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Fume cupboards - Part 3: Type test methods

Abzüge - Teil 3: Baumusterprüfverfahren

Sorbonnes - Partie 3 : Méthodes d'essai de type

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Fume cupboards - Part 3: Type test methods

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

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Foreword

This document (prEN 14175-3:2014) 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.

This document will supersede EN 14175-3:2003.

EN 14175 consists of the following parts, under the general title Fume cupboards:

— Part 1: Vocabulary

— Part 2: Safety and performance requirements

— Part 3: Type test methods

— Part 4: On-site test methods

— Part 6: Variable air volume fume cupboards

— Part 7: Fume cupboards for high heat and acidic load

Part 5 ("Recommendations for installation and maintenance") has been published as Technical Specification CEN/TS 14175-5.

Start of application

The start of application of this standard is *[Date of publication]*

EN 14175-3:2003-12 may be used in parallel until *[Date of publication] + 12 months*

1 Scope

This part of the European Standard EN 14175 specifies type test methods for the assessment of safety and performance of fume cupboards. Relevant requirements are specified in Part 2 of this European Standard.

For terms and their definitions EN 14175-1 applies. For safety and performance requirements of fume cupboards EN 14175-2 applies. For on-site test methods of fume cupboards EN 14175-4 applies. For the type testing and on-site testing of variable air volume (VAV) fume cupboards, EN 14175-6 applies in addition to this standard.

For the testing of microbiological safety cabinets EN 12469 applies.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12665, *Light and lighting — Basic terms and criteria for specifying lighting requirements*

EN 13150:2001, *Workbenches for laboratories — Dimensions, safety requirements and test methods*

EN 14175-1:2003, *Fume cupboards — Part 1: Vocabulary*

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

EN ISO 5167-1, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 1: General principles and requirements (ISO 5167-1:2003)*

EN ISO 12569, *Thermal performance of buildings and materials — Determination of specific airflow rate in buildings — Tracer gas dilution method (ISO 12569:2012)*

3 Terms and definitions

For the purposes of this European Standard, the definitions given in EN 14175-1:2003 and the following apply.

3.1
plane of sash
plane in the middle between the innermost and the outermost screen surfaces of that part of the sash forming the upper boundary of the test sash opening.

Note to entry This definition replaces the definition given in EN 14175-1:2003, 5.4.

3.2
inner measurement plane
plane of sash at the type test opening, except where the plane of sash does not meet the work surface of the fume cupboard. In the latter case, it is usually a non-vertical plane bounded;

— at the top by the lowest point of the upper edge of the type test opening in the plane of the sash;

— at the bottom by the uppermost point of the lower edge of the opening closest to the plane of sash;

— at the sides by the side edges of the opening.

Note 1 to entry See examples in Figures 1 and 2.

Note 2 to entry This definition replaces the definition given in EN 14175-1:2003, 7.7.

3.3
containment factor (C_F)
ratio of the calculated volume concentration of tracer gas in the workspace of the fume cupboard to the measured concentration in the inner or outer measurement plane.

Note to entry The containment factor is not a constant value but depends on the extract volume flow rate and the measured concentration of tracer gas.

3.4
protection factor (P_F)
ratio of the volume flow rate of the tracer gas to the measured volume flow rate of the tracer gas in the tidal breathing flow

3.5
tidal breathing flow
volume flow rate of air moved into (or out of) human lungs during breathing

Note to entry For healthy adults, it is in the range of 6 l/min to 10 l/min. For the purposes of this standard, 10 l/min is used.

4 Test room and general test conditions

4.1 Dimensions and construction

The test room shall consist of an enclosure of cuboid shape, constructed of suitable materials, within a building or laboratory. The internal width and length shall be not less than 4,0 m and the ceiling height not less than 2,7 m. The ceiling and floor shall be level and the room shall be devoid of internal supports, internal walls or other obstacles to the airflow.

4.2 Test room conditions

The room air temperature shall be (23 ± 3) °C. The make-up air temperature during measurements shall be room air temperature ± 1 °C. Temperature gradients shall be avoided as far as possible. The make-up air shall be supplied at a distance greater than 2 m from the front of the fume cupboard.

The test zone boundary shall extend approx. 1,5 m in front of the fume cupboard and approx. 1,0 m from the outer sidewalls of the cupboard over the full room height.

Room extract air shall be extracted symmetrically on the opposite side to the make-up air supply and from outside the test zone. The air speed shall be less than 0,1 m/s at the test zone boundaries. Care shall be taken regarding uncontrolled air streams and draughts entering into the test room.

Any device the temperature of which exceeds 40 °C, except components which form part of the fume cupboard and/or the test equipment, shall be located outside the test zone boundaries.

The air extracted from the test room shall be discharged to atmosphere in such a way as to prevent its re-entrainment in the make-up air.

4.3 Fume cupboard installation

The fume cupboard shall be installed centrally on a wall with its opening facing away from the wall.

The test shall be carried out on the fume cupboard installed in the test room in accordance with the manufacturer's installation instructions.

