ISO/DTS 11665-13~~:2025(en)~~

ISO-/TC-85/SC-2

Secretariat:-AFNOR

Date: 2025-~~07-25~~xx

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

Part-13:
Determination of the diffusion coefficient in waterproof materials: membrane two-side activity concentration test method

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

Partie 13: Détermination du coefficient de diffusion des matériaux imperméables : méthode de mesurage de l'activité volumique des deux côtés de la membrane

Contents

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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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*

This second edition cancels and replaces the first edition (ISO/TS 11665-13:2017), which has been technically revised.

The main changes are as follows:

— 6.2 ~~6.2 :~~: configuration of the measuring system has been revised and supplemented with new figures to show different configuration options with different types of radon sources and radon detectors;

— new 7.5~~7.5 :~~: Method D (determining the radon diffusion coefficient from the stationary radon activity concentrations in receiver and source containers) has been introduces;

— 8.4 ~~8.4 :~~: a new procedure for determining the minimum duration of decisive measurement has been established for method A;

— 8.5 ~~8.5 :~~: a revised procedure for determining the minimum duration of decisive measurement has been established for method B;

— new 8.7~~8.7~~ has been inserted describing the measurement procedure according to method D;

— 8.8 ~~8.8 :~~: the procedures for determining the minimum radon activity concentration in the source container and for situations when the growth curve is not clearly determined, or when no radon penetrates the receiver container were specified.

A list of all 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. Solid elements, also radioactive, followed by stable lead are produced by radon disintegration[0[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[0[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 series and ISO 13164 series[0] 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·m^{-3} is recommended by the World Health Organization.[0.[8]] 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 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·m^{-3}[0[4].].

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.

When a building requires protection against radon from the soil, radon-proof insulation (based on membranes, coatings or paints) placed between the soil and the indoors may be used as a stand-alone radon prevention/remediation strategy or in combination with other techniques such as passive or active soil depressurization. Radon-proof insulation functions at the same time as the waterproof insulation.

Radon diffusion coefficient is a parameter that determines the barrier properties of waterproof materials against the diffusive transport of radon. Applicability of the radon diffusion coefficient for radon-proof insulation can be prescribed by national building standards and codes. Requirements for radon-proof