SLOVENSKI STANDARD
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Digestoriji - 8. del: Digestoriji za delo z radioaktivnimi snovmi

Fume cupboards - Part 8: Fume cupboards for work with radioactive materials

Abzüge - Teil 8: Abzüge für Arbeiten mit radioaktiven Substanzen

Sorbonnes - Partie 8 : Sorbonnes pour matières radioactives

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Fume cupboards - Part 8: Fume cupboards for work with radioactive materials

Sorbonnes - Partie 8 : Sorbonnes pour matières radioactives

Abzüge - Teil 8: Abzüge für Arbeiten mit radioaktiven Substanzen

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

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European foreword

This document (EN 14175-8:2022) has been prepared by Technical Committee CEN/TC 332 “Laboratory equipment”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by January 2023, and conflicting national standards shall be withdrawn at the latest by January 2023.

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Introduction

Before using radioactive materials, a safety (risk) assessment is performed with reference to legislation and advice from radiation protection experts.

The maximum amount of activity allowed for every activity with radioactive material is evaluated in accordance to the three principles of radiological protection, namely justification, optimization, and the application of dose limits, clarifying how they apply to radiation sources delivering exposure and to individuals receiving exposure. Shielding or abatement system when appropriate are also evaluated.

There are three kinds of dose in radiological protection. Absorbed dose is a measurable, physical quantity, while equivalent dose and effective dose are specifically for radiological protection purposes. Dose is used in this document as defined in IAEA Glossary 2018.

Attention is drawn to the publication IAEA SAFETY STANDARDS SERIES, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards General Safety Requirements Part 3 (No. GSR Part 3).

1 Scope

This document specifies the characteristics of fume cupboards, as defined in EN 14175-1, for work with unsealed radioactive materials with specific requirements regarding radiation protection. It does not apply to fume cupboards, glove boxes or hot cells (shielded radiation containment cells which can incorporate fume extraction).

The purpose of this document is to set out rules for the design and testing of fume cupboards for work with unsealed radioactive materials, in order to provide guidelines for the manufacturer, planner, installer, operator, assessor and the authorities.

This document only covers bench type fume cupboards.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

EN 13150, *Workbenches for laboratories in educational institutions - Dimensions, safety and durability requirements and test methods*

EN 14056, *Laboratory furniture - Recommendations for design and installation*

EN 14175-1, *Fume cupboards - Part 1: Vocabulary*

EN 14175-2:2003, *Fume cupboards - Part 2: Safety and performance requirements*

EN 14175-3:2019, *Fume cupboards - Part 3: Type test methods*

EN 14175-4, *Fume cupboards - Part 4: On-site test methods*

EN 14175-6, *Fume cupboards - Part 6: Variable air volume fume cupboards*

ISO 16170:2016, *In situ test methods for high efficiency filter systems in industrial facilities*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 14175-1, EN 14175-2:2003, EN 14175-3:2019, EN 14175-4, EN 14175-6 and the following apply.

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

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
abatement system
equipment dedicated to the removal or reduction of pollutants from releases from installation to air or liquid

Note 1 to entry: Examples for abatement systems are filters, scrubbers or holding tanks.

3.2
activity
quantity *A* of radionuclide that disintegrates in a second, defined as:

$$A\left(t\right) = \mathrm{d}N \,/\, \mathrm{d}t$$

where

d*N* is the expectation value of the number of spontaneous nuclear transformations from the given energy state in the time interval d*t*.

Note 1 to entry: The SI unit for activity is reciprocal second (s^{-1}), termed becquerel (Bq).

Note 2 to entry: This definition is generally based on the definition of activity given in Council Directive 2013/59/Euratom.

3.3
chamber
materials that form the work space

3.4
contamination
unintended or undesirable presence of radioactive substances on surfaces or within solids, liquids or gases or on the human body

Note 1 to entry: The term 'contamination' might have a connotation that is not intended. The term 'contamination' refers only to the presence of radioactivity, and gives no indication of the magnitude of the hazard involved.

[SOURCE: Council Directive 2013/59/Euratom, Chapter II, Article 4 (18) – modified, Note 1 to entry was added]

3.5
decontamination
complete or partial removal of contamination by a deliberate physical, chemical or biological process

Note 1 to entry: This definition is intended to include a wide range of processes for removing contamination from people, equipment and buildings, but to exclude the removal of radionuclides from within the human body or the removal of radionuclides by natural weathering or migration processes, which are not considered to be decontamination.

[SOURCE: IAEA SAFETY STANDARDS SERIES, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards General Safety Requirements Part 3 (No. GSR Part 3)]

3.6
exposure
act of exposing or condition of being exposed to ionising radiation

Note 1 to entry: If exposure is taken place outside the body this is called external exposure. If exposure is taken place inside the body, this is called internal exposure.

Note 2 to entry: This definition is generally based on the definition of exposure given in Council Directive 2013/59/Euratom.

3.7
ionizing radiation
energy transferred in the form of particles or electromagnetic waves of a wavelength of 100 nanometres or less capable of producing ions directly or indirectly

Note 1 to entry: A wavelength of 100 nanometres corresponds to a frequency of 3×10^{15} Hz or more.

Note 2 to entry: The definition of ionizing radiation is based on the definition given in Council Directive 2013/59/Euratom.

