

Safety Code of Practice 49: Part 1

3rd Edition, May 2014

User guide to safe use of

LABORATORY FUME CUPBOARDS



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1 SUMMARY

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). It is essential that users understand how to use them effectively, and that they are maintained, inspected and tested by competent persons.

- 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.
- Schools must identify the location of each ducted fume cupboard under their control, and ensure these are registered with Estates and Facilities (E&F).
- Schools must maintain copies of records of system inspections, tests and maintenance.
- Schools must take any fume cupboard that fails an inspection or test out of use immediately, and must ensure that it is clearly marked as such.
- Users must be trained in correct use, including selection of the correct cupboard for the proposed work; function of alarms and gauges; correct sash height; avoiding air flow disturbance; emergency procedures; and good housekeeping.
- Fume cupboards use significant amounts of energy. Users must be trained in how their appropriate operation, in line with health and safety guidance, can reduce energy use and contribute to a more comfortable working environment.
- E&F must arrange for statutory inspections and tests of ducted fume cupboards, as required under the Control of Substances Hazardous to Health Regulations (COSHH), and in accordance with the relevant British Standards (see Safety Code of Practice 50).
- Schools must arrange for statutory inspections and test of recirculating fume cabinets.
- Every fume cupboard must undergo thorough examination and testing at least every 14 months. If this period is exceeded the fume cupboard must be taken out of use until it has been tested.
- Persons carrying out inspections and tests must mark any fume cupboard that fails with a red 'Fail' label. E&F will inform Schools of any ducted systems that fail an inspection or test.
- E&F will maintain records of inspections, tests and maintenance of ducted systems and will advise Schools of the need to undertake repairs or maintenance.

2 SCOPE

This Safety Code of Practice instructs users of fume cupboards on how to use them effectively and safely. It should be read in conjunction with:

- Safety Guide 28 "The Assessment and Control of Hazardous substances (COSHH)".
- Safety Guide 46 Part 4 "Local Exhaust Ventilation" which summarises the legal and management requirements for selecting, installing and using all types of LEV.
- Safety Code of Practice 49 Part 2 "Fume Cupboards - Selection, installation, maintenance and decommissioning".

The principal legislation is the Control of Substances Hazardous to Health Regulations 2002 (as amended) (COSHH) and the Provision and Use of Work Equipment Regulations 1998 (PUWER). See Safety Guide 28 for further information on COSHH.

3 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.

For the purposes of this CoP, 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 materials. 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 must NOT be used for the containment of biological materials. Where such containment is required a microbiological safety cabinet must be used.

This CoP does not cover capture hoods, downflow benches, snorkels, and other forms of Local Exhaust Ventilation (LEV).

Many fume cupboards are designed to run continuously and the room air intake is balanced to account for this. Some other fume cupboards may be switched off after being emptied and cleaned, but this must only be done in laboratories where this does not impact on other safety considerations, such as room pressure regimes. This should be indicated in the lab risk assessment or local rules.

Guidance:

Switching off a fume cupboard can save approximately £1,000/year per cupboard (based on 2012 energy prices). Increasingly, cupboards are fitted with energy efficient controls which save energy, reduce laboratory heat loss and maintain constant air flow rates.

4 RESPONSIBILITIES

4.1 Schools/departments

General management responsibilities are set out in Safety Guide 46 Part 4 Local Exhaust Ventilation. With respect to fume cupboards, Schools/Departments must ensure that:

- A responsible person(s) is designated to have overall control of the fume cupboards in their area.
- All ducted fume cupboards are registered with Estates and Facilities (E&F) for servicing, maintenance and inspection (including any new installations supplied through E&F Projects).
- Fume cupboards are used in accordance with the user manual/operating instructions.
- Work undertaken in the fume cupboard is consistent with the level of protection/control provided by that system e.g. flow rates are adequate to protect the worker, the correct type of fume cupboard is used.
- Users are trained in correct operating procedures. This includes selection of the correct fume hood or cabinet for the proposed work, and recognising when systems are operating effectively or are out of test. See section 6 for training requirements.
- A system is established to:
 - Record the location of each fume cupboard

