

This is a preview of "ISO 11665-8:2019". [Click here to purchase the full version from the ANSI store.](#)

Second edition
2019-12

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

Part 8: Methodologies for initial and additional investigations in buildings

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

Partie 8: Méthodologies appliquées aux investigations initiales et complémentaires dans les bâtiments



Reference number
ISO 11665-8:2019(E)

© ISO 2019



COPYRIGHT PROTECTED DOCUMENT

© ISO 2019

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

This is a preview of "ISO 11665-8:2019". [Click here to purchase the full version from the ANSI store.](#)

Contents

	Page
Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms, definitions and symbols	1
3.1 Terms and definitions.....	1
3.2 Symbols.....	3
4 Organization of the measuring stages	4
5 Initial investigations	4
5.1 Objective.....	4
5.2 Methodology followed during the initial investigation.....	4
5.3 Selection of measuring devices.....	5
5.4 Location of the measuring points.....	5
5.4.1 General.....	5
5.4.2 Determination and selection of the homogeneous zones.....	5
5.4.3 Number of measuring devices to be installed.....	6
5.4.4 Installation of measuring devices.....	6
5.5 Installation and removal of the measuring devices.....	6
5.6 Processing of the measuring devices.....	7
5.7 Data analysis.....	7
5.8 Initial investigation report.....	8
6 Additional investigations	8
6.1 General.....	8
6.2 Methodology for additional investigations.....	9
6.2.1 General.....	9
6.2.2 Building mapping.....	9
6.2.3 Identification of radon sources and entry routes.....	9
6.2.4 Identification of transfer pathways.....	10
6.3 Report of additional investigations.....	11
7 Immediate post-mitigation testing of the technical solutions applied	12
8 Control of the effectiveness of the technical solutions applied	12
9 Control of the sustainability	12
Annex A (informative) Examples of underground buildings and buried levels	13
Annex B (informative) Organization of radon measuring phases in a building	14
Annex C (informative) Initial investigation report	15
Annex D (informative) Example of analysis of initial investigation measurement results	17
Bibliography	18

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.

This is a preview of "ISO 11665-8:2019". [Click here to purchase the full version from the ANSI store.](#)

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^[4].

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.