CODE OF PRACTICE

LOCAL EXHAUST VENTILATION
FUME CUPBOARDS

Document Information

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CONTENTS

SUMMARY

The control of exposure to hazardous substances is governed by the Control of Substances Hazardous to Health (COSHH) Regulations 2002. This sets out principles of good control practice that an employer must apply to obtain effective and reliable control in order to prevent or minimise exposure and therefore the impact on human health.

Fume cupboards are one of the most common and effective controls used in laboratories to minimise exposure to respirable hazardous substances. Where a fume cupboard has been identified as a control measure in a risk and/or COSHH assessment to protect users from an inhalation hazard, then it is classed as Local Exhaust Ventilation (LEV). This document aims to provide guidance to ensure that fume cupboards are used effectively and maintained appropriately to ensure they provide the level of protection needed for users.

SCOPE

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

This guidance document does not cover microbiological safety cabinets, capture hoods, downflow benches, snorkels, and other forms of Local Exhaust Ventilation (LEV). Please refer to other SHEW guidance documents.

INTRODUCTION

Fume cupboards are used widely in laboratories and are designed to capture and remove air-borne hazardous substances generated during laboratory experiments (e.g. gases, vapours, aerosols and particulates/dust). Work with substances that produce/generate toxic or harmful fumes, vapours, gases, dust or chemical aerosols should be carried out in a fume cupboard to eliminate or reduce the risk of exposure to an acceptable and safe level.

Fume cupboards should always be considered if a Workplace Exposure Limit (WEL) will be exceeded even with other controls in place. WELs are occupational exposure limits to hazardous substances approved by HSE and can be found in the document EH40. Exposure to substances listed in EH40 as carcinogens or sensitisers should be reduced to as low as reasonably practicable (ALARP), in these cases Fume Cupboards should be considered even if WELs have not been exceeded. To find out the level of exposure to a substance in the workplace air monitoring can be used.

The absence of a substance from the list of WELs does not indicate that it is safe. For these substances, exposure should be controlled to a level to which nearly all the working population could be exposed, day after day at work, without any adverse effects on health.

A fume cupboard consists of an enclosed compartment with a sash at the front; a current of air is pulled through the front of the opening, across the experiment and away from the user to prevent the inhalation of hazardous substances. The extract air is either ducted away from the point of use to an external discharge point, or is recirculated through a filter.

Fume cupboards also serve as physical barriers between reactions and the laboratory, offering a measure of protection against inhalation exposure, chemical spills, run-away reactions and fires.

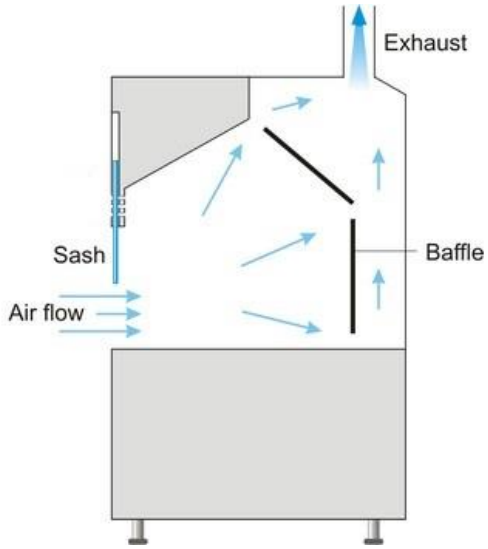
Fume cupboards must NOT be used for the containment of biological materials. Where such containment is required a microbiological safety cabinet must be used.

Only if the hazard cannot be eliminated or reduced by alternative methods should the work go ahead in a fume cupboard.

FUME CUPBOARDS

GENERAL TYPES OF FUME CUPBOARD

Ducted Fume Cupboards – this type of fume cupboard is the most common type utlised generally in laboratories. They function by drawing laboratory air into the fume cupboard, thus containing and diluting the contents before discharging them to the environment, usually without filtration, three meters above roof level.

