Irish Standard
I.S. EN ISO 11665-1:2015

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 11665-1:2012)

I.S. EN ISO 11665-1:2015

Incorporating amendments/corrigenda/National Annexes issued since publication:

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National Foreword

I.S. EN ISO 11665-1:2015 is the adopted Irish version of the European Document EN ISO 11665-1:2015, 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 11665-1:2012)

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 11665-1

September 2015

ICS 17.240

English Version

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 11665-1:2012)

Mesurage de la radioactivité dans l'environnement - Air: radon 222 - Partie 1: Origine du radon et de ses descendants à vie courte, et méthodes de mesure associées (ISO 11665-1:2012)

Ermittlung der Radioaktivität in der Umwelt - Luft: Radon-222 - Teil 1: Radon und seine kurzlebigen Folgeprodukte: Quellen und Messverfahren (ISO 11665-1:2012)

This European Standard was approved by CEN on 12 June 2015.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

The text of ISO 11665-1:2012 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 11665-1:2015 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of an identical text or by endorsement, at the latest by March 2016, and conflicting national standards shall be withdrawn at the latest by March 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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Endorsement notice

The text of ISO 11665-1:2012 has been approved by CEN as EN ISO 11665-1:2015 without any modification.

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I.S. EN ISO 11665-1:2015

INTERNATIONAL STANDARD

ISO 11665-1

First edition
2012-07-15

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

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

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

Partie 1: Origine du radon et de ses descendants à vie courte, et méthodes de mesure associées

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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.

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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ISO 11665-1 was prepared by Technical Committee 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*

The following parts are under preparation:

— *Part 9: Method for determining exhalation rate of dense building materials*

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

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 (see Annex A for further information). Solid elements, also radioactive, followed by stable lead are produced by radon disintegration[1].

Radon is considered a noble gas in the periodic table of elements, along with helium, argon, neon, krypton and xenon.

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[2][3][4][5].

Radon is today considered to be the main source of human exposure to natural radiation. The UNSCEAR (2006) report[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). For this reason, references to radon in this part of ISO 11665 refer only to radon-222.

Radon activity concentration can vary by 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.

The values usually found in the continental environment are normally between a few becquerels per cubic metre and several thousand becquerels per cubic metre. Activity concentrations of less than one becquerel per cubic metre may be observed in the oceanic environment. Radon activity concentrations vary inside houses from several tens of becquerels per cubic metre to several hundreds of becquerels per cubic metre[7]. Activity concentration can reach several thousands of becquerels per cubic metre in very confined spaces. Variations of a few nanojoules per cubic metre to several thousand nanojoules per cubic metre are observed for the potential alpha energy concentration of short-lived radon decay products.

ISO 11665 consists of 10 parts (see Figure 1) dealing with:

— measurement methods for radon-222 and its short-lived decay products (see ISO 11665-2, ISO 11665-3, ISO 11665-4, ISO 11665-5 and ISO 11665-6);

NOTE 1 There are many methods for measuring the radon-222 activity concentration and the potential alpha energy concentration of its short-lived decay products. The choice of measurement method will depend on the expected level of concentration and on the intended use of the data, such as scientific research and health-related assessments[8][9].

— measurement methods for the radon-222 exhalation rate (see ISO 11665-7 and ISO 11665-9);

NOTE 2 ISO 11665-7 refers back to ISO 11665-5 and ISO 11665-6.

— measurement methods for the radon-222 diffusion coefficient (see ISO 11665-10);

— methodologies for radon-222 measurements in buildings (see ISO 11665-8).

NOTE 3 ISO 11665-8 refers back to ISO 11665-4 for radon measurements for initial investigation purposes in a building and to ISO 11665-5, ISO 11665-6 and ISO 11665-7 for measurements for any additional investigation.

