Health and Safety Office

Fume Cupboard Guidance

Contents

1. Introduction

The University has a responsibility under Health and Safety legislation to provide and maintain plant and systems of work, which are safe, and without risk to health (Health & Safety at Work etc Act 1974). Hence there is a duty to ensure that fume cupboards used within the University effectively protect staff and students from exposure to substances that may be hazardous to their health.

The Control of Substances Hazardous to Health (COSHH) 2002 Regulations impose a duty on employers to manage the exposure of their employees to hazardous substances. Where it is not reasonably practicable to prevent exposure, control measures must be employed to reduce it to an appropriate level. Fume cupboards are a common form of engineered control employed within laboratories with the aim of partially containing hazardous chemicals and preventing their release into the workplace environment.

COSHH requires all Local Exhaust Ventilation (LEV) including fume cupboards to be maintained in effective and efficient working order and to be subject to inspection and testing every 14 months or more frequently when risk assessments identify a high risk of exposure. The COSHH Approved Code of Practice 5th edition 2002 and the HSE publication ‘Maintenance, Testing and Examination of Local Exhaust Ventilation’ provide detailed guidance for employers to help ensure testing and maintenance is carried out as required by the regulations to demonstrate LEV is operating as it is designed to do and is adequately controlling exposure to hazardous substances.

The British Standards BS EN 14175-2:2003 and BS7989:2001 specify the safety and performance requirements for general purpose fume cupboards and further outline the technical specifications required for design, manufacture, installation and containment testing of fume cupboards. Whilst past guidance has relied on face velocity measurements as a representative means of demonstrating fume cupboard performance, current philosophy places the emphasis on demonstrating containment, which is most reliably done by establishing a program of regular tracer gas containment testing. The current British and European standard (BS EN 14175-2:2003) describes all suitable performance test methodologies in detail.Copies of the standards documents are held by the Health and Safety Office.

This guidance document is intended for all staff who may use, manage or maintain fume cupboards and provides information on the safe use, maintenance and testing of the different types of fume cupboards in use across the University.

2. Responsibilities.

2.1 Schools and Units

Schools and Units have a responsibility to ensure that

2.1.1 Where ductless, re-circulating fume cupboards are installed, these units are maintained and tested in accordance with COSHH regulations.

2.1.2 Users are trained in the safe operation of fume cupboards

2.1.3 Staff and students are using fume cupboards correctly, and work is carried out in the appropriate fume cupboard.

2.1.4 Fume cupboards are regularly checked before use, and this is recorded.

2.1.5 Information regarding the substances used is recorded and available to maintenance staff before any remedial work is carried out.

Defects are reported immediately to Estates Maintenance Service.

2.2 Estates

As outlined in the Works Instruction WI-6 document, the University Estates Operations department are responsible for the maintenance and testing of ducted, permanently installed fume extraction systems as follows -

2.2.1 Maintaining ducted fume cupboard performance to provide acceptable containment levels and face velocity flow rates.

2.2.2 Arranging a routine preventative maintenance schedule and remedial maintenance as necessary.

2.2.3 Arranging a regular testing schedule (as required by COSHH regulations 2002), recording and regularly reviewing test results and performance data.

2.2.4 Upkeep of all maintenance and testing records.

2.2.5 Provision of fume cupboard operational specifications, performance conditions and test results to users.

2.2.6 Ensuring fume cupboards are labelled appropriately

3. Fume Cupboard Types.

3.1 Conventional, ducted fume cupboards.

These are fume cupboards whose exhaust is ducted to the outside atmosphere, usually via a stack/chimney whose height above roof level is designed to ensure full and proper dispersion of the fumes away from all areas where people might be affected. The University operates two types of conventional, ducted units:

3.1.1 Constant Air Volume (CAV).

These are designed to maintain a constant air extraction volume no matter where the sash is positioned. Face velocities will vary depending on where the sash is set and will increase as the sash is closed. Air bypass openings situated near the sash ensure that changes in face velocity are kept within a specified range. Depending on design, fume cupboard sashes may move vertically, horizontally or in combination.

3.1.2 Variable Air Volume (VAV).

These units use sash positioning controls to vary the fume cupboard extract fan speeds and subsequently alter the air extract volume. The extract volume varies depending on where the sash is positioned and allows face velocities to remain constant, at a predetermined level. The systems may be linked to building monitoring systems to enable extract and room make up air to be balanced.