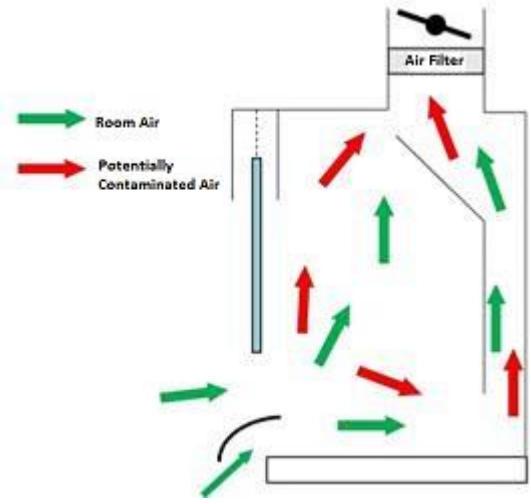


Most ducted fume cupboards are constant air volume cupboards – these always pull the same amount of air regardless of sash position. As the sash is moved the velocity of the fume cupboard face changes (increases as sash is lowered/decreases as it is raised).

Variable air volume fume cupboards are also available and these are present in some departments such as Chemistry in 1 South. These are fitted with a face velocity control which varies the amount of total air pulled/exhausted in response to the sash height, maintaining a constant face velocity.

Recirculating filtered fume cupboards – these operate by drawing air into the fume cupboard and exhausting it though a set of filters (for example a particulate pre-filter and a carbon filter) before the air is passed back into the laboratory.

They are designed to reduce the airborne concentration of a defined range of chemical vapours, fumes, smells and dusts in the air to acceptable levels. They can capture low levels of some vapours and fumes very efficiently but are not suitable for dealing with large spillages or boiling off solvents or acids.



The filters are specific for a set of chemicals and need to be changed when they become saturated, otherwise the efficiency will decrease significantly.

Recirculating fume cupboards must not be used for highly toxic chemicals, or for regular use of toxic and/or flammable solvents in large quantities. They are not suitable for:

- Radioactive substances
- Any substance for which the filters are not specified
- Small molecules such as nitrogen, carbon monoxide or hydrogen
- Boiling off large (>100ml) quantities of solvents or acids
- High heat loadings, where internal surfaces are heat sensitive plastics
- Unventilated work areas

In addition, careful evaluation needs to be given before they can be used for work with carbon nanotubes or other nanotechnologies. Additional maintenance and performance checks may be required.

SPECIFIC USE FUME CUPBOARDS

Perchloric Acid Fume Cupboard

Perchloric acid reacts violently with organic materials. Dried perchloric acid is also highly explosive. Therefore, perchloric fume cupboards require built-in water wash down systems in order to prevent perchlorate salt deposits. Interior liners are made of acid resistant materials like stainless steel. Interior corners are coved to aid in cleaning. All procedures that use perchloric acid must be confined to a perchloric fume cupboard to prevent dangerous reactions with other chemicals; a conventional fume cupboard should not be used.

Radioisotope Fume Cupboard

Radioisotope fume cupboards are constructed specifically to protect users from radioactive materials. They have specially constructed worktops to withstand the weight of lead shielding plates, and may also have lead laced sashes. Interiors are made of stainless steel with coved corners to aid in decontamination.

Acid Digestion Fume Cupboard

Acid digestion fume hoods have special liners manufactured of acid resistant materials such as unplasticized PVC. For acid digestion applications involving high service temperatures, other materials such as PVDF may be used. Sashes may be made of polycarbonate to resist hydrofluoric acid etching.

Distillation Fume Cupboard

A distillation fume cupboard is characterized by a low worktop height which results in a large working height for the operator. This allows tall distillation equipment to be installed and mounted in the work chamber. Otherwise, it has similar features to that of a standard fume cupboard.

Floor Mounted Fume Cupboard

Floor mounted fume cupboards are used for applications which require large apparatus. As the name implies, these are floor mounted without any work surface. This facilitates the transfer of equipment and materials into, and out from the cupboard. Floor mounted cupboards are sometimes referred to as walk-in fume cupboards.

SAFE OPERATION

PRIOR TO STARTING WORK IN A FUME CUPBOARD

Any process involving the use of hazardous substances must have been subject to risk assessment before starting the work. In addition to considering the use of a fume cupboard it must also have considered whether it is practical to:

- Use less hazardous substances
- Change the process to eliminate the production of hazardous substances
- Totally enclose the process
- Reduce the quantities of the substances used
- Reduce the amount of substance released into the airflow e.g. use a condenser, watch glass cover etc.
- Use a slower reaction rate

- Apply simple controls such as fitting lids

Once it has been determined that the work should be undertaken within a fume cupboard you need to ensure you are using the correct type. The risk and COSHH assessments should also clearly include the use of a fume cupboard as a control measure for the identified inhalation hazard of hazardous materials.

