HEALTH AND SAFETY POLICY

LABORATORY FUME CUPBOARDS

ARRANGEMENTS & GUIDANCE

ROYAL FREE NHS TRUST

&

ROYAL FREE & UC MEDICAL SCHOOL

OF UNIVERSITY COLLEGE LONDON

ROYAL FREE CAMPUS

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INTRODUCTION

This document gives guidance on how best to use their fume cupboard and what their limitations are. It also gives guidance to managers on assessing and maintaining their fume cupboards. Section 3 of this document contains a list of commonly used terms.

Fume cupboards are fitted in laboratories for the protection of users, to prevent exposure of harmful respirable substances. The control of exposure to such substances is governed by the Control of Substances Hazardous to Health (COSHH) Regulations 1999 (1). The COSHH Regulations require the prevention or control of exposure to any harmful substance(s) which includes using such measures as laboratory fume cupboards discharging to atmosphere, re-circulating fume cupboards, microbiological safety cabinets and fume extract systems such as those used in welding.

This document deals with fume cupboards venting to atmosphere, and re-circulating fume cupboards (Appendix 3). Advice is also provided on ventilated benches (Appendix 4).

The main guidance that has been produced on installation and use of vented fume cupboards is British Standard, BS 7258 (2). British Standard BS 7989 (3) contains similar advice for re-circulating fume cupboards.

At the Royal Free a significant number of vented fume cupboards pre-date the British Standard. These tend to be on a central extract system which runs continuously and vents above the 12th floor. There is a programme to bring these fume cupboards up to an acceptable level of safety and to maintain them to the level of the standard.

With regard to ventilated benches (Appendix 4) some manufacturers claim that their products meet the same standard of protection (containment) as that for fume cupboards. Anything less than the same standard of containment for fume cupboards should not be considered for work with harmful substances.

Fume cupboards used for work with harmful substances must meet minimum requirements of the British Standards. Installations only used to control low levels of fume, dusts or noxious smells does not need to meet such strict standards.

SUMMARY OF THE COSHH REGULATIONS IN RELATION TO USE OF FUME CUPBOARDS

- When making an assessment of the experimental process, deciding on which operations need to be carried out in a fume cupboard.

- Where the assessment indicates that a fume cupboard is necessary, ensuring that the fume cupboard is used.

- Testing and maintaining the fume cupboard on a regular basis which includes checking its performance, and keeping a record of such checks.

- Reporting any defects of the fume cupboard to the person(s) responsible.

- Instruction and training in the use of fume cupboards.

These regulations apply to both vented and re-circulating fume cupboards as well as ventilated benches.
3 DEFINITIONS

**Average Face Velocity** means the inward airflow velocity measured in several specific locations across the plane of the fume cupboard sash opening. Air velocities measured in any single location should not vary by more than 20% from the mean. (Note for most work the average should be equal or greater than 0.5m/s (metres per second) at an opening of 500mm).

**Compensating Fume Cupboards** These types of fume cupboards achieve more stable flow velocities at different sash openings by allowing air to enter from a bypass system as the sash is lowered or raised.

**Containment** This is a measure of how well the fume cupboard is able to prevent escape of any substance released inside the enclosure. Fume cupboards should have a better containment then 10^5, which means that one particle may escape for every 100,000 released within the fume cupboard. Containment is affected by average face velocity, design of structure, external air currents and equipment inside the fume cupboard.

**Hazardous Substance** Have been classified by the CHIP Regulations (4) into the following types:

- Very Toxic
- Toxic
- Harmful
- Corrosive
- Irritant
- Sensitising agent
- Carcinogenic
- Toxic to reproduction
- Mutagenic

Biological agents (micro-organisms, blood and body fluids etc) are also covered by this classification, however, these substances should not be used in a fume cupboard.

**Make-up Air** This is the air supplied to the room to replace that removed by the fume cupboard. This must not rely on windows and doors having to be opened.

**Safe Point** Sash position at which the average face velocity is equal or greater than 0.5m/s. This is normally used where average velocity is below 0.5m/s at a sash opening of 500mm.

**Working Opening** Is the height up to which the sash may be raised whilst the experimental procedure is being carried out to ensure a velocity of no less than 0.5m/s. (For experiments involving low risk an average face velocity of 0.3m/s to 0.5m/s would be acceptable). The working height of the sash in vented fume cupboards should not normally be above 500 mm.