3.2 Ducted, low flow fume cupboards.

These fume cupboards are specially designed to maintain suitable containment at lower face velocities thus offering significant energy efficiency over standard systems. They typically operate with face velocities of 0.3 ms-1.

3.3 Ductless, re-circulating fume cupboards.

These are self contained units in which the exhaust air is passed through a filtration system and discharged back into the room.

3.3.1 Filters must be matched to the class of chemicals to be used and have a limited absorbent capacity (Appendix Two). Care must be taken to ensure this limit is not exceeded as it can result in the release of hazardous substances into the work environment.

3.3.2 These units are not suitable for work involving radioactive, highly toxic, carcinogenic or sensitising substances. It should be noted that HSE do not recommend using these fume cupboards for exposure control of vapours or carbon nanotubes (HSE Control Guidance note 201 and HSE Risk Management of Carbon Nanotubes 2009).

3.3.3 The selection and fitting of recirculating systems must be carefully reviewed. Consideration should be given to whether such a unit can provide adequate, reliable control of the anticipated hazards and that the resources and a safe system of work

are in place to ensure the unit is monitored and maintained to expected specifications. These units should be only installed under exceptional circumstances, following risk assessment with guidance from the Health and Safety Office.

3.6 Specialty Fume Cupboards.

Other specialty fume extraction systems exist, which offer protection against specific hazards or classes of chemicals. These include acid digestion, water wash and scrubber systems, further information can be provided by the Health and Safety Office.

4. Fume Cupboard Performance Criteria.

4.1 Fume cupboards should be maintained within the performance thresholds recommended by the manufacturer and confirmed at the time of commissioning. This includes expected face velocity and containment values where provided by the manufacturer.

4.2 Work with radioactive materials that may result in a gaseous or aerosol release should be performed within a designated conventional ducted fume cupboard that has a minimum face velocity of 0.5ms-1 or an average SF6 containment of 0.01ppm. These designated fume cupboards are signed appropriately (Appendix Three) and listed on the University Radiation Permit. Further guidance can be obtained from the University Radiation Protection Adviser.

4.3 Where manufacturer performance specifications are not available e.g. older units currently installed, the following face velocity guidelines should be followed:

4.3.1 Conventional, ducted fume cupboards.

- For standard work with hazardous substances, the face velocity should be 0.5 ms-1 ±10% with the sash set to 500mm height.
- When face velocities fall below 0.45 ms-1 the unit should be removed from use until remedial work has been completed.

4.3.2 Ducted, low flow fume cupboards

- Standard work with hazardous substances, the face velocity should be 0.3 ms-1 ±10%.
- Where face velocity falls below 0.27 ms-1 the unit should be removed from use until remedial work has been completed.

5. Factors affecting Containment.

5.1 Many factors can influence how effectively a fume cupboard will contain vapours, users should be aware of these and ensure the fume cupboard is set up to minimise these effects. Schools and departments have a responsibility to ensure their staff and students have been fully briefed on the correct use before beginning work and have read and signed off on this guidance document.

5.1 Obstruction

5.2.1 Large, bulky items and overcrowding with equipment & reagents can cause turbulence within the fume cupboard and may block the air flow to the rear baffles and result in a reduction in fume cupboard efficiency.

5.2.2 Containment may be significantly reduced by operator movements at the front of the fume hood.

5.2 Disruption of laboratory air supply

5.3.1 Cross draughts can interfere with the laminar air flow into a fume cupboard.

5.3.2 Locations near to doors, windows, fans, air conditioning baffles and heavy pedestrian traffic can therefore reduce fume cupboard performance.

5.3 Heat sources

Hotplates and Bunsen burners can affect the air dynamics within the cupboard.

5.4 Incorrect Velocity

5.5.1 Face velocity should be maintained within manufacturer recommended thresholds.

5.5.2 Where face velocity differs significantly from these values, containment can be significantly reduced. Low fume cupboard air flow is more readily disrupted by general air movement within the room, whilst high face velocities can result in turbulence and eddies within the unit thus allowing substances to escape.

