RADIOAKTIIVSUSE MÕÕTMINE KESKKONNAS
Õhk: radoon-222
Osa 8: Esialgsete ja lisauuringute metoodikad hoonetes

Measurement of radioactivity in the environment
Air: radon-222
Part 8: Methodologies for initial and additional investigations in buildings
(ISO 11665-8:2019, identical)

EESTI STANDARDIKESKUS
ESTONIAN CENTRE FOR STANDARDISATION

EESTI STANDARDI EESSÕNA	NATIONAL FOREWORD
See Eesti standard EVS-ISO 11665-8:2020 „Radioaktiivsuse mõõtmine keskkonnas. Õhk: radoon-222. Osa 8: Esialgsete ja lisauuringute metoodikad hoonetes“ sisaldab rahvusvahelise standardi ISO 11665-8:2019 „Measurement of radioactivity in the environment. Air: radon-222. Part 8: Methodologies for initial and additional investigations in buildings“ identset ingliskeelset teksti.	This Estonian Standard EVS-ISO 11665-8:2020 consists of the identical English text of the International Standard ISO 11665-8:2019 „Measurement of radioactivity in the environment. Air: radon-222. Part 8: Methodologies for initial and additional investigations in buildings“.
Ettepaneku rahvusvahelise standardi ümbertrüki meetodil ülevõtuks on esitanud EVS/TK 28, standardi avaldamist on korraldanud Eesti Standardikeskus.	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.
Standard EVS-ISO 11665-8:2020 on jõustunud sellekohase teate avaldamisega EVS Teatajas.	Standard EVS-ISO 11665-8:2020 has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Standard on kättesaadav Eesti Standardikeskusest.	This standard is available from the Estonian Centre for Standardisation.

Käsitlusala

Selles dokumendis kirjeldatakse radooni aktiivsuskontsentratsiooni määramisele esitatavad nõuded kõikide ehitise tüüpide puhul. Ehitised võivad olla ühepereelamud, avalikud hooned, tööstusehitised, allmaaehitised jne.

Selles dokumendis kirjeldatakse mõõtmismeetodeid, mida kasutatakse esialgsete uuringute etapis hoonetes leiduva radooni aasta keskmise aktiivsuskontsentratsiooni hindamiseks. Samuti käsitletakse selles hoones leiduva radooni allikate, sisenemisteede ja levikuteedega seotud uuringuid (lisauuringud).

Lisaks kirjeldatakse dokumendis rakendatud radooni leevendusmeetmete kohesele kasutusjärgsele testimisele kohaldatavaid nõudeid, tõhususe kontrollimist ning seda, kuidas katsetada hoone käitumise jätkusuutlikkust radooni mõju suhtes.

Selles dokumendis ei käsitleta ehitiste tehnilist kontrolli ega radooni leevendusmeetmete rakendamist.

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 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 the following URL: 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*.

This second edition cancels and replaces the first edition (ISO 11665-8:2012), of which it constitutes a minor revision. The changes compared to the previous edition are as follows:

— update of the Introduction;

— update of the Bibliography.

A list of all the parts in the ISO 11665 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

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 (see Annex A of ISO 11665-1:2019 for further information). 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[2][3][4][5].

Radon is today considered to be the main source of human exposure to natural radiation. UNSCEAR[6] 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 (see Annex A of ISO 11665-1:2019). 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 and building materials, 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 series for water[7].

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·m^{-3} is recommended by the World Health Organization[5]. Wherever this is not possible, this reference level should not exceed 300 Bq·m^{-3}. This recommendation was endorsed by the European Community Member States that should establish national reference levels for indoor radon activity concentrations. The reference levels for the annual average activity concentration in air should not be higher than 300 Bq·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 assessment of the radon activity concentration of the atmosphere in a building is based on a step-by-step procedure with two measuring stages: the initial investigation, to estimate the annual average value of the radon activity concentration in the building, and, when needed, additional investigations.

When it is decided that the radon activity concentration in a building has to be reduced, mitigation techniques are adapted to each individual case[8][9][10]. The impact of the mitigation is assessed using new radon measurements in the building.

NOTE The origin of radon-222 and its short-lived decay products in the atmospheric environment are described generally in ISO 11665-1 together with measurement methods.

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

Part 8: Methodologies for initial and additional investigations in buildings

1 Scope

This document specifies requirements for the determination of the activity concentration of radon in all types of buildings. The buildings can be single family houses, public buildings, industrial buildings, underground buildings, etc.

This document describes the measurement methods used to assess, during the initial investigation phase, the average annual activity concentration of radon in buildings. It also deals with investigations needed to identify the source, entry routes and transfer pathways of the radon in the building (additional investigations).

Finally, this document outlines the applicable requirements for the immediate post-mitigation testing of the implemented mitigation techniques, monitoring of their effectiveness and testing of the sustainability of the building's behaviour towards radon.

This document does not address the technical building diagnostic or the prescription of mitigation work.

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 6707-1, *Building and civil engineering — Vocabulary — Part 1: General terms*

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 11665-4, *Measurement of radioactivity in the environment — Air: Radon 222 — Part 4: Integrated measurement methods for determining average activity concentration using passive sampling and delayed analysis*

ISO 11665-7, *Measurement of radioactivity in the environment — Air: radon-222 — Part 7: Accumulation method for estimating surface exhalation rate*