NF X 15-211_UNM 61-335

French Standard

Index Class : X 15-211

ICS : 13.040.30 ; 71.040.10

T1 Laboratory Installations

T2 Re-circulatory fume hood

T3 Generalities, Classification, Requirements

E : Laboratory equipment — Re-circulatory fume hood — General, classification,

D : Laboreinrichtungen — Absaugbox mit Luftrückführung — Allgemeines, Klassifizierung, Anforderungen

Note of the UNM Administrative office to the UNM 61 standardization commission "Laboratory Installations"

The following project
NF X 15-211 "Laboratory installations – Re-circulatory fume hood- Generalities, Classification, Requirements"

Is published for validation before investigation probation

Remarks: Your comments are to be given to the UNM secretariat office by August 25, 2008 at the latest.

Questions followed by: Secretariat

 Mlle LUDIVION
 01 47 17 67 77
 n.ludivion@unm.fr
Mme MORET
 01 47 17 67 75
 a.moret@unm.fr
Mlle NAGAMAH
 01 47 17 67 87
 f.nagamah@unm.fr

French Standard

Index Class : X 15-211

ICS : 13.040.30 ; 71.040.10

T1 Laboratory Installations

T2 Re-circulatory Fume hood

T3 Generalities, Classification, Requirements

E : Laboratory equipment — Re-circulatory fume hood— General, classification,

D : Laboreinrichtungen — Absaugbox mit Luftrückführung — Allgemeines, Klassifizierung, Anforderungen

French standard approved by order of the AFNOR Managing Director to take effect by:

Correspondence

At the time of publication of this document, there are no similar international or European works pertaining to this same subject.

Analysis

The present document which is aimed at manufacturers and users of re-circulatory fume hoods defines specifications which these apparatus must comply with in relation to their class and performance tests.

Descriptors

International Thesaurus Technique: Laboratory equipment, enclosure, classification, exposure, personnel, toxic agent, dangerous substance, smoke, specification, testing, marking, instruction handbook.

Modifications

Corrections

H:\Secteur4\Normes en cours\NF\X 15-211_NF EN\NF_X_15-211_(F).doc

Laboratory Installations **UNM 61**

Standard Commission Members

President: M CASAGRANDE

Administrative Staff: Miss LUDIVION & Mme MORET – UNM

M BERTEAUX	SEAT VENTILATION
M BLOMET	PREVOR
MME BOUST	INRS
M CASAGRANDE	SEAT VENTILATION
M DINAUX	ROT
MM DUBOIS	ROT
MME GESLIN-LEVASSEUR	AFNOR
M GREJON	EQUIP LABO
M HAUVILLE	ERLAB D.F.S SAS
M HERRY	ERLAB D.F.S SAS
M LALOUX	ERLAB D.F.S SAS
M LAUNAY	CYLTEC
M MAGNERON	BACOU-DALLOZ
M MARTIGNENE	SECURIGAZ DOUCHES
M MARTIN	MIDILABOR
M PITHON	FABRILABO
M THIEULIN	TRIONYX
M TRIOLET	INRS
M WIELEZYNSKI	BNBA
M ZENONE	LABOVER

Summary Page

1 - Scope of application..... 5

2 - Normative references..... 5

3 - Terms & definitions..... 5

4 - Classification..... 6
4.1 - Classification according to the level of safety..... 6
4.2 - Classification according to the type of filtration..... 6

5 - Requirements..... 7
5.1 - Working status..... 7
5.2 - Frontal air speed 7
5.3 - Containment..... 7
5.4 - Filtration..... 7
5.5 - Documentation..... 8
5.6 - Specific requirements for re-circulatory fume hoods class 1..... 8
5.7 - Specific requirements for re-circulatory fume hoods class 2..... 8

6 - Performance tests..... 9
6.1 - Filtration..... 9
6.1.1 - Filtration tests..... 9
6.1.2 - Analyzers..... 9
6.1.3 - Test procedure method..... 9
6.1.4 - Filtration test report..... 11
6.2 - Containment..... 11
6.2.1 - Containment test..... 11
6.2.2 - Equipment..... 12

7 - Marking..... 14

8 - Instruction handbook..... 14

1 Scope of application

The present document specifies the classification and the characteristics of re-circulatory fume hoods.