4.4 Test conditions

4.4.1 General

No person other than the operator(s) shall be present in the test room during the measurements. No person shall remain in the test zone during the measurements.

There shall be no unnecessary obstructions or equipment within the test zone. No equipment other than that necessary for the tests shall be in the fume cupboard.

Windows and doors of the test room shall remain closed during measurements.

NOTE Observance of all test conditions is crucial for reproducibility and comparability of the test results.

4.4.2 Test sash positions

4.4.2.1 Vertical sash fume cupboards

The sash shall be set to the height of 500 mm ± 1 % measured in the centre of the opening. If the maximum height is less than 500 mm, the maximum operational sash opening shall be used and noted. If any additional opening is used, this shall be noted in the test report.

For the testing of walk-in fume cupboards, the upper sash opening shall be used as the test sash position. The lower edge of the sash opening should be at least 900 mm above floor level. If the physical configuration of the walk-in fume cupboard does not allow this positioning of the sash, the height of the lower edge shall be noted in the test report.

4.4.2.2 Horizontal sash fume cupboards

Sash(es) shall be set at one side opening of 500 mm ± 1 %. If the maximum sash opening is less than 500 mm, then the maximum opening shall be used and noted. The test shall be carried out with the first side opening and shall be repeated with the opening at the other side. If any additional opening is used, e.g. openings at both sides of the sash, this shall be noted in the test report.

4.4.2.3 Combination sash(es)

Vertical sash test: all horizontal sash(es) shall be set to the minimum sash opening and the procedure as in 4.4.2.1 shall be followed.

Horizontal sash test: vertical sash(es) shall be set to the minimum sash opening and the procedure as in 4.4.2.2 shall be followed.

If any additional opening is used, this shall be noted in the test report.

4.4.3 General procedure

The type testing procedures shall be applied to one example of a production model of the fume cupboard to be tested.

Adjust the make-up air and extract air systems to give the required flow rates and test conditions. Switch on all instruments and data recording (storing) device(s), and allow sufficient time for the instruments to stabilize.

5 Air flow tests

5.1 Extract volume flow rate

For each extract volume flow rate setting, the flow rate shall be measured in the extract duct in accordance with EN ISO 5167-1. The uncertainty of measurement shall not exceed ± 5 %.

5.2 Face velocity

5.2.1 Test equipment

5.2.1.1 Anemometer

The anemometer shall be of the unidirectional type with a directional sensitivity of ± 20°. The time constant of the anemometer shall be less than 0,5 s. The uncertainty of an individual measurement shall not exceed 0,02 m/s + 5 % of the reading in the range of 0,2 m/s to 1,0 m/s. An anemometer with a valid calibration certificate shall be used.

5.2.1.2 Data recording

A means of recording the output of the anemometer for subsequent analysis shall be provided.

5.2.2 Probe positions

The anemometer probe shall be positioned at points formed by the intersection of lines on the inner measurement plane (see examples in Figure 1) as follows:

a) a series of at least three equally spaced lines between the side boundaries of the inner measurement plane with the two outermost lines (100 ± 5) mm from the side boundaries. The lines in between shall be at a distance of 400 mm or less from the outermost lines and to each other.

b) a series of at least three equally spaced lines between the horizontal boundaries of the inner measurement plane with the two outermost lines (100 ± 5) mm from the horizontal boundaries. The lines in between shall be at a distance of 400 mm or less from the outermost lines and to each other.

5.2.3 Test procedure

Measurements shall be made with the anemometer probe located at each of the measurement grid points. Adjust the orientation of the sensor so that its measurement direction is perpendicular to the inner measurement plane. Disturbances to the space upstream of the sensor shall be minimized.

Measure and record the individual velocity component v_i perpendicular to the inner measurement plane at regular intervals of 1,0 s or less for a period of at least 60 s.

5.2.4 Data analysis and results

Calculate at each measurement point by equation (1) the mean value $\bar{v}$ of the measured velocity components v_i in meter per seconds and round the result to the second decimal place:

$$\bar{v} = \frac{1}{n} \sum_{i=1}^{n} v_i \qquad (1)$$

where n is the number of measurements taken during the period of min. 60 s.

Calculate at each measurement point by equation (2) the standard deviation s_r of the measured velocity components v_i in meter per seconds and round the result to the second decimal place:

$$s_r = \sqrt{\frac{\sum_{i=1}^{n} \left(v_i - \bar{v}\right)^2}{n-1}} \qquad (2)$$

Calculate the spatial average velocity (see EN 14175-1:2003, 7.6) in meters per seconds at the type test opening and round the result to the second decimal place.

5.3 Containment

5.3.1 Test equipment

5.3.1.1 General

The following test equipment shall be used. Other equipment and/or test gas may also be used provided that it is proven to give the same results within ± 10 %. Materials of construction should not affect the test results. All instruments shall have a valid certificate of calibration.

5.3.1.2 Tracer gas

The tracer gas shall be sulphur hexafluoride (SF_6).

