SLOVENSKI STANDARD
oSIST prEN 17637:2021

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Gradbeni proizvodi - Ocenjevanje sproščanja nevarnih snovi - Ocenjevanje doze emitiranega gama sevanja

Construction products: Assessment of release of dangerous substances - Dose assessment of emitted gamma radiation

Bauprodukte - Bewertung der Freisetzung von gefährlichen Stoffen - Verfahren zur Beurteilung von emittierter Gammastrahlung

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Construction products: Assessment of release of dangerous substances - Dose assessment of emitted gamma radiation

Bauprodukte - Bewertung der Freisetzung von gefährlichen Stoffen - Verfahren zur Beurteilung von emittierter Gammastrahlung

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (prEN 17637:2021) has been prepared by Technical Committee CEN/TC 351 “Construction products: Assessment of release of dangerous substances”, the secretariat of which is held by NEN.

This document is currently submitted to the CEN Enquiry.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

Introduction

In January 2014 the Basic Safety Standards Directive (2013/59/Euratom) [1], also named EU-BSS, was issued laying down basic safety standards for the protection against the danger arising from exposure to ionising radiation. The directive also sets requirements on the gamma radiation dose from the naturally occurring radionuclides (^{226}Ra, ^{232}Th and ^{40}K) in building materials and must be taken into account along with the 2011 EU regulation laying down harmonized conditions for the marketing of construction products (EU no 305/2011) [2], the so called CPR. Both EU regulatory documents constitute a new basis for radiation protection regulation of building materials and are intended to be complemented by EU guidance and standards of which this document is part.

Pivotal in the regulatory system of the EU-BSS and CPR is the dose assessment of building materials and its compliance against a reference level as defined under Article 75 of the EU-BSS. For this purpose an activity concentration index is provided in the directive under Annex VIII. The index value is determined using the material's massic activity ^{226}Ra, ^{232}Th and ^{40}K. As the index is proposed as a conservative screening tool provisions are put in place under Annex VIII to allow for more precise assessment of the dose if needed. This includes consideration of the material's density, thickness and other factors relating to the type of construction and the intended use. However, no method for a more refined dose assessment is provided in the directive, despite the fact that various EU member states allow for such refined assessment. This document serves as a harmonized assessment method that can support harmonized standards under the CPR, and is meant to address the provisions in the EU-BSS for a more refined assessment.

This document is an addition to the activity concentration index as formulated in the Annex VIII of the EU-BSS. The method describes a state-of-the-art dose assessment that takes account of all factors stipulated under Annex VIII of the directive. In the method, important consideration is given to differentiate between the dose from the individual construction product and the assembly of products that result in the dose from the model building. In the EU-BSS dose requirements are expressed in terms of a dose from the building, while the CPR is intended to set product specific requirements. For this reason the method provides for a calculation of dose from the individual product, followed by a calculation of the product assembly with subtraction of background to enable assessment against the reference level defined in Article 75 of the EU-BSS.

This document has the following structure:

— A normative instruction on the use of the assessment method with description of the equations and parameters to be used, followed by a list of information to be reported;

— An informative Annex A with a description of the dose assessment model, including explanation of the modelling principles, main assumptions, coefficients and conversion factors;

— An informative Annex B containing a series of examples on the use of the assessment method.

1 Scope

This document describes a calculation method to determine the indoor gamma dose from construction products. The method includes calculation of the indoor gamma dose from the individual construction product under its intended use, as well as the dose from the building taking consideration of multiple building materials where this is deemed necessary and any shielding from the terrestrial background.

The calculation method builds on existing modelling principles for photon emission and absorption. Parameters of the modelling that are not product specific, such as room geometry, exposure coefficients and conversion factors are predefined and form the underlying basis for the method in this document. The choice for pre-defined model parameters is essential from a harmonization perspective, despite the fact that such parameters can vary considerably for every homeowner, building type, region or country. Typical examples are the exposure time, building geometry, the location of exposure in the building and the terrestrial background radiation. The parameters are selected on the basis of international consensus, as laid down in ICRP, UNSCEAR, EU RP guidelines and other renowned publications. Product specific parameters such as density and thickness are specified in accordance with the product's intended use. In addition the products' massic activities of ^{226}Ra, ^{232}Th and ^{40}K are specified and obtained according to prEN 17216 [3]. The method provides a tiered approach with a basic approach intended for assessing individual construction products, followed by a more refined approach to assess a complete building design. The former approach assumes an identical structure of building materials on all six surfaces of the model room, and where needed complemented with other building materials that form an intrinsic part of the product's intended use. The latter approach enables evaluation of a known building design. Here the user can specify the applied construction product to walls, floor or ceiling separately in accordance with the product's intended use.