This standard is applicable to all re-circulatory hoods designed for works in research, analysis or teaching, in educational premises, research or control organizations for the industry, to be used with chemical agents having a professional VLE (Exposure Limit Value) and excluding bacteriological pathogenic or carcinogenic products, mutagen or toxic to reproduction of category 1 or 2.

2 Normative references

The following documents of reference are essential for the application of the present document. For dated references, only the cited edition applies. For non dated references, the last edition of the document of reference (including prospective amendments) applies.

NF EN 14175-1:2003, *Fume cupboards — Part 1 : Vocabulary.*
NF EN 14175-2:2003, *Fume cupboards — Part 2 : Safety requirements& performance.*
NF EN 14175-3:2004, *Fume cupboards — Part 3 : Type test methods.*
XP X 15-206, *Laboratory fume cupboard — Threshold for containment test, installation and maintenance.*
NF EN 1822-1:1998, Very *high efficiency air filters & very low diffusion air filters (HEPA & ULPA) - Part 1: classification, performance test & marking.*

3 Terms and definitions

For the requirements of the present document the terms & definitions of the NF EN 14175-1 standard including the following apply.

3.1
Re-circulatory fume enclosure
Protective device capable of trapping specific pollutants while exhausting air extracted from the room.
[EN 14175-1:2003 standard, definition 3.6]

3.2
Professional exposure limit value (VLEP)

3.2.1
Average exposure limit value (VME)
8 Hour limit value (VL8h)
Concentration threshold of a chemical agent expressed as10^{-6} per volume or as mg/$m^{3,}$ intended at protecting workers from long term exposure measured or estimated during a period of 8 hours (VL8h).

Note 1 The VME workplace list is published and periodically updated by the I.N.R.S (National Scientific Research Institute).

Note 2 10^{-6} by volume is commonly referred to as ppm

3.2.2
Exposure Limit Value (VLE)
Concentration threshold of a chemical agent expressed as10^{-6} per volume or as mg/$m^{3,}$ measured during a maximum period of 15 minutes.

Note 1 These values are intended to protect workers from harmful health effects due to short time exposures; they are today progressively replaced by VLCT (Short term exposure limit value).

Note 2 The VLE workplace list is published and periodically updated by the I.N.R.S (National Scientific Research Institute).

3.2.3
Short term exposure limit value (VLCT)
Concentration threshold of a chemical agent expressed as10^{-6} per volume or as mg/$m^{3,}$ intended to protect from exposure peaks relating to a period of 15 minutes (or indicated otherwise)

NOTE The VLCT workplace list is published and periodically updated by the I.N.R.S (National Scientific Research Institute).

3.3
Air Pollutant
Any pollutant emitted in the atmosphere generated by human activity or by natural process affecting humans or the environment.

3.4
Retention capacity
Chemical agent mass that a filter can retain depending in particular on the chemical agent expressed in grams.

3.5
Normal operation phase
Phase during which the filter will retain a chemical agent specified in the manufacturer's instruction handbook.

3.6
Detection phase
Phase following the normal operation phase until the detection system indicates a chemical agent concentration at the filter exhaust superior or equal to 1% of the professional exposure limit value concerned.

3.7
Safety Phase
Phase following the detection phase allowing to terminate the ongoing manipulation without exceeding 50% of the professional exposure limit value of the chemical agent concerned.

3.8
Safety reserve
Chemical agent mass which can be retained during the safety phase while guaranteeing to not exceed the professional exposure limit value concerned.

4 Classification

4.1 Classification according to the level of safety

Two classes are defined according to the level of safety:

- Class 1: re-circulatory fume enclosure with a safety reserve;
- Class 2: re-circulatory fume enclosure without a safety reserve.

4.2 Classification according to the type of filtration

Three types are defined according to the chemical agents filtered:

- Type P: Particles filtration;

- Type V: Vapors filtration;
- Type PV : Particles & Vapors filtration

5 Requirements

5.1 Working status

The re-circulatory fume hood must be equipped with a working light when the hood is activated.

