SLOVENSKI STANDARD
oSIST prEN 14175-8:2020

01-november-2020

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

Ta slovenski standard je istoveten z: **prEN 14175-8**

ICS:

13.280	Varstvo pred sevanjem	Radiation protection
71.040.10	Kemijski laboratoriji. Laboratorijska oprema	Chemical laboratories. Laboratory equipment

oSIST prEN 14175-8:2020 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 14175-8

September 2020

ICS 13.280; 71.040.10

English Version

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

Abzüge - Teil 8: Abzüge für Arbeiten mit radioaktiven Substanzen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 332.

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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 14175-8:2020) has been prepared by Technical Committee CEN/TC 332 “Laboratory equipment”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

1 Scope

This document specifies fume cupboards for work with unsealed radioactive materials with specific requirements regarding radiation protection and it does not apply to glove boxes or hot cells not even to α emitting radioisotopes.

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 planner, installer, operator, assessor and the authorities.

NOTE If, when handling unsealed radioactive substances, radiopharmaceuticals are produced for use on humans, the fume cupboards covered by this document are not sufficient.

Before using radioactive materials, a safety assessment needs to be performed. To find the maximum activity allowed for every activity with radioactive material it is necessary to take into account 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. Shield and abatement system required are also evaluated.

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 14175-6:2006, *Fume cupboards - Part 6: Variable air volume fume cupboards*

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 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 14175-1 to EN 14175-6, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards (IAEA SAFETY STANDARDS SERIES No. GSR Part 3) and the following apply.

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

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

3.1
activity
quantity A for an amount of radionuclide in a given energy state at a given time, defined as:

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

where

$\mathrm{d}N$ is the expectation value of the number of spontaneous nuclear transformations from the given energy state in the time interval $\mathrm{d}t$.

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

3.2
chamber
materials that form the work space

3.3
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.

3.4
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.

3.5
dose
measure of the energy deposited by radiation in a target

3.6
exposure
act of exposing or condition of being exposed to ionising radiation emitted outside the body (external exposure) or within the body (internal exposure)

3.7
ionizing radiation
energy transferred in the form of particles or electromagnetic waves of a wavelength of 100 nanometres or less (a frequency of 3 × 1015 hertz or more) capable of producing ions directly or indirectly

3.8
source
anything that may 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

3.8.1
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

3.8.2
unsealed source
radioactive source in which the radioactive material is neither permanently sealed in a capsule nor closely bonded and in a solid form

3.9
water tight
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(en), 3.62]

4 Dimensions

The dimensions shall be in accordance with EN 14175-2 with the following supplement.

The internal workspace of the fume cupboard should be the minimum volumetric size necessary to perform the function for which the fume cupboard is provided.

Minimizing the size is better from a cleaning and decontamination point of view, but should be large enough to accommodate all the equipment to be comfortably used.

5 Basic safety and performance objectives

The basic safety and performance objectives shall be in accordance with EN 14175-2 with the following supplements.

Fume cupboards for work with radioactive materials shall protect employee and environment from contamination and exposure to radiation.

6 Materials

6.1 General requirements

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

The workspace, the work surface and sash construction would be such that the chosen materials are suitable for the work to be carried out. Special attention should be paid to chemical and radiation resistance, mechanical stability, structural design, ease of decontamination and cleaning, for further reference see also ISO 8690[1].

NOTE The selection of material for the construction of the fume cupboard could be — powder coated steel, austenitic steel, polypropylene, epoxy resin, laboratory benchtops made of clay ceramic materials, etc. depending on the work to be carried out.

Fume cupboards shall be made of materials which withstand the anticipated mechanical, chemical, thermal and 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 radiation and shall be selected to suit the nature of the process carries out within the fume cupboard.

The choice of the appropriate material and the type of shielding needed is subject to safety assessment. Owing to an appropriate construction of the components an easy disassembly and disposal, if need be, as radioactive waste, shall be ensured.

The construction of the fume cupboard shall be in a way to give the possibility to add fixed external shielding under the worktop and if required to the side walls, ceiling and back wall. The amount and type of possible extra shielding will need to be specified by the user before the design is finalised.

Ceramic worktop or stoneware sinks may only be used if the level of natural radioactive material is so low that contamination control measurements are not affected.

When selecting the surface material, the chemical properties of the radio chemicals of the radionuclides to be used shall be taken into account. For example, stainless steel surfaces using radio iodide compounds and phosphates when using radio phosphorus compounds are not to be used.

6.2 Protective barrier

The shield materials used are based on energy, type of radiation (alpha, beta or gamma radiation) and the activity of the radionuclide to be handled. Materials with a high atomic number are appropriate shield material when dealing with gamma emitters. For the handling of beta emitters, materials with a lower 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.

NOTE Lead can be an appropriate material for gamma radiation shielding while plastic panes are suitable materials for beta radiation shielding.

6.3 Sash

To protect against beta radiation, it is advisable to provide impact-resistant transparent plastics of adequate thickness for the sash instead of glass.

7 Safety requirements

7.1 General requirements

With regard to potential risks for workers by 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 is to be checked by measurement.

[1] Under preparation. Current stage is 50.20.

The technical measures in this regard are based on:

a) the radiation type;

b) the activity of the radionuclides to be handled;

c) physical properties and form (gas, liquid, solid or powder);

d) chemical properties;

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 Workspace

7.2.1.1 General

The construction shall be in accordance with EN 14175-2 with supplements given below, under 7.2.1.2 and from 7.2.2 to 7.2.7.

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

Jointless fabrication of the chamber may be interpreted as being achieved through the use of welding. Butt-welding of sheet material shall not be allowed. Where lap or otherwise supported welds are made any resulting surface inconsistencies or irregularities shall be filled (with weld) and dressed/polished to have a surface roughness from 0,001 to 0,003 mm in order to achieve a 'jointless' finish.

Openings in the internal surfaces/components of the fume cupboard workspace and service entry points (including any associated with fire suppression) shall be limited.

All openings shall be sealed/gasketted to present a smooth surface/transition suitable to be readily cleaned/decontaminated and to be resealed following maintenance.

The design/construction of the fume cupboard workspace shall not result in voids/crackages which could become zones for the accumulation of potentially hazardous materials, and which may be difficult to clean or to decontaminate. In particular, the design of the single vertical sashes together with their support and guidance systems shall allow for readily-achieved and safe inspection, access, maintenance, and cleaning/decontamination.

7.2.1.2 Lighting units

The lighting units should be externally mounted with sealed lighting unit windows on the fume cupboard roof manufactured from glass or plastic as appropriate for the applications.

7.2.2 Work surface

The work surface is to be formed as a tray, without joints. The connections between the side and rear walls are to be either without joints or made watertight. One or more inlet openings may be provided in the work surface, and these are to be connected via outlet pipes to the radioactive waste network of the radionuclide laboratory or to a collection tank. The perimeters of the drain openings are to be raised above the work surface, but below the raised perimeter (see Figure 1). Further openings in the work surface are not permitted.