



NSAI
Standards

Irish Standard
I.S. EN ISO 16641:2016

Measurement of radioactivity in the environment - Air - Radon 220: Integrated measurement methods for the determination of the average activity concentration using passive solid-state nuclear track detectors (ISO 16641:2014)

I.S. EN ISO 16641:2016

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National Foreword

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EUROPEAN STANDARD

EN ISO 16641

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English Version

Measurement of radioactivity in the environment - Air -
Radon 220: Integrated measurement methods for the
determination of the average activity concentration using
passive solid-state nuclear track detectors (ISO
16641:2014)

Mesurage de la radioactivité dans l'environnement -
Air - Radon 220: Méthode de mesure intégrée pour la
détermination de l'activité volumique moyenne avec
des détecteurs passifs solides de traces nucléaires (ISO
16641:2014)

Ermittlung der Radioaktivität in der Umwelt - Luft -
Radon-220: Integrierende Messmethoden für die
Bestimmung der mittleren Aktivitätskonzentration mit
passiven Festkörperspurdetektoren (ISO 16641:2014)

This European Standard was approved by CEN on 21 February 2016.

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EN ISO 16641:2016 (E)

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European foreword

The text of ISO 16641:2014 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 16641:2016 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of an identical text or by endorsement, at the latest by October 2016, and conflicting national standards shall be withdrawn at the latest by October 2016.

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The text of ISO 16641:2014 has been approved by CEN as EN ISO 16641:2016 without any modification.

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INTERNATIONAL
STANDARD

ISO
16641

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**Measurement of radioactivity in the
environment — Air — Radon 220:
Integrated measurement methods
for the determination of the average
activity concentration using passive
solid-state nuclear track detectors**

Mesurage de la radioactivité dans l'environnement — Air — Radon 220: Méthode de mesure intégrée pour la détermination de l'activité volumique moyenne avec des détecteurs passifs solides de traces nucléaires



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ISO 16641:2014(E)

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).

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

Introduction

Radon isotopes 222, 220, and 219 are radioactive gases produced by the disintegration of radium isotopes 226, 224, and 223, which are decay products of uranium-238, thorium-232, and uranium-235, respectively, are all found in the earth's crust. Solid elements, also radioactive, followed by stable lead are produced by radon disintegration.^[1]

Radon is considered to be the main source of human exposure to natural radiation. The UNSCEAR (2006) report^[2] suggests that, at the international level, radon accounts for around 52 % of the global average exposure to natural radiation. Isotope 222 (48 %) is far more significant than isotope 220 (4 %), while isotope 219 is considered negligible.

Recent studies on indoor radon-222 and lung cancer in Europe, North America, and Asia provide strong evidence that radon-222 causes a substantial number of lung cancers in the general population. Current estimates of the proportion of lung cancers attributable to radon-222 range from 3 % to 14 %, depending on the average radon-222 concentration in the country concerned and the calculation methods.^[3]

Indoor radon-222 concentration is mainly measured by passive detectors that can measure both radon-222 and radon-220 signals.^[4] If the readings are overestimated, the lung cancer risk is given as a biased estimate when epidemiological studies are carried out. Radon-222 and radon-220 parallel measurements have been carried out in several countries^{[4]-[11]} (See [Table A.1](#)). Experiences from field work indicate that there is no correlation among radon-222 and radon-220 and its decay products' concentrations. This implies that one parameter cannot be estimated from the other. Unless radon-220 activity concentration is measured, a correct radon-222 concentration cannot be given with a single use of radon-222 measuring device. Therefore, a specific measurement of radon-220 is justified.

Due to its short half-life, radon-220 disappears very rapidly in the atmosphere. An activity concentration gradient is observed from the walls or grounds to the inner space of the room. Depending on the objective of the measurement (building characteristics, construction material characterization, etc.), the sampling location is to be chosen after taking into account this gradient.

Due to a highest level of radon-222 in air, radon-220 is very difficult to measure alone. This International Standard proposes a measuring method of radon-220 activity concentration using a dual system considering radon-222 and radon-220.

There are many ways of measuring the activity concentration of radon-220 and its decay products. The measuring technique proposed is an integrated measurement method for radon-220 only.

Measurement of radioactivity in the environment — Air — Radon 220: Integrated measurement methods for the determination of the average activity concentration using passive solid-state nuclear track detectors

1 Scope

This International Standard covers integrated measurement techniques for radon-220 with passive sampling only. It provides information on measuring the average activity concentration of radon-220 in the air, based on easy-to-use and low-cost passive sampling, and the conditions of use for the measuring devices.

This International Standard covers samples taken without interruption over periods varying from a few months to one year.

This type of measurement is also applicable for determination of radon-222 activity concentration.

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 11665-1:2012, *Measurement of radioactivity in the environment — Air: radon-222 — Part 1: Origins of radon and its short-lived decay products and associated measurement methods*

ISO 11929, *Determination of the characteristic limits (decision threshold, detection limit and limits of the confidence interval) for measurements of ionizing radiation — Fundamentals and application*

ISO/IEC 17025:2005, *General requirements for the competence of testing and calibration laboratories*

IEC 61577-1, *Radiation protection instrumentation — Radon and radon decay product measuring instruments — Part 1: General principles*

3 Terms, definitions, and symbols

3.1 Terms and definitions

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

3.1.1 activity

number of spontaneous nuclear disintegrations occurring in a given quantity of material over a reasonably short time interval, divided by this time interval

[SOURCE: ISO 921:1997, 23]

Note 1 to entry: Activity is expressed by the relationship:

$$A = \lambda \times N$$

The decay constant is linked to the radioactive half-life (T) by the relationship:

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