- Record the results of each examination and test, plus details of any maintenance undertaken
- Report defects in ducted systems to E&F
- Take timely action on reports from E&F identifying the need for maintenance, or requiring that the system is taken out of use pending repair, maintenance, or replacement.
- A log book is maintained which records basic information on usage, so that risks to E&F maintenance staff, contractors and engineering inspectors from substances/materials used in the fume cupboard can be assessed and managed.
- The fume cupboard is made safe before maintenance work is undertaken (i.e. removing hazardous substances, decontamination, fumigation where necessary. Tasks such as electrical isolation are the responsibility of E&F).
- Recirculating fume cupboards are maintained in a safe condition by the School, including the requirement for a competent engineer to carry out a 'thorough examination and test' at least every 14 months.
- Ensure that fume cupboards are used in the most energy efficient manner, consistent with safety requirements.
- Display appropriate signage and emergency contact details where ongoing experiments are in progress.

Before using a fume cupboard, users must first assess whether there is a safer way to do the work which will eliminate or reduce the risk of exposure to hazardous materials. Only if the hazard cannot be eliminated or reduced by alternative methods should the work go ahead in a fume cupboard.

4.2 Users

Users must:

- Attend any training required to ensure that they are competent to use a fume cupboard
- Use the cabinet in accordance with the manufacturer's instructions and their training
- Promptly report any faults and as far as possible make safe before closing the cabinet and posting a 'Faulty – Do not use' sign on the cabinet in a prominent position.

4.3 Estates and Facilities

E&F will:

- Maintain a record of the location of all ducted fume cupboards, with identification/asset tags.
- Arrange for, and maintain a record of, all maintenance and inspection of ducted fume cupboards.
- Inform Schools/Departments of any ducted fume cupboard that requires remedial work or which fails an inspection.
- Arrange for remedial work to be carried out on ducted fume cupboards, after confirmation from the School that the fume cupboard is required.
- Decommission any ducted fume cupboards that fail a performance test and which are not repaired.

5 CHEMICAL FUME CUPBOARDS

5.1 Types of fume cupboard

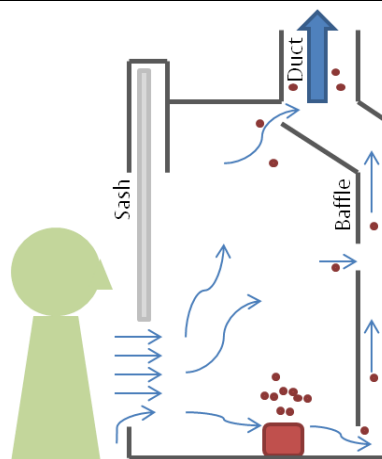
Table 1 summarises the most common types of fume cupboard.

Table 1: Summary of the main types of fume cupboards

Extract or Ducted Fume Cupboards - Extract or ducted fume cupboards are far the most common type of fume cupboard at the University. They function by drawing in 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).

Increasingly **variable air volume fume cupboards** are installed, 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.



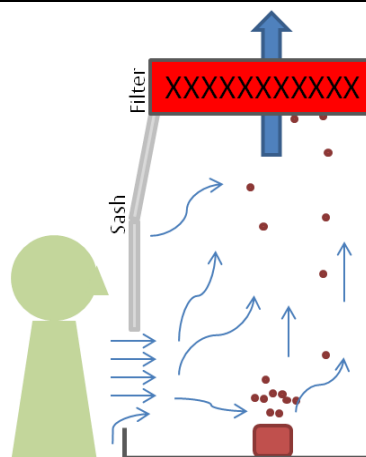
Wash-down or scrubber systems – are a form of ducted fume cupboard where contaminated air from the fume hood enters a wash-down unit where water spray and exchange systems are used to remove contaminants such as water-soluble gases, vapours, aerosols and particulates which dissolve into the scrubbing liquor. The purified air is released up the stack. The scrubbing liquor is re-circulated from the sump and back to the top of the system using a pump.