4 PURPOSE & LIMITATIONS OF FUME CUPBOARDS

Fume cupboards are designed to prevent exposure to harmful chemicals. They are not designed for use with micro-organisms. Microbiological safety cabinets must be used for this purpose.
The containment or ability of the fume cupboard to prevent exposure of the operator to harmful substances depends on a number of factors. These include the following:

- The initial design and meeting of minimum standards (e.g. BS 7258 and BS 7989),
- Subsequent maintenance and testing of the installations,
- Siting of fume cupboards in relation to other extract equipment, pedestrian traffic and local air flows within the laboratory,
- The amount of storage of equipment and chemicals,
- The types of activities carried out within the fume cupboard

and for re-circulating fume cupboards:

- The selection of the correct type of filter,
- The timely replacement of filters using a safe method,
- Safe disposal of filter,
- The volume of chemical challenge presented at any one moment.

5 RESPONSIBILITIES (UNDER THE COSHH REGULATIONS)

Heads of Department / Manager

It is up to the Head of Department / Manager to ensure that:

5.1 Fume cupboards are properly used. (See also point 5.7 below).

5.2 Fume cupboards are regularly tested and inspected and that adequate records of all such tests are kept.

5.3 Should it be suspected that contaminants are not being contained within the fume cupboard, to inform the Safety Adviser.

5.4 For re-circulating fume cupboards, filters are tested and replaced as required.

Directorate of Projects

New Installations

5.5 The Head of Department / Manager and Director of Projects will be jointly responsible for ensuring that the fume cupboard of the correct type for the purpose, is adequately sited and that the materials and installation work is carried out in accordance with BS 7258 or BS 7989

Maintenance of testing

5.6 The Director of Works Operations will be responsible for testing and maintaining vented fume cupboards. (see Appendix 2)

Breakdowns

5.7 The Director of Works Operations will be responsible for informing all departments with fume cupboards that feed into the main extract stack when there is a failure of the extract system.

The Head of Department / Manager will be responsible for ensuring the fume cupboards are not used once notification of failure of extraction has been received.
De-commissioning

5.8 The Director of Works Operations in consultation with the Head of Department / Manager will be responsible for the de-commissioning of redundant fume cupboards. A certificate of decontamination of the fume cupboard installation (but not ducting) will need to be produced.

Employees

5.9 Employees will be responsible for using fume cupboards when required to do so as a result of a COSHH assessment and in making sure that they work in a safe manner. They will also be responsible for checking the proper functioning of the fume cupboard prior to starting to use it. The sash position must not be above the Safe Point (see Appendix 1) during normal use.

Supervising Tutors

5.10 Supervising tutors are responsible for how students in their charge, use fume cupboards. They are responsible for ensuring information, instruction and training for users of fume cupboards.

6. ASSESSING THE USE OF FUME CUPBOARDS

The following need to be considered:

Process - The decision to use a fume cupboard would normally be made when the risk (COSHH) assessment is carried out.

Type - Vented fume cupboards are acceptable for most types of laboratory work with chemicals. Re-circulating fume cupboards, in general, are suitable for lower risk laboratory work. Processes involving hydrofluoric, perchloric or hot concentrated mineral acids may require a more specialised type of cupboard not covered by this document (see references 5-7).

Use - The use of fume cupboards both for experimental use and storage needs to be discouraged. For example, should there be an explosion within the fume cupboard, what would be the consequences? There needs to be sufficient working space on the outside. The user must not be put at risk through being knocked by another person.

Fume cupboard performance considerations are outlined in Appendix 1.

Significant risks and controls need to be recorded and regularly reviewed. The record may be on an individual risk assessment form or with a documented operating procedure.

7. NEW INSTALLATIONS AND MODIFICATIONS

The fume cupboard, ducting and dispersal system outside the building are to be constructed and fitted in accordance with the British Standard on Laboratory Fume Cupboards, BS 7258. Siting within the laboratory needs to be in accordance with the guidance supplied in BS 7258 or BS 7989, (Contact Safety Office ext.8034 or 020 7830 2520).

New vented fume cupboard installations must have adequate make-up air. Where more than one fume cupboard is fitted in a room or there is a biological safety cabinet vented to the outside, these must not compete for the make-up air.

The fume cupboard must not be sited next to frequently used passage ways, as this can adversely affect the containment, see Part 2 of reference 2.

The height of the discharge stack must at least comply with the minimum requirements of paragraph 9.4.1 of Part 2 of Reference 2. Because of the complex nature of the Royal Free Hospital and Medical School buildings, consideration must be given to ensuring most of the
discharge fumes do not re-enter the buildings, (see Reference 8). This will involve observing airflow patterns using a smoke generator.
APPENDIX 1
Maintenance and Testing of Fume Cupboard Performance.