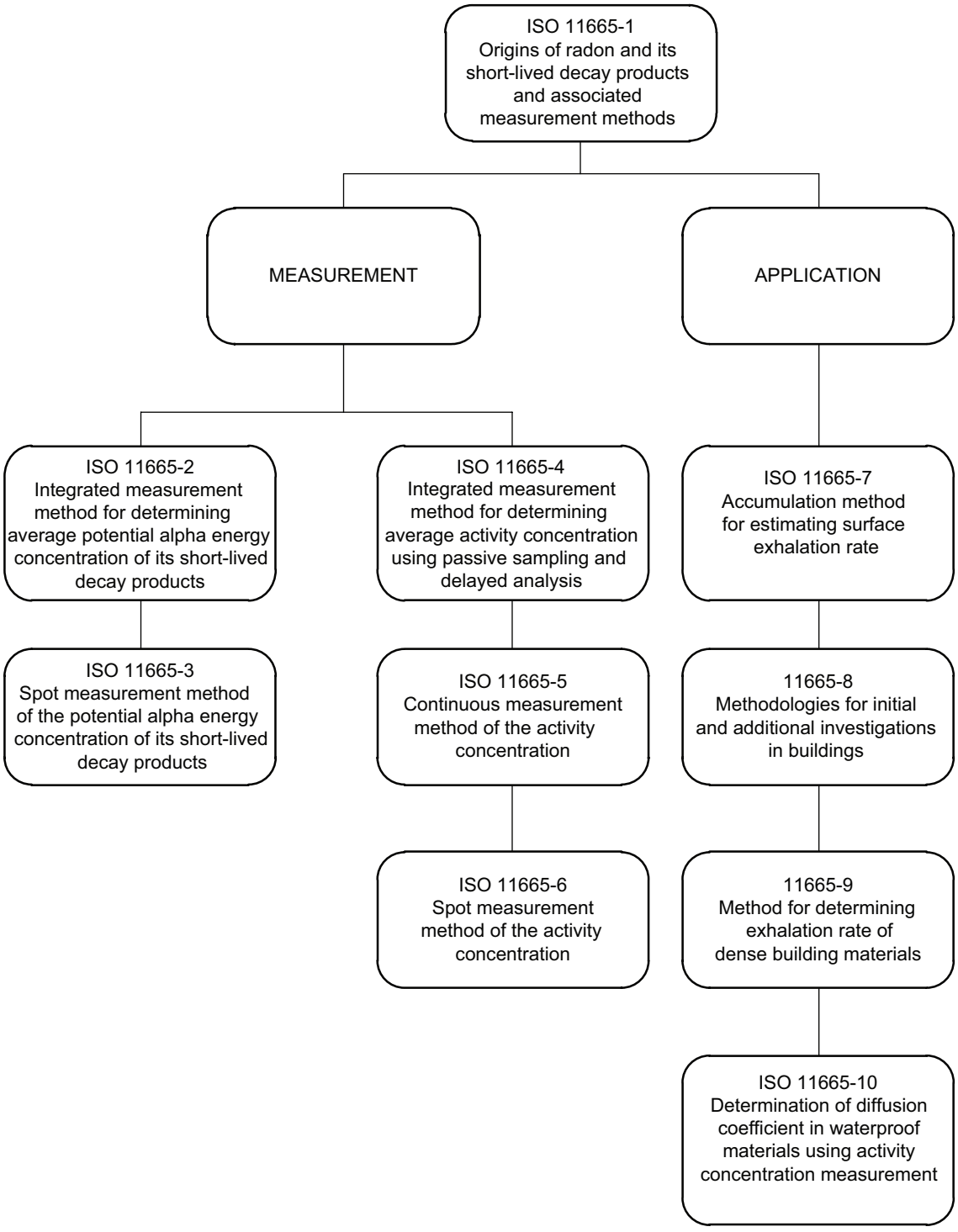

Figure 1 — Structure of the ISO 11665 series

INTERNATIONAL STANDARD ISO 11665-1:2012(E)

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

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

1 Scope

This part of ISO 11665 outlines guidance for measuring radon-222 activity concentration and the potential alpha energy concentration of its short-lived decay products in the air.

The measurement methods fall into three categories:

a) spot measurement methods;

b) continuous measurement methods;

c) integrated measurement methods.

This part of ISO 11665 provides several methods commonly used for measuring radon-222 and its short-lived decay products in air.

This part of ISO 11665 also provides guidance on the determination of the inherent uncertainty linked to the measurement methods described in its different parts.

2 Normative references

The following referenced documents are indispensable for the application 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/IEC 17025, *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*

IEC 61577-2, *Radiation protection instrumentation — Radon and radon decay product measuring instruments — Part 2: Specific requirements for radon measuring instruments*

IEC 61577-3, *Radiation protection instrumentation — Radon and radon decay product measuring instruments — Part 3: Specific requirements for radon decay product measuring instruments*

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
active sampling
sampling using active devices like pumps for sampling the atmosphere

[IEC 61577-1:2006]

3.1.2
activity
disintegration rate
number of spontaneous nuclear disintegrations occurring in a given quantity of material during a suitably small interval of time divided by that interval of time

[ISO 921:1997, term 23]

NOTE 1 Activity, A, is expressed by the relationship given in Formula (1):

$$A = \lambda \cdot N \tag{1}$$

where

λ is the decay constant per second;

N is the number of atoms.

NOTE 2 The decay constant is linked to the radioactive half-life by the relationship:

$$\lambda = \frac{\ln 2}{T_{1/2}} \tag{2}$$

where

$T_{1/2}$ is the radioactive half-life, in seconds.

3.1.3
activity concentration
activity per unit volume

[IEC 61577-1:2006]

3.1.4
attached fraction
fraction of the potential alpha energy concentration of short-lived decay products that is attached to the ambient aerosol

[IEC 61577-1:2006]

NOTE The sizes of the carrier aerosol to which most of the short-lived decay products are attached are generally in the 0,1 µm to 0,3 µm range of median values.

3.1.5
average activity concentration
exposure to activity concentration divided by the sampling duration

3.1.6
average potential alpha energy concentration
exposure to potential alpha energy concentration divided by the sampling duration

3.1.7
background noise
signals caused by something other than the radiation to be detected

NOTE A distinction can be made between signals caused by radiation from sources inside or outside the detector other than those targeted for the measurements and signals caused by defects in the detection system electronic circuits and their electrical power supply.