International Standard

ISO 20553

Second edition
2025-01

Radiation protection — Monitoring of workers occupationally exposed to a risk of internal contamination with radioactive material

Radioprotection — Surveillance professionnelle des travailleurs exposés à un risque de contamination interne par des substances radioactives

Reference number
ISO 20553:2025(en)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 85, *Nuclear energy, nuclear technologies, and radiological protection*, Subcommittee SC 2, *Radiological protection,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 430, *Nuclear energy, nuclear technologies, and radiological protection,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 20553:2006), which has been technically revised.

The main changes are as follows:

— the reference to the recent publication of ICRP Occupational Intakes of Radionuclides (OIR) series, instead of ICRP publications 66 and 78, to calculate the maximum time intervals for routine monitoring programmes.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

In the course of employment, individuals may work with radioactive materials that could be taken into the body. Minimising the risks to workers from incorporated radionuclides requires the monitoring of potential or actual intakes. The requirements for such a monitoring programme and the selection of methods and frequencies of monitoring depend upon the applicable legislation or regulatory body, the purpose of the radiation protection programme, the probability of potential intakes, and the characteristics of the materials handled.

This document offers guidance for making a decision whether a monitoring programme is required, in the absence of any value set by regulations, and proposes the methodology for setting up a monitoring program, as well as its design. Its intention is to optimise the efforts for such a monitoring programme consistent with legal requirements and with the purpose of the radiation protection programme. Recommendations of international expert bodies and international experience with the practical application of these recommendations in radiation protection programmes have been considered in the development of this document. Its application facilitates the exchanges of information between authorities, supervisory institutions and employers. This document is not a substitute for legal requirements.

Radiation protection — Monitoring of workers occupationally exposed to a risk of internal contamination with radioactive material

1 Scope

This document specifies the minimum requirements for the design of programmes to monitor workers exposed to the risk of internal contamination by radioactive material and establishes principles for the development of compatible goals and requirements for monitoring programmes.

This document specifies the

a) purposes of monitoring and monitoring programmes,

b) description of the different categories of monitoring programmes,

c) quantitative criteria for conducting monitoring programmes,

d) suitable monitoring methods and criteria for their selection,

e) information that has to be collected for the design of a monitoring programme,

f) general requirements for monitoring programmes (e.g. detection limits, tolerated uncertainties),

g) frequencies of measurements calculated using the ICRP Occupational Intakes of Radionuclides (OIR) series,

h) individual monitoring in specific cases (intake of actinides, intake via a wound and intake through the intact skin),

i) quality assurance, and

j) documentation, reporting and record-keeping.

This document does not apply to

— the monitoring of exposure to radon and its radioactive decay products,

— detailed descriptions of measuring methods and techniques,

— detailed procedures for in vivo measurements and in vitro analysis,

— interpretation of measurements results in terms of dose,

— biokinetic data and mathematical models for converting measured activities into absorbed dose, equivalent dose and effective dose,

— the investigation of the causes or implications of an exposure or intake.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 15189, *Medical laboratories — Requirements for quality and competence*

ISO 17025, *General requirements for the competence of testing and calibration laboratories*

ISO 23588, *Radiological protection — General requirements for proficiency tests for in vivo radiobioassay*

ISO 28218, *Radiation protection — Performance criteria for radiobioassay*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
absorption type
type of material, classified according to its rate of absorption from the respiratory tract into blood

3.1.1
absorption type V
type V
deposited materials that, for dosimetric purposes, are assumed to be instantaneously absorbed into blood from the respiratory tract (only certain gases and vapours; very fast absorption)

[SOURCE: ICRP publication 130]

3.1.2
absorption type F
type F
deposited materials that are readily absorbed into blood from the respiratory tract (fast absorption)

[SOURCE: ICRP publication 130]

3.1.3
absorption type M
type M
deposited materials that have intermediate rates of absorption into blood from the respiratory tract (moderate absorption)

[SOURCE: ICRP publication 130]

3.1.4
absorption type S
type S
deposited materials that are relatively insoluble in the respiratory tract (slow absorption)

[SOURCE: ICRP publication 130]

3.2
activity
quotient of $-dN$ by dt, where dN is the change in the number of radioactive nuclei, at a particular energy state and at a given time, due to spontaneous nuclear transformations in the time interval dt

Note 1 to entry: It is expressed as $A = -dN/dt$. Activity can be calculated as $A = \lambda N$, where λ is the decay constant and N is the number of present radioactive nuclei.

Note 2 to entry: The special name for the unit of activity in the International System of Units is becquerel (Bq), One Bq equals one transformation per second ($1\ Bq = 1\ s^{-1}$). The use of the former unit curie ($1\ Ci = 3{,}7 \times 10^{10}\ Bq$), is also accepted in many countries and by the Bureau International des Poids et Mesures.

[SOURCE: ISO 12749-1:2020, 3.1.2, modified – By removing the capital letter from the word "Curie" and adding “One Bq equals one transformation per second”]

3.3
activity median aerodynamic diameter
AMAD
value of aerodynamic diameter such that 50 % of the airborne *activity* (3.2) in a specified aerosol is associated with particles smaller than the AMAD, and 50 % of the *activity* (3.2) is associated with particles larger than the AMAD

Note 1 to entry: The aerodynamic diameter of an airborne particle is the diameter of a unit density sphere that has the same terminal settling velocity in air as the particle of interest.

3.4
clearance
net effect of the biological processes by which radionuclides are removed from the body or from a tissue, organ or region of the body

Note 1 to entry: The clearance rate is the rate at which this occurs.