USER CHECKS

Users and laboratory supervisors should make regular pre-use and ongoing checks to confirm that performance remains satisfactory, i.e. that substances being used are being contained and that any faults are identified and corrected (BS EN 14175-2:2003). Manufacturers instructions and supplied log books where available should be consulted for appropriate and relevant user checks. These checks should be recorded, this could be in the available log books or alternative record sheet.

User checks should be carried out to ensure the fume cupboard is fit for use including:

- Check that the fume cupboard has a test label fixed to the front of the cabinet to confirm that it has been tested/examined within the last 14 months, and has passed the test. Check that the retest date has not been passed. Do not use the fume cupboard if it is outside the 14 month period.
- Confirm that the fume cupboard is working satisfactorily by a visual check of function lights and the air flow reading is within safe parameters; minimum of 0.5 m/s. The fume cupboard should not be used if any alarms are indicating.
- Filter(s) in recirculating units are present, of an appropriate type and within date.
- Looking for any obvious damage to the fume cupboard and seals. Check the sash operates through full range and remains in position.
- No debris or items obstructing vents / baffles.
- Area free of items 15cm inside the fume cupboard.
- Checking for obvious surface contamination. Clean if necessary, to avoid adverse reactions with the chemicals you intend to use.

Do not use the fume cupboard if it fails any of the first 4 user checks, or if any of the other checks cannot be recitified by the user. Report failure/defects promptly to your Laboratory Manager/Area Safety Co-ordinator/Technical Staff for remedial action.

See checklist and example record log in Appendix 1 which should be made available/posted in areas where fume cupboards are present and used.

PREPARING TO USE THE FUME CUPBOARD

- Ensure that you have enough space to conduct your work safely and that all unnecessary items of equipment and chemicals not required in the process are removed.
- Where practical, ensure that all items for the operation are available in the fume cupboard to avoid moving in and out of the fume cupboard for items which can disturb the airflow.
- Position equipment, apparatus, and materials in the centre and back of the cupboard to minimise disturbance to the airflow. Do not obstruct the rear baffle.
- Equipment and materials in the fume cupboard should be kept to a minimum and sited at least 15cm inside the plane of the sash to ensure efficient containment. Keep items away from the sash opening and the lip to allow instant closure in an emergency.
- Avoid placing large pieces of equipment in a fume cupboard; they affect the aerodynamic flow and may reduce the containment of fumes/vapours. If their use cannot be avoided they should be raised up about 10cm using

lab jacks or shelving, in order to allow air to pass unimpeded across the work surface and to be exhausted from the rear of fume cupboard.

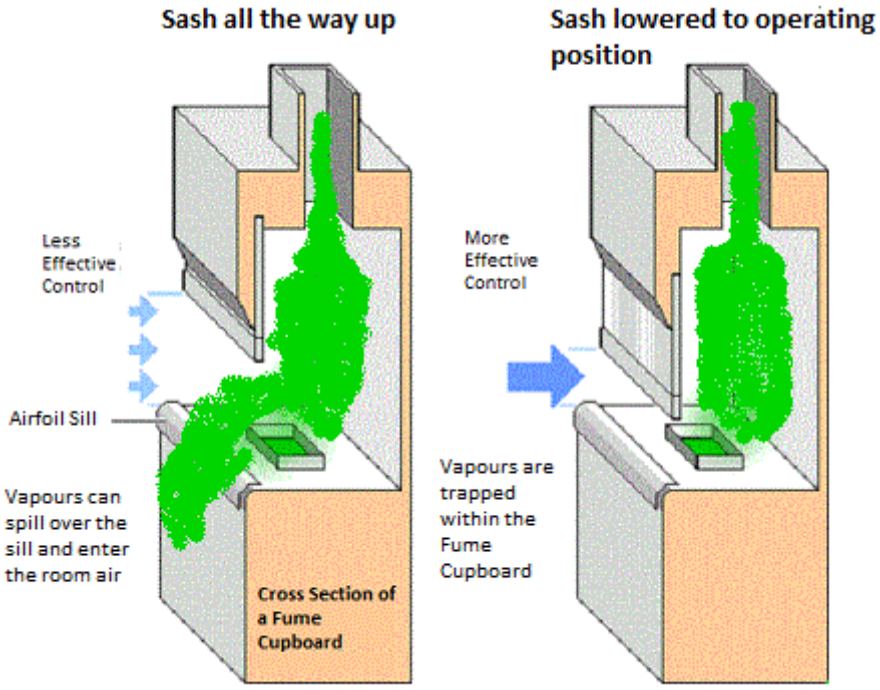
- Many fume cupboards are equipped with flat or rounded sills or air foils which direct the flow of air smoothly across the work surface. Sills should not be removed or modified by the user. Objects should never be placed on these sills. Materials released from containers placed on the sills may not be adequately captured. In addition, an object on the sill may prevent the quick and complete closure of the sash in an emergency.
- If using flammable materials, check that you know the location of the nearest suitable fire extinguisher. Also, use a fume cupboard with Firetrace (automatic suppression system) installed where possible.
- Tubing is frequently used to channel exhaust to the cupboard from equipment located some distance away, usually on the open bench. This is not an effective control method for many reasons and unless it can be justified by risk assessment, alternative methods of venting, preferably via suitable Local Exhaust Ventilation (LEV), should be sought.