5.2 Frontal air speed

Re-circulatory fume hoods must be equipped with a continuous ventilation monitoring device according to NF EN 14175-2:2003 standard, paragraph 8.2.

For re-circulatory fume hoods equipped with a rectangular mobile facade capable of moving vertically or horizontally, the frontal air speed is measured according to paragraph 5.2 of the NF EN 14175-3:2004 standard. The measured values must be superior to 0.4 m/s at any point.

For re-circulatory fume hoods equipped with a fixed facade the frontal air speed at any point of the openings must be between 0,4m/s & 0,6 m/s.

5.3 Containment

The containment threshold selected for re-circulatory fume hoods must be that of the XP X 15-206 standard. During the containment test the air extracted from the re-circulatory fume hood must be aspirated by an air exhaust device to the outside in order to prevent SF_6 accumulation within the testing room's atmosphere.

The testing protocol is described in section 6.2 of the existing standard.

5.4 Filtration

For filtration evaluation when a chemical agent has several limit values, the professional limit value retained must be the lowest of the VME, VL8h, VLE or VLCT.

The filtration system of re-circulatory fume hoods must allow not to exceed, at the filter or filters exhaust, more than 1% of the professional limit value for the chemical agent manipulated in the re-circulatory fume hood during the normal operation phase as defined in section 3.5 according to the mode of operation test described in section 6.1.3a.

The filtration system of re-circulatory fume hoods must present itself as interchangeable cartridges, corrosion resistant to chemical agents capable of being used in the re-circulatory fume hood.

The filtration system must be identified by a tag acknowledging the chemical agents filtered.

The filter installation date must be visible at the front of the re-circulatory fume hood.

Re-circulatory fume hoods of type P or PV must have a particles filter with an efficiency of type H14 at the very least as defined in the NF EN 1822-1 standard.

Re-circulatory fume hoods of type P or PV must at least be submitted to the following:

a) In the case of filters designed to be used with volatile organic chemicals: two successive tests must be made, one with cyclohexane (C_6H_{12}; CAS n°110-82-7) and the other with isopropanol (C_3H_8O; CAS n° 67-63-0). Each test must be performed with a new filter.

b) In the case of filters designed to be used with acid vapors: a test will be carried out with hydrochloric acid (HCL ; CAS n° 7647-01-0).

5.5 Documentation

Re-circulatory fume hoods must come together with a booklet including an exhaustive list of chemical agents that the manufacturer certifies can be manipulated in the re-circulatory fume hood within the conditions of the present standard.

This list must include for each chemical agent:

1) The chemical agent name, its formula, its CAS number, its boiling point, its molecular mass, its vapor pressure at 20°C;

2) The adapted filter reference and its retention capacity during normal operation phase

3) The saturation detection system type for the adapted filter or filters and eventually its tune up.

4) The maximum mass of the chemical agent which can be introduced within the re-circulatory fume hood.

5) The name of the testing laboratory which has performed the type test.

The re-circulatory fume hood manufacturer must be able to justify all declared retention capacity values within that exhaustive list according to the mode of operation test described in article 6, for each chemical agents considered.

5.6 Specific requirements for re-circulatory fume hoods class 1

Class 1 re-circulatory fume hoods must be equipped with a continuous chemical agent concentration measurement system allowing the triggering of an alarm when entering into the safety phase.

During the detection phase class 1 re-circulatory fume hoods must not release at the filter or filters exhaust more than 1% of the professional exposure limit value for the chemical agent manipulated (see section 6.1.3b)

During the safety phase class 1 re-circulatory fume hoods must not release at the filter or filters exhaust more than 50 % of the professional exposure limit value for the chemical agent manipulated (see section 6.1.3c)

5.7 Specific requirements for re-circulatory fume hoods class 2

Class 2 re-circulatory fume hoods must include:

- Either a sound & visual alarm triggered by an hour counter set at maximum every 60 working hours and a sample portal device allowing to cyclically measure the manipulated chemical agent concentration at the filter exhaust point.

- Or a continuous measurement system for detecting the concentration of chemical agents at the filter exhaust associated with an alarm.