3.5
radioactive contamination
contamination
radioactive substances on surfaces, or within solids, liquids or gases, including the human body, where their presence is unintended or undesirable, or the process giving rise to their presence in such places

[SOURCE: ISO 12749-2:2022, 3.1.5]

3.6
committed effective dose
quantity $E(\tau)$, defined as:

$$E(\tau)=\sum_{T} w_T \cdot H_T(\tau)$$

where $H_{\mathrm{T}}(\tau)$ is the committed equivalent dose to tissue or organ T over the integration time τ elapsed after an *intake* (3.12) of radioactive substances and w_{T} is the tissue weighting factor for tissue or organ T.

Note 1 to entry: The committed equivalent dose to an organ or tissue is the time integral of the equivalent dose rate to that organ or tissue after an *intake* (3.12) of radioactive substances.

Note 2 to entry: Where τ is not specified, it is taken to be 50 years for adults and the time to the age of 70 years for *intakes* (3.12) by children. For workers, the integration time to calculate committed equivalent doses is 50 years.

[SOURCE: ISO 12749-2:2022, 3.1.19, modified by adding Note 1 and “For workers, the integration time to calculate committed equivalent doses is 50 years” in Note 2]

3.7
annual committed dose
committed effective dose (3.6) from *intakes* (3.12) of radionuclides in one year

3.8
dose coefficient
committed effective dose (3.6) per unit *intake* (3.13), e(50), where 50 is the dose-commitment period in years over which the dose is calculated

3.9
retention function
function $m(t)$ representing the activity of a radionuclide in the whole body or in an organ, at a time t after a unit acute *intake* (3.12) as predicted by a reference biokinetic model

3.10
excretion function
function $m(t)$ representing the activity of a radionuclide in a 24 h excreta sample, at a time t after a unit acute *intake* (3.12) as predicted by a reference biokinetic model

3.11
event
any unintended occurrence, including operating error, equipment failure or other mishap, and deliberate action on the part of others, the consequences or potential consequences of which are not negligible from the point of view of protection and safety

[SOURCE: ISO 12749-2:2022, 3.3.25]

3.12
intake
<process> act or process of taking radionuclides into the body by inhalation or ingestion or through the skin

Note 1 to entry: Other exposure pathways by intake are injection (e.g. in nuclear medicine) and intake via a wound, as distinguished from intake through (intact) skin.

[SOURCE: IAEA Nuclear Safety and Security Glossary: 2022 (Interim) Edition]

3.13
intake
<quantity> *activity* (3.2) of a radionuclide taken into the body in a given time period or as a result of a given *event* (3.11)

[SOURCE: IAEA Nuclear Safety and Security Glossary: 2022 (Interim) Edition]

3.14
in vitro analysis
analysis including measurements of radioactivity present in biological samples taken from an individual

Note 1 to entry: These include urine, faeces and nasal samples. In special monitoring programmes, samples of other materials such as blood and hair may be taken.

Note 2 to entry: These analyses are sometimes referred to as indirect measurements.

Note 3 to entry: In the case of urine or faeces analysis, the time of the measurement is the end day of sample collection.

3.15
in vivo measurement
direct measurements
measurement to determine the presence of or to estimate the amount of radioactive material in a living organism

Note 1 to entry: Normally, the measurement devices are whole-body or partial-body (e.g. lung, thyroid) counters.

[SOURCE: ISO 12749-2:2022, 3.4.8]

3.16
investigation level
value of a quantity such as effective dose, *intake* (3.13) or *contamination* (3.5) per unit area or volume at or above which an investigation would be conducted

[SOURCE: IAEA Nuclear Safety and Security Glossary: 2022 (Interim) Edition]

3.17
detection limit
smallest true value of the measurand which ensures a specified probability of being detectable by the measurement procedure

[SOURCE: ISO 12749-1:2020, 3.4.11]

3.18
monitoring
measurement of dose, dose rate or activity for reasons relating to the assessment or control of exposure to radiation or exposure due to radioactive material, and the interpretation of the results

3.18.1
individual monitoring
monitoring using measurements by equipment worn by individuals, or measurements of the quantities of radioactive substances in or on, or taken into, the bodies of individuals, or measurements of quantities of radioactive substances excreted from the body by individuals

[SOURCE: IAEA Nuclear Safety and Security Glossary: 2022 (Interim) Edition]

3.18.2
workplace monitoring
monitoring using measurements made in the working environment

3.19
monitoring programme
pre-planned set of personal or workplace measurements used to determine personal exposure to radioactive materials

Note 1 to entry: This document distinguishes four different categories of monitoring programme, namely *routine monitoring programme* (3.19.1), *special monitoring programme* (3.19.2), *confirmatory monitoring programme* (3.19.3), and *task-related monitoring programme* (3.19.4).

3.19.1
routine monitoring programme
monitoring programme associated with continuing operations and intended to demonstrate that working conditions, including the levels of individual dose, remain satisfactory, and to meet regulatory requirements

3.19.2
special monitoring programme
monitoring programme performed to quantify *intakes* (3.13) following actual or suspected *events* (3.11)

3.19.3
confirmatory monitoring programme
monitoring programme carried out to confirm assumptions about working conditions, for example that significant *intakes* (3.13) do not occur

3.19.4
task-related monitoring programme
monitoring programme related to a specific operation, to provide information on a specific operation of limited duration, or following major modifications applied to the installations or operating procedures, or to confirm that the routine monitoring programme is suitable

3.19.5
monitoring interval
period between two times of measurement of the same type and category

3.20
quality assurance
QA
part of quality management focused on providing confidence that quality requirements will be fulfilled

[SOURCE: ISO 9000:2015, 3.3.6]

3.21
quality control
part of quality management focused on fulfilling quality requirements

[SOURCE: ISO 9000:2015, 3.3.7]