DURING USE

Fume cupboards should be used with the sash as low as reasonably practicable as this gives the best containment of fume/vapour and helps contain any fire or explosion that may occur. The maximum height when working at the fume cupboard should be 500mm, and where reasonably practicable should be lower.

Use the sash position to your advantage:

- Fully open (any height beyond working limit), to provide access for setting up equipment
- Partially open, to a comfortable work height (not exceeding 500mm) when handling the material inside the cupboard
- Lowered as far as is practicable, when the process is in operation and your intervention is no longer required, including when stepping away for any period of time.



In addition to the safety protection the fume cupboard provides when the sash is used correctly, there are also environmental benefits in terms of energy savings and minimising carbon emissions.

When using the fume hood, keep your face outside the plane of the hood. Use the sash for partial protection during hazardous work.

The performance of any fume cupboard can be severely compromised by incorrect use, in particular anything that disturbs the flow of air into the enclosure. Any of the following could cause interference to airflow and cause fumes or vapours from within the enclosure to exit from the fume cupboard and enter the worker's breathing zone:

- External draughts which can be caused by the user's sudden and rapid movements, by people walking past the front of the cupboard, by doors and windows opening, by air conditioning units or by other fans;
- The use of naked flames, hot air fans, ovens, hotplates, fans or centrifuges, all of which may cause turbulence as well as presenting a fire risk;
- Large items placed too close to the front opening or too close to the back baffle.

Chemicals must not be stored in a fume cupboard - they could escalate an incident.

Hotplates must be kept to a minimum and be aware that they might adversely affect the airflow. If hot plates are used, these should be placed at least 10cm from the side and back of the cupboard to avoid damage to the cupboard structure.

If using flammable liquids above their flash point, avoid direct heating by bunsen burners, and take particular care to minimise spills. If practical, place electrical equipment where it will not be splashed from a spill.

Care should be taken with use of paper products, aluminum foil, and other lightweight materials within a fume cupboard. For example, a single paper towel or chemical wipe can potentially decrease the airflow into the cupboard if it restricts exhaust flow.

Use appropriate personal protective equipment as identified by the risk assessment such as safety glasses, lab coat and gloves. This enhances safety in case of catastrophic spills, run-away reactions or fire. Consider a full face shield if there is possibility of an explosion or eruption.

Any accidental spill of chemicals must be cleaned up immediately (i.e. as soon as it is safe to do so).

If an experiment is left running out of hours, an in date unattended experiment form with a contact name and telephone number must be prominently displayed. Do not leave potentially hazardous work unattended.

DIVERSITY FACTOR

In the Chemistry Department located in 1 South Buildng, the fume cupboard extract system was physically designed with a 68% diversity factor based on various factors at the design stage such as predicted occupancy levels. This factor means that only this proportion of fume cupboards can be open beyond the working height of 500mm to maintain safe operating parameters. In real terms this means that in a laboratory containing 6 fume cupboards; only 3 can be fully open at one time. If any more are opened then the face velocity will drop below the safe working limit of 0.5 m/s.

Only 3 x fume cupboards (in a 6 fume cupboard laboratory) may be open beyond the working height of 500mm at any one time to ensure the safe operating face velocity of 0.5m/s is achieved

If the diversity alarm is activated these steps should be followed:

- Immediately cease work, lower the sash and warn others in the vicinity that there may be a problem.

- Check other fume cupboards in the laboratory to determine if more fume cupboard sashes are fully open than is allowed under the diversity factor rule above. If this is the case, then shut sashes and check if the alarm has ceased.
- If alarm has ceased then work may continue.
- If alarm continues then there may be a maintence fault which must be reported to the Area Safety Co-ordinator/Technical Staff and Campus Infrastructure via their Green Button reporting procedure.
- If a coincident loss of containment event has also occurred then this must be reported via the University incident reporting procedure.