6. The safe use of fume cupboards.

6.1 Risk Assessments and safe operating procedures.

6.1.1 Activities involving hazardous substances must be subject to COSHH risk assessment before beginning work and the need for exposure control using fume cupboards should be determined through this process.

6.1.2 Users should ensure the hazards they have identified are matched to the capability of the fume cupboards available, fume cupboard performance data should

be considered during the risk assessment process and the most appropriate fume cupboard type identified.

6.1.3 Safe operating procedures should outline the actions to take when events differ from normal operating conditions e.g. failure of the fume cupboard, spills, runaway reactions.

6.2 Pre-use checks.

6.2.1 Users should be aware of the type of fume cupboard they are using and any specific instructions they must follow that relate to its safe operation.

6.2.2 Before starting work, users should complete a check of the basic functions of the system.

- Operation of control switches.
- Operation of Sash and correct positioning of sash stopper.
- Air flow indicator is demonstrating an acceptable flow rate.
- Internal light functions correctly.
- Surfaces should be clean and free of contamination.

6.2.3 Checks should be recorded on a regular basis (e.g. weekly/monthly) to demonstrate the unit is working correctly (Appendix 1, Example Fume Cupboard Log).

6.3 Work space and equipment arrangement.

6.3.1 Where possible, avoid using large items in the fume cupboard. If these are necessary consider raising the item on lab jacks to allow air flow underneath and avoid obstructing the rear baffles.

6.3.2 Limit the fume cupboard contents to the minimum equipment needed for the work.

6.3.3 Maintain an equipment free zone of 150mm depth inside the front of the fume cupboard. It may be useful to mark this area out for reference.

6.3.4 Ensure lightweight items (e.g. filter papers, disposable gloves, aluminium foil etc) are stored securely to prevent them being drawn into the ducting and caught around the fan mechanism. If arrestor grilles are in place to catch objects, these should be regularly cleared of obstructions.

6.3.5 Sinks must be kept clear of obstructions to prevent overflow.

6.4 Sash position.

6.4.1 Vertical sash opening cupboards should be set to the lowest comfortable working height when handling material in the fume cupboard.

6.4.2 The maximum working opening should not be more than 500mm.

6.4.3 Where fitted, horizontal sliding sash panels should not be removed during use as this will reduce face velocity below acceptable levels and disrupt containment.

6.4.3 When the process is operating without user intervention, the sash opening should be minimised as far as is practicable.

6.5 Fume cupboard contents.

6.5.1 Bottles and containers will affect the airflow within the fume cupboard. Limit the volume of reagents inside the cupboard to that needed for the day's work. Materials not in current use should be stored in an alternative location.

6.5.2 To ensure that other individuals who are not directly involved in the work are aware of the substances being released into the system (e.g. co- workers, maintenance engineers, laboratory supervisors) details of the substances currently used and the contact details of the person responsible for the work should be clearly displayed near the fume cupboard.

6.5.3 If experiments need to be run out of normal working hours, a suitable risk assessment must be completed and authorisation given by the individual responsible for the laboratory (as defined in the School Local Rules). Emergency procedures and 'out of hours' contact details must be clearly displayed.

6.5.4 The COSHH Regulations require employers to provide information on any hazardous substances to which an employee may be exposed. COSHH assessments and Material Safety Data sheets should be kept for 5 years and be readily available to provide maintenance staff and contractors with suitable hazard information relating to substances that have been used in the fume cupboard, before commencing any maintenance or decommissioning work. Where practicable, it may be useful to include a record of substances used as part of any fume cupboard log (Appendix1, Example Fume Cupboard User Log).

6.6 After use.

6.6.1 Leave the fume cupboard in a clean and safe condition. When the work is completed, ensure that redundant equipment is removed and the fume cupboard surfaces are cleaned.

6.6.2 Dispose of waste in an appropriate manner, as indicated by the COSHH assessment, local rules procedures and relevant waste legislation. Consult Sustainability for further advice.

6.6.3 When not in use, fume cupboard sashes should be closed to minimise air flow and provide maximum containment.

6.7 Reporting problems.

6.7.1 Report any defects immediately to the nominated responsible person (as outlined in the School/Unit local rules), who will arrange for remedial work to be carried out and advise of any restrictions to be placed on the use of the fume cupboard.

