RADIOAKTIIVSUSE MÕÕTMINE KESKKONNAS
Õhk: radoon-222
Osa 9: Ehitusmaterjalide ekshalatsioonikiiruse katsemeetodid

Measurement of radioactivity in the environment
Air: Radon-222
Part 9: Test methods for exhalation rate of building materials
(ISO 11665-9:2019, identical)

EESTI STANDARDI EESSÕNA

See Eesti standard EVS-ISO 11665-9:2022 sisaldab rahvusvahelise standardi ISO 11665-9:2019 „Measurement of radioactivity in the environment. Air: Radon-222. Part 9: Test methods for exhalation rate of building materials“ identset ingliskeelset teksti.

Ettepaneku rahvusvahelise standardi ümbertrüki meetodil ülevõtuks on esitanud EVS/TK 28, standardi avaldamist on korraldanud Eesti Standardimis- ja Akrediteerimiskeskus.

Standard EVS-ISO 11665-9:2022 on jõustunud sellekohase teate avaldamisega EVS Teatajas.

Standard on kättesaadav Eesti Standardimis- ja Akrediteerimiskeskusest.

NATIONAL FOREWORD

This Estonian Standard EVS-ISO 11665-9:2022 consists of the identical English text of the International Standard ISO 11665-9:2019 „Measurement of radioactivity in the environment. Air: Radon-222. Part 9: Test methods for exhalation rate of building materials“.

Proposal to adopt the International Standard by reprint method has been presented by EVS/TK 28, the Estonian Standard has been published by the Estonian Centre for Standardisation and Accreditation.

Standard EVS-ISO 11665-9:2022 has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation.

This standard is available from the Estonian Centre for Standardisation and Accreditation.

Käsitlusala

Selles dokumendis kirjeldatakse mõõtmismeetodit, mida kasutatakse radooni ekshalatsioonikiiruse määramiseks mineraalse ehitusmaterjali partii puhul. See dokument käsitleb ainult Rn-222 ekshalatsiooni määramist, kasutades kaht mõõtemeetodit: vedelikstsintillatsioon (*liquid Scintillation Counting*, LSC) ja gammaspektromeetria (vt lisad A ja B).

Torooni (Rn-220) ekshalatsioon ei mõjuta katsetulemust, kui on kasutatud selles dokumendis kirjeldatud meetodeid.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

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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).

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

This document was prepared by 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 11665-9:2016), which has been technically revised.

A list of all the parts in the ISO 11665 series can be found on the ISO website

Introduction

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

When disintegrating, radon emits alpha particles and generates solid decay products, which are also radioactive (polonium, bismuth, lead, etc.). The potential effects on human health of radon lie in its solid decay products rather than the gas itself. Whether or not they are attached to atmospheric aerosols, radon decay products can be inhaled and deposited in the bronchopulmonary tree to varying depths according to their size.

Radon is today considered to be the main source of human exposure to natural radiation. UNSCEAR[2] suggests that, at the worldwide level, radon accounts for around 52 % of global average exposure to natural radiation. The radiological impact of isotope 222 (48 %) is far more significant than isotope 220 (4 %), while isotope 219 is considered negligible. For this reason, references to radon in this document refer only to radon-222.

Radon activity concentration can vary from one to more orders of magnitude over time and space. Exposure to radon and its decay products varies tremendously from one area to another, as it depends on the amount of radon emitted by the soil, weather conditions, and on the degree of containment in the areas where individuals are exposed.

As radon tends to concentrate in enclosed spaces like houses, the main part of the population exposure is due to indoor radon. Soil gas is recognized as the most important source of residential radon through infiltration pathways. Other sources are described in other parts of ISO 11665 and ISO 13164 (all parts) for water[3].

Radon enters into buildings via diffusion mechanism caused by the all-time existing difference between radon activity concentrations in the underlying soil and inside the building, and via convection mechanism inconstantly generated by a difference in pressure between the air in the building and the air contained in the underlying soil. Indoor radon activity concentration depends on radon activity concentration in the underlying soil, the building structure, the equipment (chimney, ventilation systems, among others), the environmental parameters of the building (temperature, pressure, etc.) and the occupants' lifestyle.

To limit the risk to individuals, a national reference level of 100 $Bq \cdot m^{-3}$ is recommended by the World Health Organization[4]. Wherever this is not possible, this reference level should not exceed 300 $Bq \cdot m^{-3}$. This recommendation was endorsed by the European Community Member States that shall establish national reference levels for indoor radon activity concentrations. The reference levels for the annual average activity concentration in air shall not be higher than 300 $Bq \cdot m^{-3}$[5].

To reduce the risk to the overall population, building codes should be implemented that require radon prevention measures in buildings under construction and radon mitigating measures in existing buildings. Radon measurements are needed because building codes alone cannot guarantee that radon concentrations are below the reference level.

The radon atoms in materials are produced by the disintegration of the radium-226 contained in the mineral grains of the material. Some of these atoms reach the interstitial spaces between the grains: this is the phenomenon of emanation. Some of these atoms produced by emanation reach the material's surface by diffusion and convection: this is the phenomenon of exhalation.

