SLOVENSKI STANDARD
SIST EN ISO 20046:2021

01-april-2021

Radiološka zaščita - Merila za delovanje laboratorijev, ki uporabljajo preskus translokacije fluorescenčne hibridizacije in-situ (FISH) za oceno izpostavljenosti ionizirnemu sevanju (ISO 20046:2019)

Radiological protection - Performance criteria for laboratories using Fluorescence In Situ Hybridization (FISH) translocation assay for assessment of exposure to ionizing radiation (ISO 20046:2019)

Strahlenschutz - Leistungskriterien für Laboratorien, die den Fluoreszenz-in-situ-Hybridisierungs-(FISH)-Translokationstest zur Bewertung der Exposition gegenüber ionisierender Strahlung verwenden (ISO 20046:2019)

Radioprotection - Critères de performance pour les laboratoires utilisant l'analyse des translocations visualisées par hybridation in situ fluorescente (FISH) pour évaluer l'exposition aux rayonnements ionisants (ISO 20046:2019)

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Radiological protection - Performance criteria for laboratories using Fluorescence In Situ Hybridization (FISH) translocation assay for assessment of exposure to ionizing radiation (ISO 20046:2019)

Radioprotection - Critères de performance pour les laboratoires utilisant l'analyse des translocations visualisées par hybridation in situ fluorescente (FISH) pour évaluer l'exposition aux rayonnements ionisants (ISO 20046:2019)

Strahlenschutz - Leistungskriterien für Laboratorien, die den Fluoreszenz-in-situ-Hybridisierungs-(FISH)-Translokationstest zur Bewertung der Exposition gegenüber ionisierender Strahlung verwenden (ISO 20046:2019)

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European foreword

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Radiological protection — Performance criteria for laboratories using Fluorescence In Situ Hybridization (FISH) translocation assay for assessment of exposure to ionizing radiation

Radioprotection — Critères de performance pour les laboratoires utilisant l'analyse des translocations visualisées par hybridation in situ fluorescente (FISH) pour évaluer l'exposition aux rayonnements ionisants

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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).

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This document was prepared by Technical Committee ISO/TC 85, *Nuclear energy, nuclear technologies and radiological protection*, Subcommittee SC 2, *Radiological protection*.

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

The purpose of this document is to define the use of fluorescent in situ hybridization (FISH) for chromosome translocation analysis on human peripheral blood lymphocytes for biological dosimetry of exposure to ionizing radiation. Biological dosimetry, based on the study of chromosomal aberrations, mainly the dicentric assay, has become a routine component of accidental dose assessment. Dicentric aberrations, however, disappear with time after exposure, making this assay useful only in the short term after exposure. Translocations, however, are more stable, allowing dose estimates to be made long times after exposure or after protracted exposures.

This document provides a guideline for performing the translocation assay by FISH for dose assessment using documented and validated procedures. The minimum requirements for testing translocation yield in peripheral blood lymphocytes, by precisely defining the technical aspects of staining chromosomes (number of chromosomes and types of painting), selecting types of aberrations and cells, scoring aberrations, converting aberration yield to dose, statistical considerations, problems related to heterogeneous, chronic or delayed exposures and extrapolation to full genome are described. Dose assessment using the FISH assay has relevance in medical management, radiation-protection management, record keeping, and medical/legal requirements.

A part of the information in this document is contained in other international guidelines and scientific publications, primarily in the International Atomic Energy Agency's (IAEA) technical reports series on biological dosimetry. However, this document expands and standardizes the quality assurance and quality control and the evaluation of performance.

Radiological protection — Performance criteria for laboratories using Fluorescence In Situ Hybridization (FISH) translocation assay for assessment of exposure to ionizing radiation

1 Scope

The purpose of this document is to provide criteria for quality assurance (QA), quality control (QC) and evaluation of the performance of biological dosimetry by cytogenetic service laboratories.

