of the dosimeter, for example an estimate of the equivalent dose to the finger tips from a measurement of $H_p(0,07)$ several centimetres away (RP160).^[4]