6.7.2 In the event of a catastrophic failure in the system (e.g. failure of fan motor) ensure the experiment is safely shut down and IF SAFE TO DO SO transfer any hazardous substances to another working fume cupboard. Immediately report the problem to the nominated responsible person.

6.8 Recirculating fume cupboards

Additional precautions must be taken if using recirculating fume cupboards.

6.8.1 Risk assessment should determine whether it is acceptable to use a recirculating fume cupboard for the intended substance. Chemicals with high hazard ratings (e.g. Highly Toxic, Carcinogen and known Sensitisers) must not be handled in a recirculating fume cupboard.

6.8.2 Users must ensure the correct filter for the substances to be used is fitted and they should consider the compatibility of the different substances they may be working with (Appendix Two).

6.8.3 Users should be aware of the life span of the filter and ensure the expected expiry date is clearly displayed. This will be based on expected usage patterns therefore any significant changes to use should be reassessed regularly. Routine system checks should include confirmation that the filter is ‘in date’ for use.

6.8.4 Disposal routes for all used filters should be identified either through maintenance contracts disposal routes or Sustainability to ensure all hazards, hazardous waste regulations and Duty of Care is managed.

6.8.5 A standard operating procedure should be established to monitor fume cupboard use; this must include details of handling, replacing and disposing of contaminated filters.

7. Fume cupboard specification.

The design, placement and construction of ducted units installed after November 2003 should conform to BS EN 14175-2:2003. Installation of new units should also take into account the University Estates Office Generic Project requirements for fume cupboards and microbiological cabinets. http://www.bristol.ac.uk/estates/gpr/services/ventilation/u15.html and be done in consultation with the Sustainability Manager (Energy).

7.2 The design, placement and construction of recirculatory fume cupboards should conform to BS 7989:2001. These units should only be considered under exceptional circumstances, following risk assessment with guidance and approval from the Health and Safety Office.

7.3 Each fume cupboard should be clearly marked with a unique identification code. Newly installed units should also display the name of the manufacturer/supplier, fume cupboard model and the year of production as indicated by BS14175.

7.4 Annual test information labels should be displayed and include the test date, average face velocity, who carried out the testing and indicate whether the unit has been passed for use.

7.5 An airflow indicator should be fitted to demonstrate correct functioning of the fume cupboard. This should incorporate an audible and visible alarm to warn of malfunction. Where older units lack an airflow indicator a form of ‘tell tale ‘attached to the underside of the sash should be used to confirm the flow of air through the fume cupboard.

7.6 The sash should move freely and have a maximum operating position of 500mm. Where a vertical sash is present, a form of sash stop should be incorporated to prevent opening past the maximum, this should be such that it cannot be overridden without deliberate action by the user. The sash should offer appropriate protection from splashes or flying particles when closed to its minimum position.

7.7 The fume cupboard should incorporate features such as deep sided lips (sea walls) or spill trays to retain any spills within the enclosure.

7.8 The fume cupboard components must be compatible with its intended use. If using radioactive materials contact the responsible RPA.

7.9 A user manual incorporating an operating and maintenance guide should be provided by the installer and be readily accessible to users and maintenance staff. The document should clearly state the expected operating conditions (e.g. face velocities, containment values and air extraction volumes) required to meet containment, as defined by the manufacturer/installer.

8. Fume Cupboard Testing

All fume cupboards must be tested by a competent engineer every 14 months to ensure fume cupboards are performing as intended and to demonstrate that adequate control of exposure is achieved. Test methods should be similar to those employed at commissioning and include similar measurements to allow comparison (HSG258, 2011). A variety of qualitative and quantitative methods may be employed, however HSE guidance for fume cupboard testing states the need to measure face velocity and carry out any further testing according to BS EN 14175 (HSG 258, 2011).

Testing of Recirculatory fume cupboards must also include particular filter and seal integrity testing and gaseous phase filter capacity testing as outlined in BS 7989:2001.

8.3 Test equipment must be appropriately calibrated and maintained.

8.4 Individuals carrying out fume cupboard testing should ensure they have identified the type of unit to be tested and are clearly aware of the correct performance specifications to be met.

8.5 A visual inspection of the fume cupboards should be carried out as detailed in BS EN 14175-4:2004 and HSG 258 Controlling airborne contaminants at work, 2011.