The indoor gamma dose from the individual construction product as well as the building is expressed in terms of an annual effective dose from gamma radiation in the indoor environment. The formulation of the indoor gamma dose in the building is consistent with the dose for indoor external exposure as stated under Article 75 of the Basic Safety Standards Directive. As a result the described method enables assessment of the calculated annual dose of the building against the reference level as defined in the Basic Safety Standards Directive.

The method is designed for assessment of mineral based building materials applied in bulk or superficially and used as a construction product in buildings. This includes any building materials that have been identified by EU member states as being of concern from a radiation protection point of view. The method is envisaged for use by producers of building materials, architects and building constructors as well as authorities.

It is important to state that following the calculation of dose, any subsequent regulatory classification falls explicitly outside the scope of this method and is the responsibility of the relevant authorities.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
building material
any construction product for incorporation in a permanent manner in a building or parts thereof and the performance of which has an effect on the performance of the building with regard to exposure of its occupants to ionizing radiation

[SOURCE: 2013/59/EURATOM, chapter II, Article 4, (9) [1]]

3.2
building structure
structure consisting of one or more building materials with either vertical or horizontal orientation or a combination of both, that separate the indoor space from the outdoor space or one space from another space in the building

3.3
bulk material
building material not being a superficial material

3.4
default material
building material with an assumed massic activity of 40 Bq/kg ^{226}Ra, 30 Bq/kg ^{232}Th and 400 Bq/kg ^{40}K

3.5
effective dose *E*
sum of the weighted equivalent doses in all the tissues and organs of the body from internal and external exposure

Note 1 to entry: The effective dose is defined by Formula (1):

$$E = \Sigma_T w_T H_T = \Sigma_T w_T \Sigma_R w_R D_{T,R} \quad (1)$$

where

E is the effective dose;

w_T is the tissue weighting factor for tissue or organ T;

H_T is the equivalent dose absorbed by tissue or organ T;

w_R is the radiation weighting factor;

$D_{T,R}$ is the absorbed dose averaged over tissue or organ T, due to radiation R.

Note 2 to entry: The values for w_T and w_R are specified in Annex II of the EU-BSS [1].

Note 3 to entry: The unit for effective dose is the sievert (Sv).

[SOURCE: 2013/59/EURATOM, chapter II, Article 4, (25) [1]]

3.6
^{40}K
radionuclide potassium-40

3.7
massic activity
quotient of the activity *A* of a sample and the mass *m* of that sample

[SOURCE: EN ISO 80000-10:2019, 10-28 [4]]

3.8
mass per unit area
quotient of mass and area

3.9
^{226}Ra
radionuclide radium-226 and its progenies in secular equilibrium

3.10
reference level
level of effective dose or equivalent dose or massic activity above which it is judged inappropriate to allow exposures to occur, even though it is not a limit that may not be exceeded

[SOURCE: 2013/59/EURATOM, chapter II, Article 4, (84) [1]]

3.11
sievert
Sv
special name of the unit of equivalent or effective dose

Note 1 to entry: One sievert is equivalent to one joule per kilogram: 1 Sv = 1 J/kg. Further details are provided under 3.4.

[SOURCE: 2013/59/EURATOM, chapter II, Article 4, (91) [1]]

Note 2 to entry: 1 Gy is also 1 J/kg.

3.12
superficial material
building material located on the interior side of the building structure, applied as a protective layer and/or for decorative purposes, and characterised by a low mass per unit area

Note 1 to entry: Superficial material may also include any other building material with a restricted use within the building structure, such as joint-filler, insulation material, sanitary ware, etc.

3.13
^{232}Th
radionuclide thorium-232 and its progenies in secular equilibrium

4 Symbols and abbreviated terms

This document uses the symbols and names of quantities as mentioned below; the units in which the quantities shall be expressed are also given.

Symbol	Name of quantity	Unit
A	activity	Bq
a	massic activity of ^{226}Ra, ^{232}Th or ^{40}K	Bq/kg
d	thickness of the construction product	m
$\dot{E}$	normalised nuclide specific effective dose rate	mSv/h per Bq/kg
E_{B1}	annual effective dose from the building without subtraction of background	mSv per year
E_{B2}	annual effective dose from the building with subtraction of background	mSv per year
E_{Bg}	European annual average terrestrial background from gamma radiation	mSv per year
E_{Cp}	annual effective dose from the construction product	mSv per year
i	ordinal for the construction product(s) starting with i = 1 for the construction product located on the inside of the building structure	–
j,k,l	ordinal	–
n	number of construction products in the building structure	–
ρ	density of the construction product	kg/m^3
ρ_A	mass per unit area	kg/m^2
ρ_{A1}	combined mass per unit area of the construction product i plus the constructions products that are located in front of construction product i	kg/m^2
ρ_{A2}	combined mass per unit area of the constructions products that are located in front of the construction product i	kg/m^2

