

Radiological protection - Minimum criteria for electron paramagnetic resonance (EPR) spectroscopy for retrospective dosimetry of ionizing radiation - Part 2: Ex vivo human tooth enamel dosimetry (ISO 13304-2:2020)

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN ISO 13304-2:2022 sisaldab Euroopa standardi EN ISO 13304-2:2022 ingliskeelset teksti.	This Estonian standard EVS-EN ISO 13304-2:2022 consists of the English text of the European standard EN ISO 13304-2:2022.
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English Version

Radiological protection - Minimum criteria for electron paramagnetic resonance (EPR) spectroscopy for retrospective dosimetry of ionizing radiation - Part 2: Ex vivo human tooth enamel dosimetry (ISO 13304-2:2020)

Radioprotection - Critères minimaux pour la spectroscopie par résonance paramagnétique électronique (RPE) pour la dosimétrie rétrospective des rayonnements ionisants - Partie 2: Dosimétrie ex vivo à partir de l'émail dentaire humain (ISO 13304-2:2020)

Strahlenschutz - Mindestanforderungen an die Elektronenspinresonanz (EPR-Spektroskopie) für die retrospektive Dosimetrie ionisierender Strahlung - Teil 2: Ex-vivo-Dosimetrie des menschlichen Zahnschmelzes (ISO 13304-2:2020)

This European Standard was approved by CEN on 18 December 2022.

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COMITÉ EUROPÉEN DE NORMALISATION
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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of ISO 13304-2:2020 has been prepared by Technical Committee ISO/TC 85 "Nuclear energy, nuclear technologies, and radiological protection" of the International Organization for Standardization (ISO) and has been taken over as EN ISO 13304-2:2022 by Technical Committee CEN/TC 430 "Nuclear energy, nuclear technologies, and radiological protection" the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2023, and conflicting national standards shall be withdrawn at the latest by June 2023.

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Endorsement notice

The text of ISO 13304-2:2020 has been approved by CEN as EN ISO 13304-2:2022 without any modification.

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Foreword

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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).

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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*.

A list of all parts in the ISO 13304 series can be found on the ISO website.

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

Electron paramagnetic resonance (EPR) or electron spin resonance (ESR) is an approach for retrospective dosimetry of exposure to ionizing radiation in any situation where dosimetric information is potentially incomplete or unknown for an individual. EPR is a tool for retrospective evaluation of doses, pertinent as well for acute and protracted exposures in the past or recently. Doses estimated with EPR were used to correlate the biological effect of ionizing radiation to received dose, to validate other dosimetry techniques or methodologies, to manage casualties, or for forensic expertise for judicial authorities.

EPR dosimetry is based on the fundamental properties of ionizing radiation: the generation of unpaired electron species (e.g., radicals) proportional to absorbed dose. The technique of EPR specifically and sensitively detects the unpaired electrons that have sufficient stability to be observed after their generation. The amount of the detectable unpaired electrons is proportional to the total amount that were generated, and hence to the absorbed dose. These species can interact with microwaves generating the EPR signal, and therefore the relationship between the intensity of the EPR signal and the radiation dose should be established.

The most extensive use of EPR in retrospective dosimetry has been with calcified tissue, especially with enamel from teeth. EPR dosimetry is one of the methods of choice for retrospective evaluation of doses to the involved populations from the atomic weapon exposures in Japan, after the Chernobyl accident and radioactive releases of the Mayak facilities in the Southern Urals.

This document provides a guideline to perform the *ex vivo* measurements of human tooth enamel samples by X-band EPR for dose assessment using documented and validated procedures. The minimum requirements for reconstructing the absorbed dose in enamel, by defining precisely the technical aspects of preparing enamel samples, recording EPR spectra, assessment of radiation induced EPR signal, converting EPR yield to dose and performing proficiency tests, are described. Retrospective dose assessment using EPR has relevance in radiation effect research, validating radio-epidemiological dosimetry systems, medical management, 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 "Use of electron paramagnetic resonance dosimetry with tooth enamel for retrospective dose assessment"^[1]. However, this document expands and standardizes the measurement and dose reconstruction procedures and the evaluation of performance.

This document is compliant with ISO 13304-1^[2] with particular consideration given to the specific needs of X-band EPR dosimetry using human tooth enamel.

Radiological protection — Minimum criteria for electron paramagnetic resonance (EPR) spectroscopy for retrospective dosimetry of ionizing radiation —

Part 2: Ex vivo human tooth enamel dosimetry

1 Scope

The purpose of this document is to provide minimum criteria required for quality assurance and quality control, evaluation of the performance and to facilitate the comparison of measurements related to absorbed dose estimation obtained in different laboratories applying ex vivo X-band EPR spectroscopy with human tooth enamel.

This document covers the determination of absorbed dose in tooth enamel (hydroxyapatite). It does not cover the calculation of dose to organs or to the body.

This document addresses:

- a) responsibilities of the customer and laboratory;
- b) confidentiality and ethical considerations;
- c) laboratory safety requirements;
- d) the measurement apparatus;
- e) preparation of samples;
- f) measurement of samples and EPR signal evaluation;
- g) calibration of EPR dose response;
- h) dose uncertainty and performance test;
- i) quality assurance and control.

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

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 <http://www.electropedia.org/>