5.3.1.3 Test gas

The test gas shall be (10 ± 1) % volume fraction of sulphur hexafluoride (SF_6) in nitrogen (N_2). The storage temperature of the test gas shall be at the test room temperature ± 2 °C.

5.3.1.4 Test gas flow regulator

The test gas flow regulator shall be capable of regulating the flow rate with a maximum permissible error of ± 5 %.

5.3.1.5 Test gas injector

The test gas injector shall be a hollow cylinder made of sintered metal with a length between 20 mm and 25 mm and a diameter between 10 mm and 15 mm. The pressure drop through each test gas injector shall be within 10 % of their mean value. Test gas injectors shall be connected to the test gas source by flexible tubes of equal length.

5.3.1.6 Sampling probe

Each sampling probe shall consist of a tube of internal diameter (10 ± 1) mm and a length of at least 100 mm. The tube's wall thickness shall not exceed 2 mm.

5.3.1.7 Sampling manifold

The sampling manifold shall be a hollow cylinder. The sampling probe connecting tubes shall be evenly distributed around the perimeter of the cylinder with the manifold outlet in the centre.

5.3.1.8 Connecting tubing

The sampling probes shall be connected to the sampling manifold by flexible tubes of equal lengths.

5.3.1.9 Sampling pump

The sampling pump shall be capable of operating at a flow rate constant within ± 5 %.

5.3.1.10 Gas analyser

The gas analyser including the connected means of recording shall have a detection level of 10^{-8} or less volume fraction of the tracer gas.

5.3.1.11 Time constant of the test system

The time constant of the sampling system including gas analyser shall be less than 15 s.

5.3.1.12 Data recording

A means of recording the output signal of the gas analyser for subsequent analysis shall be provided. The recording interval shall be 2 s or less.

5.3.2 Test conditions

The background concentration of tracer gas in the test room shall not exceed 10^{-8} volume fraction.

5.3.3 Positioning of test equipment for inner measurement plane

Nine sampling probes (see 5.3.1.6) shall be arranged in a grid formed by the intersection of lines as follows:

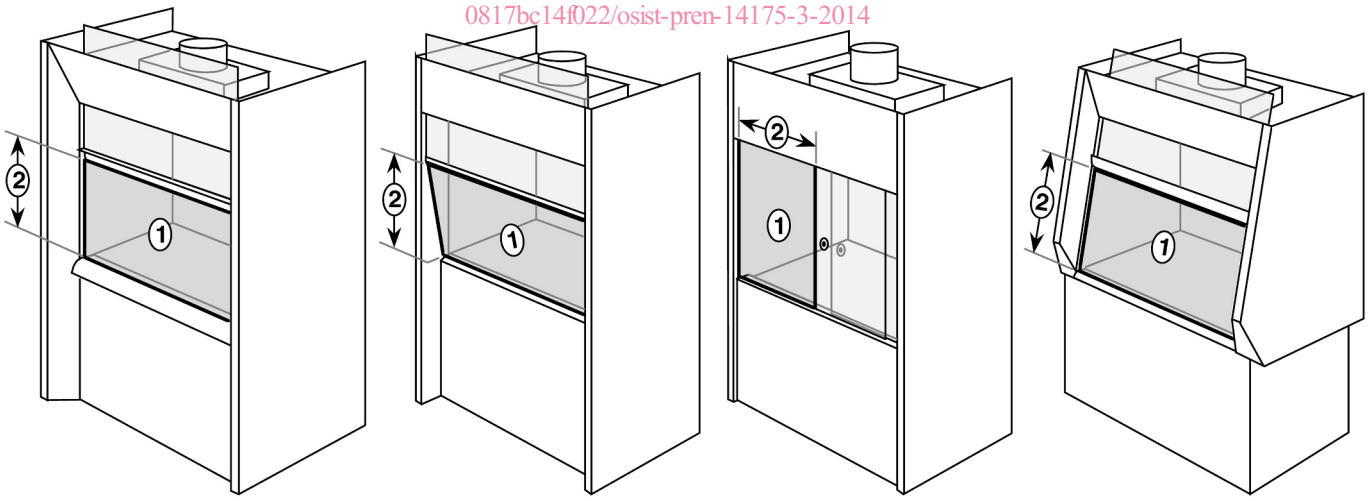
a) three equally spaced lines in the vertical direction. The space between the lines shall be (100 ± 5) mm.

b) three equally spaced lines in the horizontal direction. The space between the lines shall be (100 ± 5) mm.

The test gas injector (see 5.3.1.5) shall be arranged with its centre in line and (150 ± 5) mm from the centre of the sampling probe grid.

The sampling probe grid shall be positioned together with the injector so that the sampling probes are on the inner measurement plane and the injector is in the workspace of the fume cupboard on a plane (150 ± 5) mm from the inner measurement plane.

Figure 1 and Figure 2 show examples of the positioning of the inner measurement plane for different designs of fume cupboards.



Key

1 inner measurement plane
2 test sash opening

Figure 1 — Inner measurement plane