AFTER USE

- At the end of your experiment remove equipment and clean the surfaces. Leave the fume cupboard in a clean, tidy and safe state. Clsoe the sash.
- Dispose of waste in a safe appropriate manner as identified by the risk assessment and in accordance with laboratory rules.
- Items contaminated with odorous or hazardous substances (including waste containers) should be removed from the cupboard only after appropiate decontamination where necessary or if placed in a closed outer container to avoid releasing contaminants into the laboratory air.
- If permitted by local rules/lab risk assessment, switch off the fume cupboard.

EMERGENCIES

- If the ventilation system fails, immediately stop working. If safe to do so, replace lids on containers and terminate any ongoing processes.
- Pull the sash as low as possible and move away from the fume cupboard. Warn other workers there is a problem.
- Deal with spillages immediately, using the correct absorption materials. Spill kits should be available nearby. Dispose of as hazardous waste.
- Treat fires with extreme caution. The use of high pressure CO2 may spread flames and eject items out of the fume cupboard. Only tackle fires if you have the correct fire fighting equipment and have been trained to use it. Otherwise, close the sash and raise the alarm. Activate the fire alarm (press red manual call point) and phone the emergency number. Evacuate the building.
- Report the incident to Technical Staff and to SHEW via University incident reporting procedures.
- Report the Fault to Campus Infrastructure via their Green Button reporting process.

TRAINING, INSTRUCTION AND INFORMATION

Users of fume cupboards must be trained in correct use, not only in order to understand how the fume cupboard works but also because poor technique can compromise the protection it provides to the user. Manufacturers instructions should be utilised in preparing this training.

Training should cover:

- Principles of how fume cupboards work, the airflow and limitations of performance
- How to work at fume cupboards safely including pre-use and ongoing checks
- Operation and function of all controls and indicators
- Operating fume cupboards in an energy efficient manner, whilst maintaining safety standards
- Actions to be carried out in the event of a system failure/what to do if something goes wrong

It is recommended that included in this training is a visual demonstration of how airflow can be affected when a fume cupboard is not used correctly such as with a smoke pen. This could be either through a practical demonstration within the lab or via a video or similar media.

A record of training completed should be made and kept, along with a timeframe (every 3 years is recommended) for refresher training identified in local arrangements.

THOROUGH EXAMINATION AND TEST

Every fume cupboard used for work with hazardous substances to protect the user from an inhalation hazard identified in the risk/coshh assessment, must have a Thorough Examination and Test (TexT) at least every 14 months.

This must be carried out by a competent person and in accordance with the requirements of the COSHH Regulations 2002, BS EN 14175-4:2004 and HSG258 Controlling airborne contaminants at work, 2011 where applicable. TExT reports must be kept for at least 5 years. A copy should be available at the workplace containing the LEV system.

Also, refer to SHEW Safe Use of LEV Standard for more information regarding duties and responsibilities.

Campus Infrastructure are responsible for arranging this for the majority of ducted fume cupboards. However Departments must be aware of the process and be able to recognise if thorough examination and testing has not taken place or where the responsibility sits with them, e.g. for recirculating fume cupboards. Departments and users are also responsible for ensuring fume cupboards are in a safe condition for the testing to be carried out and any hazards and controls/lab rules are communicated to those carrying out the testing. Fume cupboards that have failed the TexT and/or routine tests and are awaiting repair should be taken out of service with appropriate signage (writing on sash is not acceptable) and communication to users. Departments must also co-ordinate with Campus Infrastructure to agree if maintenance or repair is required, or whether systems that are not fit for purpose or have failed a thorough examination and test should be decommissioned. Departments are also responsible for notifying Campus Infrastructure when new ducted fume cupboards are installed so they can be included on the TExT schedule.

There will be occasions when access to the roof of a building operating fume cupboards will be required for maintenance purposes etc. In order to minimise any potential exposure of the maintenance worker to emissions from the roof stacks via which the laboratory fume cupboards discharge, it is University procedure for the fume cupboard ventilation to be switched off. Campus Infrastructure will liaise with the relevant Departments when this type of work is to be undertaken, in order for them to put in place procedures to ensure hazardous work is not undertaken in the fume cupboards during the shutdown period.