Note: ducted fume cupboards are not suitable for non-soluble hazardous materials that require filtration before being exhausted to atmosphere.

Recirculating filtered fume cupboards - operate by drawing air into the fume cupboard and exhausting it through 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 mop up low levels of some vapours and fumes very efficiently but they might not cope well with gross 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 fall rapidly.



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 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.

5.2 User checks

It is essential that fume cupboards are effective at extracting contaminants from the worker's breathing zone. Users must check that the fume cupboard that they intend to use can meet the University of Reading standards set out in Table 2 – this will normally be indicated on the test label and in the fume cupboard log book. They must also check the fume cupboard face velocity indicator before use to check the fume cupboard is operating within safe parameters (>0.5m/s).

If there is any doubt, additional smoke visualisation test, a containment test, or monitoring of the worker's breathing zone may be required to verify that the fume cupboard is capable of extracting the hazardous material from the worker's breathing zone.

5.3 Table 2 Performance criteria for ducted fume cupboards

TYPE OF WORK	MINIMUM FACE VELOCITY (AT SASH OPENING HEIGHT OF 500MM)
Standard work with hazardous substances	0.5 m/s \pm 10%
Work with radioactive material	0.7 m/s \pm 10%
Variable airflow volume fume cupboards	0.5 m/s \pm 10%
High performance/low flow fume cupboards	0.3 m/s \pm 10%
In all cases the maximum recommended face velocity is 1m/sec.	

5.3.1 Daily and weekly checks

In addition, users and laboratory supervisors should make daily and weekly checks to confirm that performance remains satisfactory and that any faults are identified and corrected – see Table 3 below.

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 enter the worker's breathing zone:

- External draughts (caused by the user's sudden movements, by people walking past the front of the cupboard, by doors opening, by air conditioning units or by other fans)
- The use of naked flames, hot air guns, ovens, hotplates, fans or centrifuges, all of which may cause turbulence
- Large items placed too close to the front opening or too close to the back baffle
- The use of screens for protection against ionising radiation or explosion.

5.4 Table 3 Suggested operational checks for fume cupboards

User	<ul style="list-style-type: none"> • Make daily checks of general condition (clean, tidy etc). • Make pre-use checks of warning lights, air flow gauges and sash alarms where fitted. • Report any faults to supervisor.
Lab Supervisor	<ul style="list-style-type: none"> • Make weekly checks of warning lights, air flow gauges and sash alarms (where fitted). Keep record in log book. NB This may be delegated to

trained users.

- Report faults to E&F.
- Where the fume cupboard has ventilated storage integrated into the system check the general condition of the storage cupboard, and inflow of air into it (using a smoke pen), at least annually.
- Monitor that annual inspections and tests are undertaken by E&F contractors – see section 4.4.
- Where there are concerns about the effectiveness of a fume cupboard, the following checks may be undertaken (speak to H&SS for further assistance):
 - Face velocity, using an anemometer
 - Air flow visualisation (smoke test)
- Where the fume cupboard has variable air volume (VAV) controls fitted, check that face velocities remain constant when sash is closed

5.5 Thorough examination and test

Every fume cupboard used for work with hazardous materials must have a thorough examination and test at least every 14 months.

E&F are responsible for arranging this for ducted cupboards. However Schools must be aware of the process and be able to recognise if thorough examination and testing has not taken place. They must also co-ordinate with E&F 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.

Schools are responsible for arranging thorough examinations and tests of recirculating cabinets.

More information on thorough examination and test can be found in Part 2 of this Code of Practice "Fume Cupboards - Selection, installation, maintenance and decommissioning". A summary of the process can be found in Appendix 1.