Values of the radon-222 surface exhalation rate observed for building materials vary from not detectable up to 5 $mBq \cdot m^{-2} \cdot s^{-1}$[6][7].

ISO 11665 consists of 12 parts (see Figure 1).

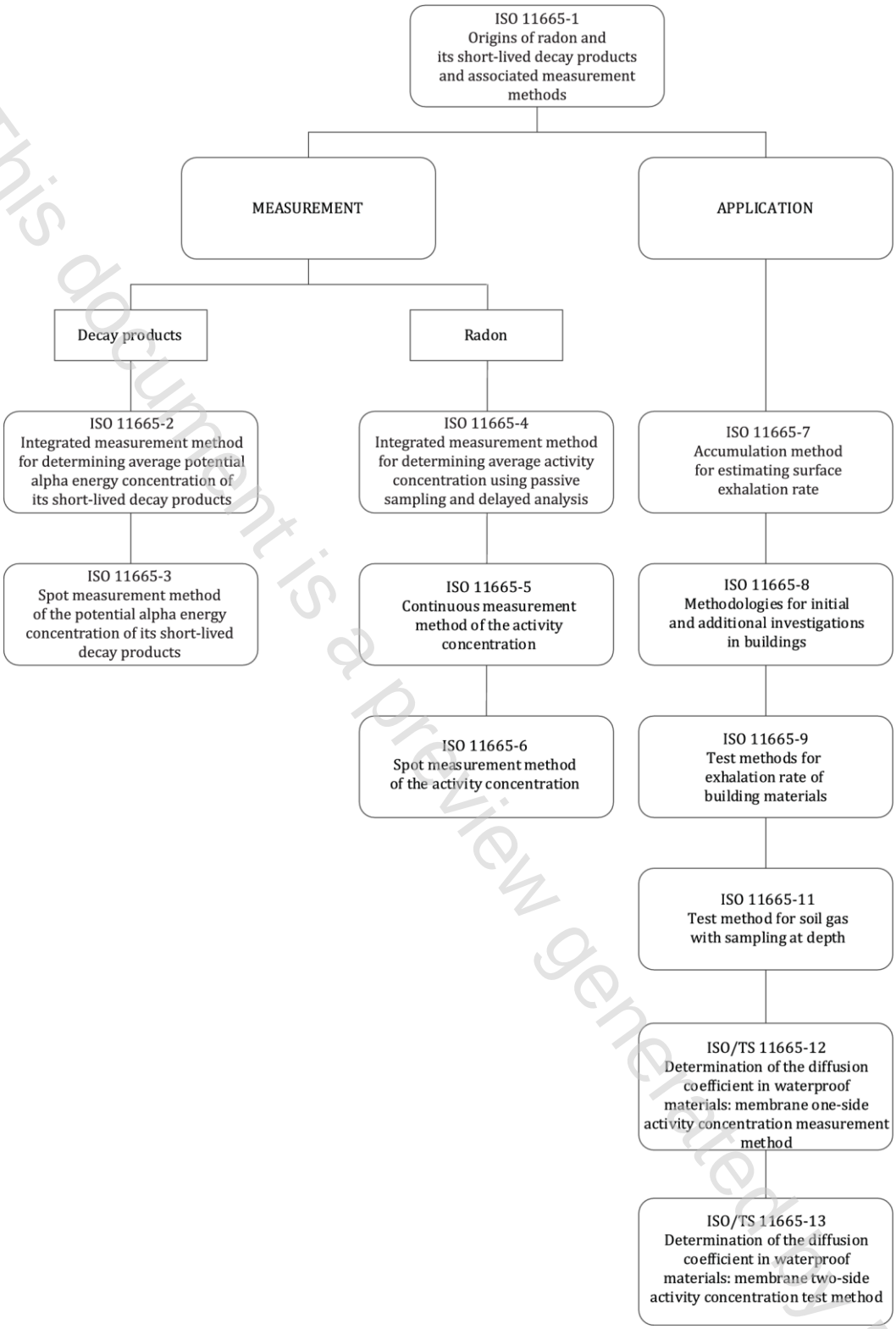

Figure 1 — Structure of the ISO 11665 series

Measurement of radioactivity in the environment — Air: Radon-222 —

Part 9: Test method for exhalation rate of building materials

1 Scope

This document specifies a method for the determination of the free radon exhalation rate of a batch of mineral based building materials. This document only refers to ^{222}Rn exhalation determination using two test methods: liquid Scintillation Counting (LSC) and gamma ray spectrometry (see Annex A and Annex B).

The exhalation of thoron (^{220}Rn) does not affect the test result when applying the determination methods described in this document.

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 11665-1, *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, *General requirements for the competence of testing and calibration laboratories*

3 Terms, definitions and symbols

3.1 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 http://www.iso.org/obp

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

3.1.1
batch
quantity of material that is regarded as a unit and for which it is assumed that it has uniform characteristics or an amount of fresh concrete produced under uniform conditions and which has the same strength and environmental class or which has the same composition

3.1.2
building material
product that is made of one or more materials and possibly admixtures and which has characteristics that meet previously set requirements after a formation process which may have been supplemented with a curing process if required