During the detection phase, class 2 re-circulatory fume hoods must not release at the filter exhaust more than 50 % of the professional exposure limit value for the chemical agent manipulated (see section 6.1.3b)

For class 2 re-circulatory fume hoods, the chemical agent mass which can be introduced within the re-circulatory fume hood must not exceed 1/8 of the filter retention capacity during the normal operation phase as conformably described in section 6.1.3a.

6 Performance Tests

6.1 Filtration

6.1.1 Filtration Tests

The re-circulatory fume hood under test, equipped with a new set of filters is placed into a closed space.

The chemical agent used for the test is evaporated within the re-circulatory fume hood so as to obtain a constant concentration during all operational phases.

a) 200 x10^{-6} per volume for the isopropanol test

b) 200 x10^{-6} per volume for the cyclohexane test

c) 50 x10^{-6} per volume for the hydrochloric acid test

The chemical agent concentration at the filtration system exhaust must be controlled at least three (3) times per hour during all operational phases of the re-circulatory fume hood and must be expressed as 10^{-6} per volume. The limit values of the reference chemical agents for the filtration test must be supplied in table 1.

Table 1 - Limit values of the reference chemical agents for the filtration test

Chemical agent name for the test	CAS Number	Limit Value 10^{-6} per volume
Isopropanol	67-63-0	400
Cyclohexane	110-82-7	300
Hydrochloric Acid	7647-01-0	5

The test must be performed by 8 hour sequences at16 hour intervals

6.1.2 Analyzers

No matter what product is submitted for testing, the analysis procedure must be adapted so as to obtain a detection threshold inferior to 1% of the professional exposure limit value selected.

The procedure may be for example one of those stated hereunder or any other equivalent methods:

- Hydrochloric Acid vapors sampling is performed by gas bubbling a known volume of air to be taken (flow rate known, sampling time known) in a buffered Na_2CO_3/$NaHCO_3$ solution. The prepared sample is then analyzed by ionic chromatography (CI).

- Organic vapors sampling (cyclohexane or isopropanol) is performed by trapping a known volume (flow rate known, sampling time known) of air to be taken from an adsorbing cartridge (Tenax or activated carbon). The prepared sample is then desorbed by a disulfide carbon solution (CS_2) before it is analyzed by gas phase chromatograph equipped with a proper detector (DIF).

6.1.3 Test procedure method

Tests must be performed at a temperature of (20± 2) ℃ and at a relative humidity level ranged between 40% and 70%.

The re-circulatory fume hood submitted for testing is placed into a closed test chamber which internal volume must be between 10 to 50 times the size of the re-circulatory fume hood internal volume.

The device used to evaporate the selected chemical agent (for example a hot plate) must not raise by more than 5 °C the temperature within the re-circulatory fume hood in comparison to the temperature in the test chamber.

The chemical agent used for the test is introduced by means of a peristaltic pump, dripping into a heated dish, placed at the center of the work surface in the re-circulatory fume hood submitted for test. During the whole duration of the test the system is calibrated so as to produce a desired concentration at plus or minus 10% in the re-circulatory fume hood. I f needed, heat the dish slightly above the test chemical agent boiling point level so as to instantly evaporate it (see Figure 1).