3.8
sealed source
radioactive source in which the radioactive material is permanently sealed in a capsule or incorporated in a solid form with the objective of preventing, under normal conditions of use, any dispersion of radioactive substances

[SOURCE: Council Directive 2013/59/Euratom, Chapter II, Article 4 (90)]

3.9
source
anything that can cause radiation exposure - such as by emitting ionizing radiation or by releasing radioactive substances or radioactive material - and can be treated as a single entity for purposes of protection and safety

[SOURCE: IAEA SAFETY STANDARDS SERIES, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards General Safety Requirements Part 3 (No. GSR Part 3) – modified, Note was deleted]

3.10
watertight
capable of preventing the penetration of water into or through the structure with a water pressure head corresponding to that for which the surrounding structure is designed

[SOURCE: ISO 19904-1:2019, 3.62]

4 Dimensions

The dimensions of fume cupboards for work with radioactive materials shall be in accordance with EN 14175-2 with the following supplement.

The internal workspace of the fume cupboard for work with radioactive materials should be the minimum volumetric size necessary to perform the function for which the fume cupboard is provided. Minimizing the internal dimensions will benefit cleaning and decontamination, but the space should be large enough to accommodate and access all the equipment to be used.

5 Basic safety and performance objectives

The basic safety and performance objectives of fume cupboards for work with radioactive materials shall be in accordance with EN 14175-2 with the following supplements.

Fume cupboards for work with radioactive materials shall protect employees and eventual public from contamination and exposure to ionizing radiation as far as reasonably practicable.

Vapours shall be effectively exhausted to reduce the risk of an explosive or hazardous atmosphere within the workspace.

Fume cupboards for work with radioactive materials shall be designed in accordance with the environmental principle of using “best available techniques” for limiting discharges, emissions and waste.

It is recommended, that all fume cupboards for work with radioactive materials are performance tested at the place of installation in accordance with EN 14175-4. On site test methods and the additional requirements are described in this document.

6 Materials

6.1 General requirements

The materials used for fume cupboards for work with radioactive materials shall be in accordance with EN 14175-2:2003, 6.1. The following requirements and the requirements given in 6.2 and 6.3 shall further apply for fume cupboards for work with radioactive materials.

Fume cupboards shall be designed and constructed such that they do not readily become contaminated and so that any contamination which does occur can be easily removed.

The workspace, the work surface and sash construction shall be such that the chosen materials are suitable for the work to be carried out. Special attention should be paid to chemical and ionizing radiation resistance, mechanical stability, structural design, ease of decontamination and cleaning, for further reference see also ISO 8690.

Fume cupboards shall be made of materials which withstand the anticipated mechanical, chemical, thermal and ionizing radiation stresses during expected use and shall not be easily combustible.

The materials of construction of these parts of the fume cupboards that are likely to come into contact with the fumes and ionizing radiation shall be selected to suit the nature of the processes to be carried out within the fume cupboard.

The choice of the appropriate material and the type of shielding needed is subject to safety assessment. The fume cupboard shall be appropriately constructed to allow easy disassembly and disposal including, where necessary, radioactive waste.

The construction of the fume cupboard shall be as such to allow for the possibility to add fixed external shielding under the worktop and if required to the side walls, ceiling, back wall and front sash. The amount and type of possible extra shielding will need to be specified by the user before the design is finalised. If shielding is implemented, it should be ensured that it cannot dissociate from the fume cupboard even in degraded conditions.

NOTE Using ceramic worktop and stoneware sinks can influence the results of contamination control measurements because of natural radioactivity.

If seals are used, they shall be set and accessible so that they can be decontaminated for example before dismantling.

When selecting the surface material, the chemical properties of the radionuclides to be used shall be taken into account. Consult radiation protection expert in regard to compounds to be used and suitability of construction materials of the fume cupboard.

6.2 Protective barrier

The choice of shielding materials used shall be based on energy, type of ionizing radiation (alpha, beta or gamma radiation) and the activity of the radionuclide to be handled. Materials with a high atomic number are appropriate shielding material when dealing with gamma emitters. For the handling of beta emitters, materials with a low atomic number are to be used for shielding. The occurrence of radiation deceleration (Bremsstrahlung) in the case of beta radiation shall be taken into consideration in the design of the shielding.

Lead can be an appropriate material for gamma radiation shielding while plastic panes are suitable materials for beta radiation shielding. A radiation protection expert should be consulted to determine the appropriate shielding material for specific cases.

6.3 Sash

In addition to protective barrier in accordance with 6.2 to protect against beta radiation, it is advisable to provide impact-resistant transparent low atomic number (Z) materials of adequate thickness for the sash. For gamma radiation, it is advisable to provide high atomic number (Z) materials of adequate thickness for the sash.

7 Safety requirements

7.1 General requirements

With regard to potential risks to workers from external or internal exposure when using a fume cupboard for work with radioactive materials as opposed to general fume cupboards, additional technical protective measures shall be taken. The effectiveness of the protective measures shall be evaluated at installation and verified and checked periodically by measurement in accordance with the advice of the radiation protection expert.

The technical measures in this regard are based on:

a) the ionizing radiation type;

b) the activity of the radionuclides to be handled;

c) physical properties and form of the ionizing material (gas, liquid, solid or powder);

d) chemical properties of the ionizing material;

e) the process(s) to be performed and duration;

f) the number of operations per period to be performed;

g) oxide friability (ease with which any oxidation layers are lost).

7.2 Construction

7.2.1 General

The construction shall be in accordance with EN 14175-2 with supplements given under 7.2.2 to 7.2.8.

7.2.2 Workspace

7.2.2.1 General

The side and rear panel connections shall be without joints and shall be watertight.

The inner surface of the chamber shall be smooth and jointless. If there are surface inconsistencies or irregularities they shall be filled and dressed or polished to have a surface roughness in the range from 0,001 mm to 0,003 mm in order to achieve a jointless finish.

Openings in the internal surfaces or components of the fume cupboard for work with radioactive materials workspace and service entry points (including any associated with fire suppression) shall be limited to as the absolutely necessary.