INTERNATIONAL STANDARD

ISO 11665-9

First edition
2016-02-01

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

Part 9: Test methods for exhalation rate of building materials

Mesurage de la radioactivité dans l'environnement — Air: Radon 222 —

Partie 9: Méthode de détermination du flux d'exhalation des matériaux de construction

Reference number
ISO 11665-9:2016(E)

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Foreword

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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*.

ISO 11665 consists of the following parts, under the general title *Measurement of radioactivity in the environment — Air: Radon 222*

— *Part 1: Origins of radon and its short-lived decay products and associated measurement methods*

— *Part 2: Integrated measurement method for determining average potential alpha energy concentration of its short-lived-decay products*

— *Part 3: Spot measurement method of the potential alpha energy concentration of its short-lived decay products*

— *Part 4: Integrated measurement method for determining average activity concentration using passive sampling and delayed analysis*

— *Part 5: Continuous measurement method of the activity concentration*

— *Part 6: Spot measurement method of the activity concentration*

— *Part 7: Accumulation method for estimating surface exhalation rate*

— *Part 8: Methodologies for initial and additional investigations in buildings*

— *Part 9: Test methods for exhalation rate of building materials*

— *Part 10: Determination of diffusion coefficient in waterproof materials using activity concentration measurement*

— *Part 11: Test method for soil gas with sampling at depth*

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, 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 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. The UNSCEAR (2006) report[8] suggests that, at the international 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 part of ISO 11665 refer only to radon-222.

Radon activity concentration can vary from one to multiple orders of magnitude over time and space. Exposure to radon and its decay products varies tremendously from one area to another, as it depends firstly on the amount of radon emitted by the soil and the building materials in each area and, secondly, on the degree of containment and weather conditions 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. A secondary source is the radon exhalation from building materials.

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 $mBq.m^{-2}.s^{-1}$.[4],[5]

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

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

Part 9: Test methods for exhalation rate of building materials

1 Scope

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

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, *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 terms and definitions given in ISO 11665-1 and the following apply.

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

Note 1 to entry: The curing process, in which a chemical reaction occurs, may take place under ambient conditions (cold binding products), under elevated temperature (baked products) or under elevated temperature and pressures (autoclaved products).