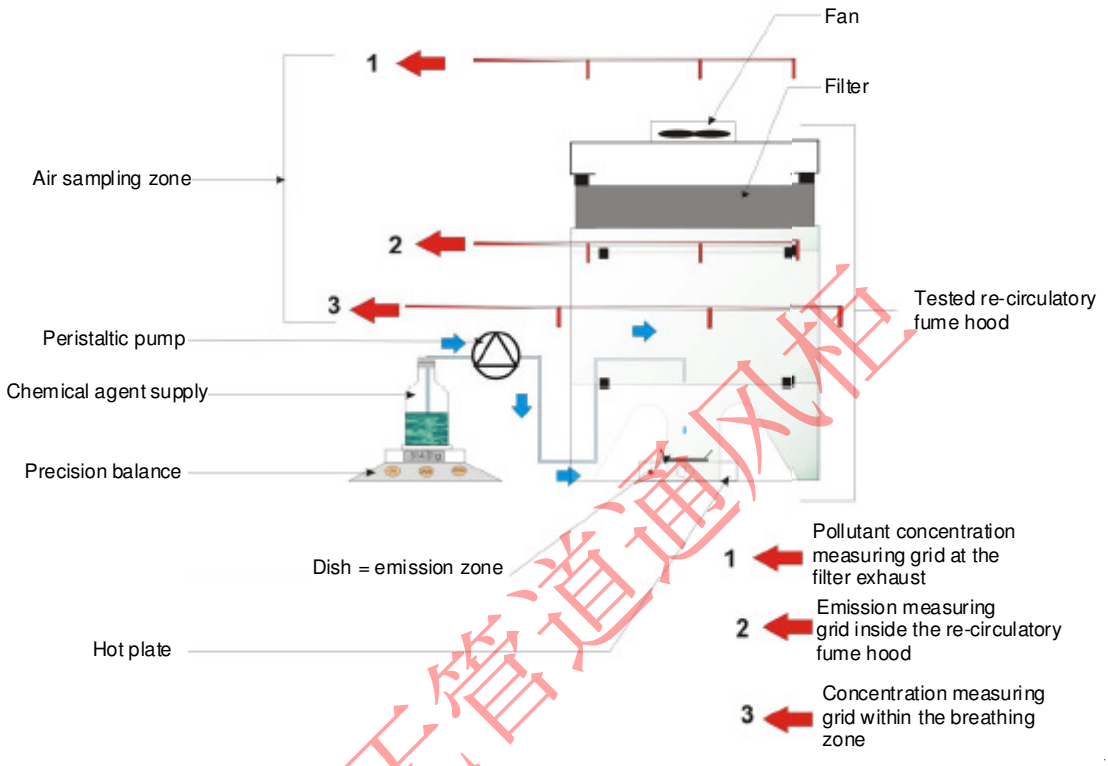


Figure 1 – Operational assembly diagram (Evaporation principle & air sampling)

The air is sampled within three (3) zones according to a procedure to be adapted in relation to the chosen measurement protocol. (see 6.1.2) :

- Zone 1: Regularly during the whole testing period, the air is sampled at 30 cm above the filtration system so as to verify the purification performances of the re-circulating fume hood submitted for test.

-Zone 2: Right from the start of the test (as soon as the evaporation concentration has stabilized itself), the air is sampled in the interior of the hood, 30 cm below the filtration system so as to verify the emitted concentration at the filters entry point.

NOTE It is important to take all necessary precautions during testing so as to avoid air sample alteration between the sampling zone and the analyzer. It is important to produce a sampling so as to obtain a reliable measurement result of the air analyzed (for example by using multipoint sampling grids).

The following steps a) & b) for class 2 re-circulatory fume hoods and steps a) to c) for class 1 re-circulatory fume hoods are performed successively. The test is satisfactory if each of the following criteria is respected.

a) During the normal operation phase, the chemical agent concentration used for the test at the filter exhaust point must not exceed 1% of the professional exposure limit value selected. The evaporation must last until the totality of the considered chemical agent (indicated in the document supplied by the manufacturer mentioned in section 5.5) is evaporated.

b) During the detection phase, the chemical agent concentration used for the test at the filter exhaust point must not exceed 1% of the professional exposure limit value selected for class 1 re-circulatory fume hoods and 50% of the professional exposure limit value selected for class 2 re-circulatory fume hoods.

c) During the safety phase, the chemical agent concentration used for the test at the filter exhaust point must not exceed 50% of the professional exposure limit value selected. The duration of this phase must not be inferior to 1/12 of the normal operation phase period.

6.1.4 Filtration report test

For each test, the test report must indicate:

- The test reference (Laboratory name responsible for the test);
- The closed test chamber volume in which is placed the re-circulatory fume hood;
- The re-circulatory fume hood reference submitted for testing;
- The type or reference of the filter or filters provided with the re-circulatory fume hood submitted for testing;
- The nature of the chemical agent used for the test.