1. TESTING AND INSPECTION

Testing and inspection are legally required to be carried out at least every 14 months, (effectively annually), on all fume cupboards. In addition, at least a weekly check needs to be carried out to indicate that the fume cupboard is functioning (unless fitted with a flow alarm).

For vented fume cupboards the following needs to be carried out on an annual basis:

i measurement of average face velocity, normally arranged by Works staff, and carried out by a contractor,

ii maintenance of motor, fans etc. and inspection of ducting and general extract system. This is to be carried out by the Works staff or contractor. (see Appendix 2),

iii inspection and maintenance of the fume cupboard itself. This is to be carried out by Works staff or contractors.

iv where fume cupboards have been fitted with special filters, these will need to be changed in accordance with manufacturers / suppliers recommendations. Who carries out the change of filter will depend on the complexity of the fume cupboard design etc.

2. Average Face Velocity

The optimal average face velocity is 0.5 m/s. Most universities have adopted the standard of 0.5 m/s at a 500 mm sash opening. The following standards have been adopted at the Royal Free:

• 0.3 - 0.5 m/s at a working opening for all work not involving very toxic or toxic substances, unless these are in minute quantities.
• 0.5 - 0.75 m/s at a working opening for all work involving very toxic, toxic, carcinogenic or radioactive substances.

Note the working opening should normally be no more than 500 mm and the average face velocity should be no more than 1 m/s at the working opening, otherwise loss of containment is likely to result due to turbulence.

3. The schedule for testing of fume cupboards is listed in point 7 below. Records of all such checks need to be kept by the Assistant Head of Administration or Head of Department (A).

4. Where a fume cupboard is not fitted with a built-in airflow velocity meter, or alarm the bottom of fume cupboard sashes should be fitted with a strip of flexible material (e.g. plastic tape) to indicate when the fume cupboard is drawing in air. This in effect does away with the necessity of a weekly check provided that the user checks the meter or tape every time they use the fume cupboard.

5. The sash mechanism should be checked every 6 months after the annual test. This operation may be carried out by the departmental technical staff. Records of all such examinations need to be kept within the department. The following need to be checked:

(A) Assistant Head of Administration – Medical School, Head of Department for the Trust,
• Inspection of sash mechanism for corrosion and damage.
• Inspection of condition of controls and services to fume cupboard. Also check any alarms for sash position or airflow.

6. All faults should be put right as soon as possible. If the fault significantly affects or is likely to affect the functioning of the fume cupboard, then the fume cupboard may not be used until the fault is corrected. A sign needs to be displayed on the front sash of the fume cupboard to prevent usage. Locking off the sash may also need to be considered.

7. **THE TESTING OF FUME CUPBOARD FACE VELOCITIES.**

7.1. This examination should be carried out using a vane anemometer (available from the Safety Office), which is capable of reading down to 0.25 m/s and up to 1 m/s. Hot wire and small diameter vane anemometers may be used but can be problematic, particularly where a wide variation of air velocities occurs over a small cross sectional area.

7.2. The measurements should be made with the fume cupboard emptied of apparatus and containers. If this is impossible, then the report should indicate the position of all chemicals / apparatus. If there are any doubts, the measurement must be repeated at a later time when the fume cupboard has been cleared.

7.3. Measurements should be carried out with the operator standing away from the opening, otherwise this is likely to affect the readings.

7.4. Measurements should be carried out with the sash open at 500 mm. If the average face velocity is well below 0.5 m/s, then the readings should be taken with the sash open at 300 mm. If the average velocity is below 0.5m/s, then the sash should be moved to the position where 0.5m/s is achieved and this point indicated on the sash frame. The sash must not be used above the marked point, the Working Opening.

7.5. The opening should be divided into 9 sections at 500 mm or 6 at 300 mm openings.

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Measurements should be taken at the centre of each section.

7.6. The readings should be taken after at least 60 seconds. If there are large fluctuations in the readings, due for example to changes in wind speed outside the building, then an average of at least three readings should be taken at each section.

7.7. Where possible, smoke tests should be carried out to examine edge integrity, using a smoke source. Smoke released at the edge of the opening on the outside should be drawn into the fume cupboard. Outward flow of smoke indicates that chemicals released in the fume cupboard could escape into the room. (a smoke generator is available from
the Safety Office).

7.8. The person carrying out the measurement should be trained. (Contact the Safety Office).

A fume cupboard where airflow velocities fall outside 20% of the mean or where edge losses are marked will have deemed to have failed.

7.9. The following information needs to be recorded:

- Department
- Room number
- Date
- Date of Last Measurement
- Make of Fume Cupboard (where known)
- Width
- Opening 500 mm (or 300 mm)

- Mean Face Velocity
  - Maximum velocity, expressed as % of mean
  - Minimum velocity, expressed as % of mean

- Was edge integrity tested Yes/No
  - If yes, were there any areas of loss, if so, where?