ROUTINE CHECKS/TESTING

It is a requirement of the COSHH Regulations (Reg 9) and HSG258 (318 to 324) that routine checks and/or testing are carried out between TExTs to ensure that the fume cupboard is running properly, continues to perform to the required standard in that substances used are being contained and there is no variation from that reported in the TExT. This should be carried out by appropriate person/s within the department that uses the equipment. Appropriate information, instruction and training will need to be provided. Manufacturers instructions and the log book provided should be followed regarding these requirements. However, if these are not available then the company who carries out the TexT could be consulted.

If the system is undocumented and further advice is not available, then BS EN 14175-4:2004 Section 6 provides guidance on what should be done. Routine checks/testing should include the following and should be recorded.

- Face velocity test – a calibrated anemometer should be used to take measurements at the face of the fume cupboard. BS EN 14175-3:2003 section 5.2.2 provides information on how this should be carried out including the probe positions. Measurements should be accurate to 10% and an average velocity calculated in m/s. An a example log sheet is provided in Appendix 2 for recording these measurements, if not provided in a log book. It is recommended that these are carried out monthly.
- Air flow visualisation – this should be done with a visible tracer such as smoke or dust (smoke pen or dust lamp) to check if any disturbance. It should be done around the fume cupboard and at the sash opening area. Any observations/disturbances should be recorded. Frequency of checks depends on use and whether any concerns have been raised regarding performance.
- Inspections – regular inspections should include checking that fume cupboards are being used in accordance with manufacturers instructions and training, that user checks are being carried out and whether there is any damage/corrosion etc. These could be included within routine inspections and findings recorded.

APPENDIX 1 – USER CHECKS LIST AND EXAMPLE RECORD LOG

Fume Cupboard User Checks (before each use):

- No obvious damage or breaches to cupboard or ductwork, e.g. no unusual noises or smells.
- Extract is on, air flow indicator (where fitted) within safe parameters.
- No visible or audible alarms indicated on the control panel. Alarms must not be ignored.
- Sash operates through full range and remains in position, sash position restrictor (where fitted) is functioning.
- Internal lighting (where fitted) working.
- Work area clean and tidy.
- No debris or items obstructing vents / baffles.
- Area free of items 15cm inside the fume cupboard.
- Filter(s) in recirculating units are present, of an appropriate type and within date.

Weekly

- Thorough examination and test is 'pass' status and in date (as indicated on the test label).

User Check Record Log					
Department					
Lab/Room No.					
LEV No.					
Month/Year					
Day	Checked	Issue Y/N	Day	Checked	Issue Y/N
1			17		
2			18		
3			19		
4			20		
5			21		
6			22		
7			23		
8			24		
9			25		
10			26		
11			27		
12			28		
13			29		
14			30		
15			31		
16					
Week	Checked	Issue Y/N	Week	Checked	Issue Y/N
1			4		
2			5		
3					

Do not use the fume cupboard if fails user checks
All issues to be reported and recorded

APPENDIX 2 – ROUTINE TESTING LOGS

Monthly Anemometer Readings Log (Face Velocity Check)

Department	
Lab/room No.	
LEV No.	

Date:		Name/Initials:
Highest Value	Lowest Value	Average Value
m/s	m/s	m/s
Within 20%	Pass/Fail	

Smoke Test/Dust Lamp Test Observations Log

Department	
Lab/room No.	
LEV No.	

Date:	Name/Initials:
Observations:	
Pass/Fail	

Note: It is recommended that the face velocity chekcs are carried out monthly with the smoke test/dust lamp test being performed periodically to provide continued assurance that contaminants are captured, or as an additional check if the air flow does not seem to be satisfactory.

APPENDIX 3 - EXAMPLES OF GOOD AND POOR PRACTICE

Below are pictures of fume cupboards depicting both good and poor use:

GOOD PRACTICE

The following demonstrate how a fume cupboard should be set up. They also demonstrate that even when there is a lot of equipment needed such as manifolds they can still be orderly and tidy ensuring maximum effectiveness. These pictures show the use of lab jacks for equipment, no excessive storage of chemicals and no trailing cables/tubing or other items on the sill.

It should be noted that sashes on some of the pictures are up to facilitate the taking of the picture.

POOR PRACTICE

The following pictures show some of the common issues that arise in fume cupboards. These include excessive storage of chemicals, overcrowding, general untidiness and items, inlcuding gloves, hanging over the sill affecting the air flow into the fume cupboard.