5 Method for dose assessment

5.1 General

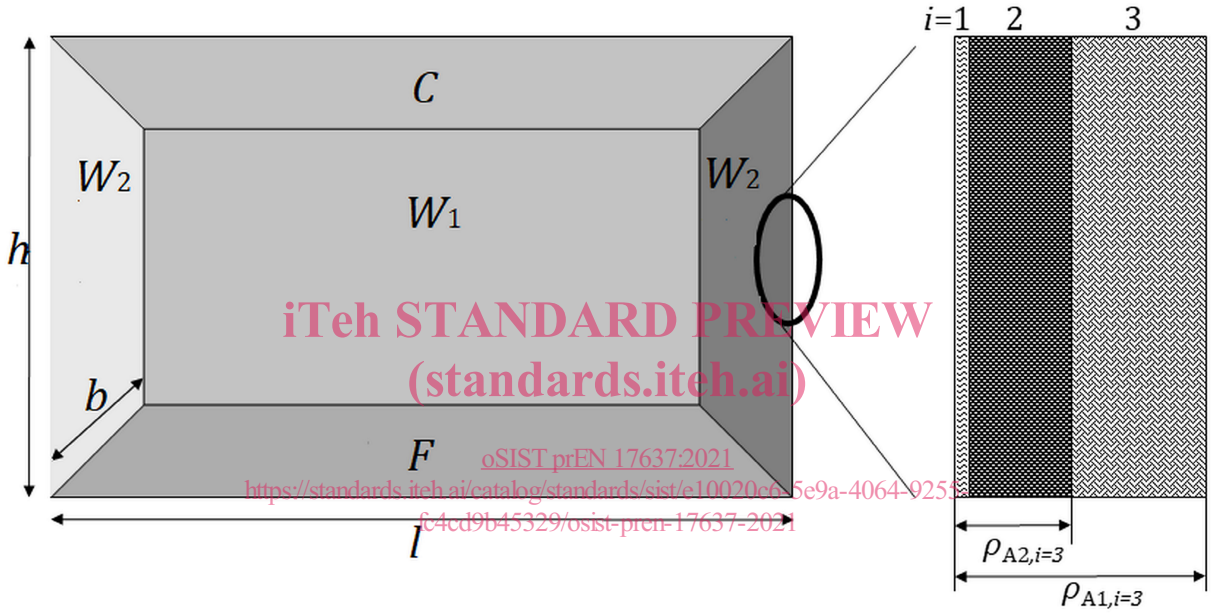
The dose assessment comprises of two approaches to calculate the dose from a single construction product or an assembly of construction products that make up a building or room. In addition it calculates the dose of the building by summing the dose from each of the construction products that make up the building. Subsequently a subtraction of background gamma radiation is applied to obtain the annual indoor effective dose from gamma radiation.

The method builds on a room geometry with a cuboid shape and six surfaces (Figure 1), not including any doors or windows. Here the front and back wall (W_1) have dimensions of 4 m × 2,5 m, the two side walls (W_2) have dimensions of 3 m × 2,5 m, and the ceiling and floor have dimensions of 3 m × 4 m. The dose is determined for the centre of the room.

Calculation of the dose within the proposed procedure is based on the concept of mass per unit area ρ_A, which is the product's density multiplied with the product's thickness in its intended use. To determine the dose from each construction product applied either at all six surfaces or only one,

shielding effects from the products located in front are considered. For this purpose the parameters ρ_{A1} and ρ_{A2} are introduced. ρ_{A1} represents the mass per unit area of the construction product of interest plus all products located in front. ρ_{A2} represents the mass per unit area of all construction products located in front of the product that is considered and excludes the mass per unit area of the product itself. An example is shown in Figure 1. The difference between ρ_{A1} and ρ_{A2} is the mass per unit area of the considered construction product. For this reason it is essential in the assessment to consider the appropriate order of the construction products, starting from the inside of the building structure. Where the assessment only considers one construction product, ρ_{A1} is the product's mass per unit area and ρ_{A2} is 0.

The dose assessment is designed for building structures with a mass per unit area of up to 500 kg/m². Any part of the building structure located on the outside that exceeds 500 kg/m² will have a negligible effect on the dose and shall be ignored in the calculation.



Key

C	Ceiling	b	= 3 m
F	Floor	h	= 2,5 m
W_1	Wall W1	i	= ordinal
W_2	Wall W2	l	= 4 m

NOTE The numbering (i) of the products runs from the inside to the outside of the building structure.

Figure 1 — Sketch of the model room together with a building structure containing three construction products

The main difference between both assessment approaches described under 5.2 and 5.3 are the following. The first assessment method for evaluation of a construction product is intended to assess the dose from an individual product and assumes its application on all six surfaces of the building. The second assessment method for evaluation of the building design is more refined and enables specifying multiple construction products for each of the building surfaces, which include the front and back wall, the two side walls, and the floor and ceiling separately.

Assessment of a single construction product does require that consideration should be given to a intended use that is intrinsically combined with other bulk products. In that case the adjacent