- Name and position of person carrying out the measurement and examination.
- Name and position of person/company carrying out the servicing, (where relevant).
此工作仅由工程部门和/或合格的承包商执行。

这些建议基于 BS 7258 的第 3 部分第 5 条款。

1) 检查风扇、电机、驱动装置和轴承的正常运行。

2) 检查防火挡板和释放机制（如果适用）。

3) 检查风扇叶轮的磨损和腐蚀。

4) 检查排气堆的稳定性和状况。

5) 检查吸风风管的状况，特别是接头。检查通过检查口清洁风管内部的必要性，特别是在弯曲处可能堵塞的地方。

6) 检查实验室补气平衡及其温度。

7) 检查平衡挡板的位置。

8) 记录所有维护工作将由相关部门保存。

助理病理服务主任和皇家免费校区助理行政主任将收到所有记录的副本。
APPENDIX 3

RE-CIRCULATING FUME CUPBOARDS/HOODS

1. These should, in general, conform to British Standards BS 7989: 2001. These
devices cannot be recommended for highly toxic chemicals and regular use of toxic
and/or flammable solvents in large quantities, (see point 2.6 of Reference 5).

2. They may be used for non-toxic, non-corrosive or non-flammable materials, or for very
small quantities.

3. The following points must be considered in assessing suitability:
   i. What chemicals is the filter designed to absorb?
   ii. What warning is given that the filter is saturated?
   iii. Are there any circumstances where de-sorption can occur due to preferential
        absorption of another chemical at a later stage?
   iv. What is the containment of the fume cupboard and are there any limitations?
   v. What is the standard for average face velocity?
   vi. Is it safe to use sources of heat in the re-circulating fume cupboard?
   vii. Can the filter be safely disposed of?

4. These devices should be tested under the COSHH Regulations, using 3 or 4 positions
along the opening, as described in point 7 of Appendix 1. It will have to be maintained
on at least an annual basis in accordance with the supplier’s information.

5. The filter(s) should be changed at intervals specified by the supplier or manufacturer
and at least on an annual basis, unless the supplier states in writing that this is not
necessary.

6. The prioritising of the fume cupboard should comply with the recommendations of part
2 of BS 7258:1994, (reference 2). Specifically there should be 3m between the fume
cupboard and another extract system operating in the same room.
APPENDIX 4

VENTILATED BENCHES

Introduction
Ventilated benches have been shown to be as successful as fume cupboards in dealing with contaminants\(^{(9)}\). They have the advantage of allowing greatly improved access and therefore are likely to reduce certain types of accidents such as those involving sharp implements and are also used in autopsies or dissection. Their limitations are that they may not contain projected particles as a result of an explosion or localised heating may adversely affect containment.

Standard
There is no set standard for ventilated benches as there is for Laboratory Fume Cupboards\(^{(2)}\). The suggested standards set out below are based on the requirements of the COSHH regulations\(^{(1)}\) and the standards set for Fume Cupboards\(^{(2)}\). These include the following:

1. Check of the performance at least every 14 months (effectively annually) using either a measure of containment or average air inflow velocities. (legal requirement).
2. A weekly visual check of function to indicate that the extract system is working. (Legal requirement).
3. Containment to be at least \(10^5\) where any hazardous substances are used. A measurement of extract air velocity in selected locations on the extract surface should be measured at the same time as containment level so that it may be used as a standard.
4. Air velocities should be measured by laying the vane anemometer head (100mm diameter) on the bed surface and the values averaged over one minute. The location of the head shall be determined by a grid method similar to that set out in Appendix 1. No single measurement should deviate by 20% from the mean.
5. Where the ventilated bench is also used for control of potential micro-organisms, then the final extract shall pass through a HEPA (High efficiency particulate absorption) filter.
6. HEPA filters will need to be changed at intervals recommended by the manufacturer/supplier. If there is no manufacturers/suppliers information then continuous airflow monitoring needs to be considered and a cut off point for changing the filter specified.
REFERENCES

1. The Control of Substances Hazardous to Health Regulations 1999 and Approved Code of Practice HSE Books 1999. (These Regulations are scheduled for revision in 2002).

2. British Standard BS 7258: 1994 - Laboratory Fume Cupboards:
   - Part 1 Specification for Safety and Performance
   - Part 2 Recommendations for the Exchange of Information and Recommendations for Installation
   - Part 3 Recommendations for Selection, Use and Maintenance
   - Part 4 Method for determination of the containment value of a laboratory fume cupboard.


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