This document addresses:

a) the responsibilities of both the customer and the laboratory;

b) the confidentiality of personal information, for the customer and the laboratory;

c) the laboratory safety requirements;

d) sample processing; culturing, staining and scoring, including the criteria for scoring for translocation analysis by FISH;

e) the calibration sources and calibration dose ranges useful for establishing the reference dose-response curves that contribute to the dose estimation from chromosome aberration frequency and the detection limit;

f) the scoring procedure for translocations stained by FISH used for evaluation of exposure;

g) the criteria for converting a measured aberration frequency into an estimate of absorbed dose (also appears as "dose");

h) the reporting of results;

i) the QA and QC;

j) Annexes A to F containing sample instructions for the customer, sample questionnaire, sample datasheet for recording aberrations, sample of report and fitting of the low dose-response curve by the method of maximum likelihood and calculating the uncertainty of dose estimate.

2 Normative references

There are no normative references in this document.

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
absorbed dose
D
quantity of ionizing radiation energy imparted per unit mass of a specified material

3.2
acentric
terminal or interstitial chromosome fragment of varying size lacking a centromere, referred to as an excess acentric fragment when it is formed independently of a dicentric or centric ring chromosome aberration

3.3
anticoagulant
drug which prevents blood from clotting

3.4
background frequency/level
spontaneous frequency (or number) of chromosome aberrations recorded in a general population

3.5
buffy coat
layer of an anticoagulated blood sample after centrifugation that contains most of the white blood cells

3.6
calibration curve
graphical or mathematical description of the dose effect relation derived by the in vitro irradiation of blood samples to known absorbed doses

Note 1 to entry: The curve is used to determine, by interpolation, the absorbed radiation dose to a potentially exposed individual.

3.7
centromere
specialized constricted region of a chromosome that appears during mitosis and joins together the chromatid pair

3.8
chromatid
either of the two strands of a duplicated chromosome that are joined by a single centromere and separate during cell division to become individual chromosomes

3.9
chromosome
structure comprised of discrete packages of DNA and proteins that carries genetic information, which condense to form characteristically shaped bodies during nuclear division

3.10
chromosome aberration
change in the normal structure of a chromosome involving both chromatids of a single chromosome at the same locus as observed in metaphase

3.11
colcemid
alkaloid compound that inhibits spindle formation during cell division

Note 1 to entry: It is used to collect a large number of metaphase cells by preventing them from progressing to anaphase.

3.12
complex aberration
aberration involving three or more breaks in two or more chromosomes and is characteristically induced after exposure to densely ionizing radiation or high doses of sparsely ionizing radiation

3.13
confidence interval
range within which the true value of a statistical quantity lies with a specified probability

3.14
covariance
measure of the correlation of the variance between two (or more) dependent sets of data or parameters

3.15
decision threshold
value of the estimator of the measurand, which when exceeded by the result of the actual measurement using a given measurement procedure of a measurand quantifying a physical effect, one decides that the physical effect is present

Note 1 to entry: The decision threshold is defined such that in cases where the measurement result, y, exceeds the decision threshold, y^*, the probability that the true value of the measurand is zero is less or equal to a chosen probability, α.

Note 2 to entry: If the result, y, is below the decision threshold, y^*, the result cannot be attributed to the physical effect; nevertheless it cannot be concluded that it is absent.

3.16
detection limit
smallest true value of the measurand which ensures a specified probability of being detectable by the measurement procedure

Note 1 to entry: With the *decision threshold* (3.15), the detection limit is the smallest true value of the measurand for which the probability of wrongly deciding that the true value of the measurand is zero is equal to a specified value, β, when, in fact, the true value of the measurand is not zero

3.17
dicentric
aberrant chromosome bearing two centromeres derived from the joining of parts from two broken chromosomes, generally accompanied by an acentric fragment

3.18
fluorescence in situ hybridization
FISH
technique that uses specific sequences of DNA as probes to particular parts of the genome, allowing the chromosomal regions to be highlighted or “painted” in different colours by attachment of various fluorochromes

3.19
fluorochrome
molecules that are fluorescent when appropriately excited

Note 1 to entry: They are used for FISH cytogenetics to highlight specific chromosomal regions.

3.20
genome equivalent
number of translocations that would be observed with all chromosomes painted, calculated from the number of translocations detected with a limited number of painted chromosomes

3.21
insertion
chromosome rearrangement in which a piece of one chromosome has been inserted within another chromosome