8.6 Face Velocity measurements.

These tests measure the average rate at which air is drawn through the opening of the fume cupboard and is the conventional method for measuring fume cupboard performance; however it is not a direct measure of the containment ability of a fume cupboard. Acceptable fume cupboard face velocity criteria are given in section 3. Fume Cupboard Performance Criteria.

8.7 Containment testing using tracer gas.

This provides a quantitative measure of fume cupboard containment under normal working conditions by analysing the escape of a tracer gas (sulphur hexafluoride) from within the fume cupboard. It is advisable to carry out containment testing and robustness of containment testing on newly installed equipment and following any major repair work

8.8 A routine test report should be completed and include the following

- Fume Cupboard Identification number
- Date of test
- Reference to the type of test carried out
- General room conditions during the test
- Results of fume cupboard inspection.

- Results of performance test
- List of any remedial actions necessary.

8.9 Test results will be reported to the University Compliance officer and the nominated School representative as outlined in the Estates Operations works instruction WI-6 document.

8.10 Test results must be kept for a minimum of five years.

9. Maintenance

9.1 The COSHH regulations require employers to ensure that control measures are ‘maintained in an efficient state, efficient working order, in good repair and in a clean condition’; therefore a regular, routine maintenance schedule in addition to the annual testing is recommended.

9.2 Individuals carrying out maintenance activities on fume cupboard systems must be made fully aware of the hazards they may encounter. Separate risk assessments (to include chemical and other hazards e.g. work from height, mechanical, electricity etc) of the maintenance work should be completed in consultation with the School representative and a safe system of work devised. Chemical hazard information should be provided by fume cupboard users from their COSHH records and/or fume cupboard logs.

9.3 Where maintenance is likely to interrupt the normal operation of the fume cupboard a permit to work may be issued as outlined in Estates Operations works instruction WI-6. This is essential when maintenance work is carried out on systems used for radiation work. These units are labelled accordingly.

9.4 Maintenance records should be kept by Estates Operations for 5 years.

9.5 If maintenance work is likely to influence fume cupboard performance, suitable containment or face velocity tests should be carried out on completion of the work.

10. Appendix One, Example Fume Cupboard User Log.

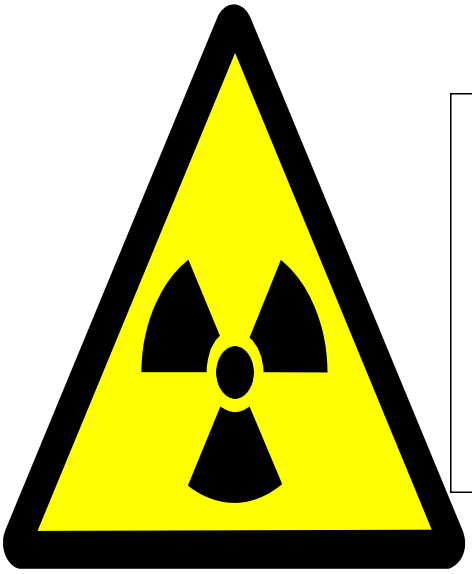
FUME CUPBOARD USER LOG

Fume Cupboard Identification					**Location**		**Laboratory Manager**	
Date	**Fan on/off**	**Sash**	**Work Surface Clean?**	**Airflow** Indicator	**Faults detected**	**Substances in use**	**Name**	**Contact** **Telephone**

11. Appendix Two, Recirculatory Fume Cupboard Filter types.

1. General Purpose – generally used for removal of organic vapours with molecular weights greater than 30 and boiling points above 60oC.
2. Inorganic Acids – alkali impregnated to neutralise inorganic acid vapours.
3. Formaldehyde – impregnated with an agent to oxidise formaldehyde to formate salts and gluteraldehyde.
4. Ammonia and Amines- impregnated with copper compounds to remove ammonia vapour and low molecular weight amines.
5. Diethyl Ether
6. Hydrogen Sulphide and Organosulphur compounds
7. Hydrogen Cyanide
8. HEPA – High efficiency particulate filtration.

12. Appendix Three, Fume Cupboard Designation for Radioactive Materials.



CAUTION
THIS FUMECUPBOARD IS USED FOR RADIOACTIVE MATERIALS