For each test phase the test report must indicate:

- The duration expressed in hours;
- The chemical agent mass retained;
- The chemical agent concentration used during the test expressed as 10^{-6} per extracted air volume.

6.2 Containment

6.2.1 Containment test

6.2.1.1 General test conditions

During the containment test, the front facade of the re-circulatory fume hood must be tested in the work position recommended by the manufacturer. The position and geometry of the front mobile facade must be precisely described in the test report.

The positioning of the measurement points during the containment test must be performed by taking into account the opening geometry of the facade.

Three configurations are distinguished:

- Mobile facade with vertical or horizontal movement;

- Fixed facade with non rectangular openings which surface is superior to 30 cm x 30 cm allowing the positioning of the measurement probe.

- Fixed facade with non rectangular openings which surface is inferior to 30 cm x 30 cm not allowing the positioning of the measurement probe.

6.2.1.2 Test protocol in relation to configurations

Case 1: Mobile facade with vertical or horizontal movement

The sampling probes grid must be positioned within the interior measuring plane, the central probe being placed at the points formed by the intersection of the lines as follow:

a) A series of lines at equal distance between the vertical edges of the interior measuring plane, the two most exterior lines being located at (130 ± 5) mm of the vertical edges. The intermediate lines must be located at a distance inferior or equal to 600 mm of the most exterior lines and one compared with the other.

b) A series of lines at equal distance between the horizontal edges of the interior measuring plane, the two most exterior lines being located at (130 ± 5) mm of the vertical edges. The intermediate lines must be located at a distance inferior or equal to 600 mm of the most exterior lines and one compared with the other.

Case 2: Fixed facade with non rectangular openings which surface is superior to 30 cm x 30 cm allowing the positioning of the measurement probe.

The sampling probes grid must successively be positioned on a number of sampling point, at minimum equal to 1, and calculated according to the following formula:

$$Nb = \frac{A}{0{,}09} \text{ rounded to the inferior whole number}$$

With:

Nb = number of sampling points

A = Total facade opening surface area expressed in m^2

The positioning points of the sampling grid probes must be arranged evenly on the surface opening within the interior measuring plane. None of the sampling points must be placed at less than 135 mm from the opening surface edges. The test report must detail precisely the position of the sampling points.

Case 3: Fixed facade with non rectangular openings which surface is inferior to 30 cm x 30 cm not allowing the positioning of the measurement probe.

The fixed facade of the hood must be replaced for the containment test by a testing facade opened at the center by a square of 30 cm x 30 cm. Only one measuring point is carried out at the center of the test facade opening within the interior of the measurement plane.

6.2.2 Equipment

- Test Gas:

The tracer gas must be sulfur hexafluoride SF_6. The test gas must be a fraction of the volume of (10 ± 1) % of sulfur hexafluoride (SF_6) in Nitrogen (N_2). The gas storage temperature must be equal to the temperature of the testing room at ± 2 °C;

- Gas flow regulator:

The gas flow regulator must be capable of maintaining a flow with a maximum margin of error of ± 5 %;

- Test gas injector:

The test gas injector must be a hollow cylinder made of sintered metal with a length ranging between 20 mm & 25 mm and a diameter ranging between 10 mm & 15 mm. The charge loss in each test gas injector must be equal to a mean value ranging between ± 10 %. Flexible tubes of equal length must connect the test gas injectors to the gas source.

- Sampling pump:

The sampling pump must be able to work with a constant flow of ± 5 %. The sampling flow choice is selected in relation to the characteristics of the analyzer. The sampling pump must not pump or reject more than 50l/mm.

- Gas analyzer:

The tracer gas analyzer must measure continuously and specifically the tracer gas concentration. The measurable concentration scale must be at least ranging between 0, 01 x 10^{6} per volume and 100 x 10^{-6} per volume of tracer gas. The measurement precision must be between ± 10 % for concentrations superior to 0, 1 x 10^{-6} per volume and ± 25 % for concentrations ranging between 0, 01 x 10^{-6} per volume and 0, 1 x 10^{-6} per volume. Before the test is performed, the gas analyzer must be calibrated according to the manufacturer's recommendations.

- Sampling probes grid

Each sampling probe must be made up of a tube with an interior diameter of (10 ± 1) mm and a minimum length of 100 mm. Wall thickness must not exceed 2 mm.

All grid sampling probes are connected to a sampling collector. The sampling collector must be a hollow cylinder with a minimum deformation ratio (diameter/height) of 10. Sampling probes connecting tubes must be evenly spread around the cylinder perimeter, the collector exit point being located at its center. Sampling probes and the sampling collector must be connected with flexible tubes of equal length.

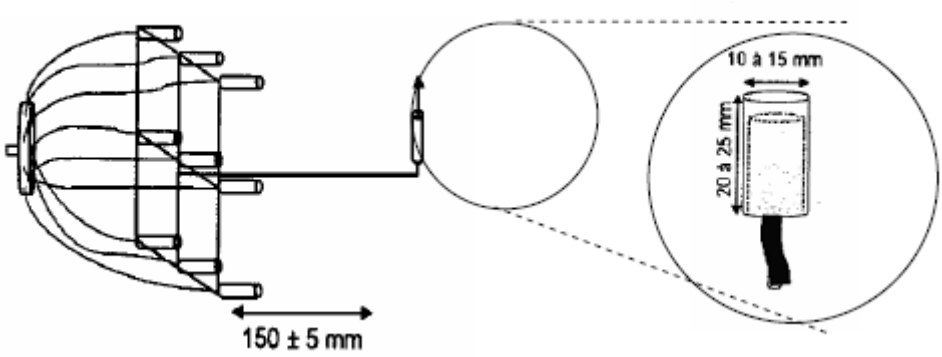
Nine sampling probes must be placed on a grid by the intersection of lines as follow:

1) Three lines vertically positioned at equal distance. The space between the lines must be (100 ± 5) mm;

2) Three lines horizontally positioned at equal distance. The space between the lines must be (100 ± 5) mm.

The test gas injector center must be aligned and withdrawn by (150 ± 5) mm from the sampling grid center.

The measurement grid and the injector must be positioned so that the sampling probes are placed on the interior of the measuring plane and that the injector be placed within the re-circulatory fume hood working space on a plane placed at (150 ± 5) mm from the internal measurement plane (see figure 2).



Injector and sampling probes position Test Gas Injector

Figure 2 – Sampling probes grid

7 Marking

Re-circulatory fume hoods must show an identification tag visible from the work station including at least the following permanent and non erasable information:

- Name of the manufacturer;
- The model, manufacturing date and the serial number of the re-circulatory fume hood;
- Class according to the filtration type;
- Safety level class;
- Reference to the present standard.

8 Instruction handbook

The instruction handbook must indicate usage limitations of the re-circulatory fume hood and in particular:

- Must only be manipulated in the re-circulatory fume hood chemical agents which have a professional exposure limit value and which are part of an exhaustive list supplied by the fume hood manufacturer;
- Quantities used in the re-circulatory fume hood must not exceed those contained in the instruction handbook supplied by the manufacturer mentioned in section 5.5;
- For class 2 re-circulatory fume hoods only those manipulations which can be stopped without delay can be performed. The filter must be changed as soon as the presence of a chemical agent is detected at the filter exhaust.

The instruction handbook must:

- Indicate the filters to be used in relation to the chemical agents manipulated;
- Caution the user on the rapid increase in concentration of pollutants at the filter exhaust when it is nearing the saturation point;

- Indicate the rule of choice for pollutants to be monitored and the detector to be used when several chemical agents are manipulated within the re-circulatory fume hood;

- Make clear the operational mode for filter replacement, maximum filter lifetime and proper storage;

- Make clear the nature and the frequency of routine tests allowing to insure the proper use of the re-circulatory fume hood including filter leakage verification;

- Make clear the maintenance instructions of the re-circulatory fume hood and the periodic verifications to be performed for example: air flow, concentration of pollutants at the filter exhaust;

- Recommend to keep a control handbook for each re-circulatory fume hood making clear the quantities and the nature of the chemical agents used in the re-circulatory fume hood;

- Indicate setting ups to be avoided.