5.6 Use of specific materials

5.6.1 Radioisotopes

The use of radioisotopes is covered in Safety Guides 16 to 19. Fume cupboards must be maintained in a condition that allows easy cleaning and does not allow radioactive contamination to be trapped.

5.6.2 Nanoparticles

Anyone proposing to work with nanoparticles must consult H&SS in the first instance about safety precautions and the suitability of extract systems.

5.7 Ventilation

In most cases fume cupboards are ducted to roof discharge stacks. It is common for fume cupboards in a lab complex to share an extract system with all the fume cupboards will eventually flow through the same stack. The potential for vapours, fumes and dusts to intermingle in an extract system must be considered. If there is a potential for harmful chemicals to intermix in the extract system the School, in consultation in E&F and H&S Services, may need to limit the quantities of certain materials used in this system. Where this applies all fume cupboards in the system must be clearly labelled.

6 SAFE USE

6.1 BEFORE 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 materials
 - 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
- Ensure you are using the correct type of fume cupboard.
 - Check that the fume cupboard has a test sticker 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, air flow gauge is in safe zone (normally above 0.5 m/s, see Table 2) and by means of a tissue paper strip in the opening. For high risk operations the air velocity must be measured using a vane anemometer, and the reading must be recorded in the log book. If the indicators show that the airflow is not satisfactory, do not use the fume cupboard, and report it to your AHSC or laboratory manager.
 - Check for obvious surface contamination. Clean if necessary, to avoid adverse reactions with the chemicals you intend to use.
 - 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.
 - If using flammable materials, check that you know the location of the nearest suitable fire extinguisher.

- 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.

6.2 PREPARING TO USE THE FUMECUPBOARD

- 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 in the fume cupboard should be kept to a minimum and sited at least 150mm inside the plane of the sash to ensure efficient containment. Keep items away from the sash opening to allow instant closure in an emergency.
- Avoid placing large pieces of equipment in a fume cupboard - they spoil the aerodynamic flow and may reduce the containment of fumes. If their use cannot be avoided they should be raised up about 10cm using lab jacks, in order to allow air to pass unimpeded across the work surface and to be exhausted from rear of fume cupboard.
- The experimental materials must be sited at least 150 mm inside the plane of the sash to ensure efficient containment.

6.3 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 0.5m, and where reasonably practicable should be lower.
- Use the sash position to your advantage -
 - Fully open, to provide access for setting up equipment
 - Partially open, to a comfortable work height 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.
- Try to avoid sudden rapid movements in front of the cupboard. These can cause turbulence that may draw the airborne hazardous material out of the cupboard.
- Do not use naked flames as they will have a serious adverse effect on the air flow.
- Perchloric acid must not be used in fume cupboard, unless fitted with wash down facility, as this presents a risk of fire - consult your local Area H&S Coordinator for advice.
- Chemicals must not be stored in a fume cupboard used for experimental work - they could escalate an accident.
- 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 10 cm from the side and back of the cupboard to avoid damage to the cupboard structure.
- 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, a contact name and telephone number must be prominently displayed. Do not leave potentially hazardous work unattended.

6.4 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.
- Dispose of waste in a safe appropriate manner as identified by the risk assessment and in accordance with laboratory rules.
- If permitted by local rules/lab risk assessment, switch off the fume cupboard.

6.5 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. 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 if possible turn off the fume cupboard. Raise the alarm by activating the fire alarm (press red manual call point) and phone the emergency services (999). Evacuate the building.

7 TRAINING, INSTRUCTION AND INFORMATION

Users of fume cupboards must be trained in correct use, not only in order to understand how the cabinet works but also because poor technique can compromise the operation protection afforded by the cabinet.

Training should cover:

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

The form at Appendix 2 can be used to record training. Records of all training, including refresher training, must be kept and only those trained are authorised to use the system. This applies to all users (whether staff or students).

If the extraction system changes (removal of cabinets on the system, change in extract routes or fans), the system must be re-commissioned and the users re-trained. Consideration must also be given to the possible need to clean the system of any residues from previous uses.

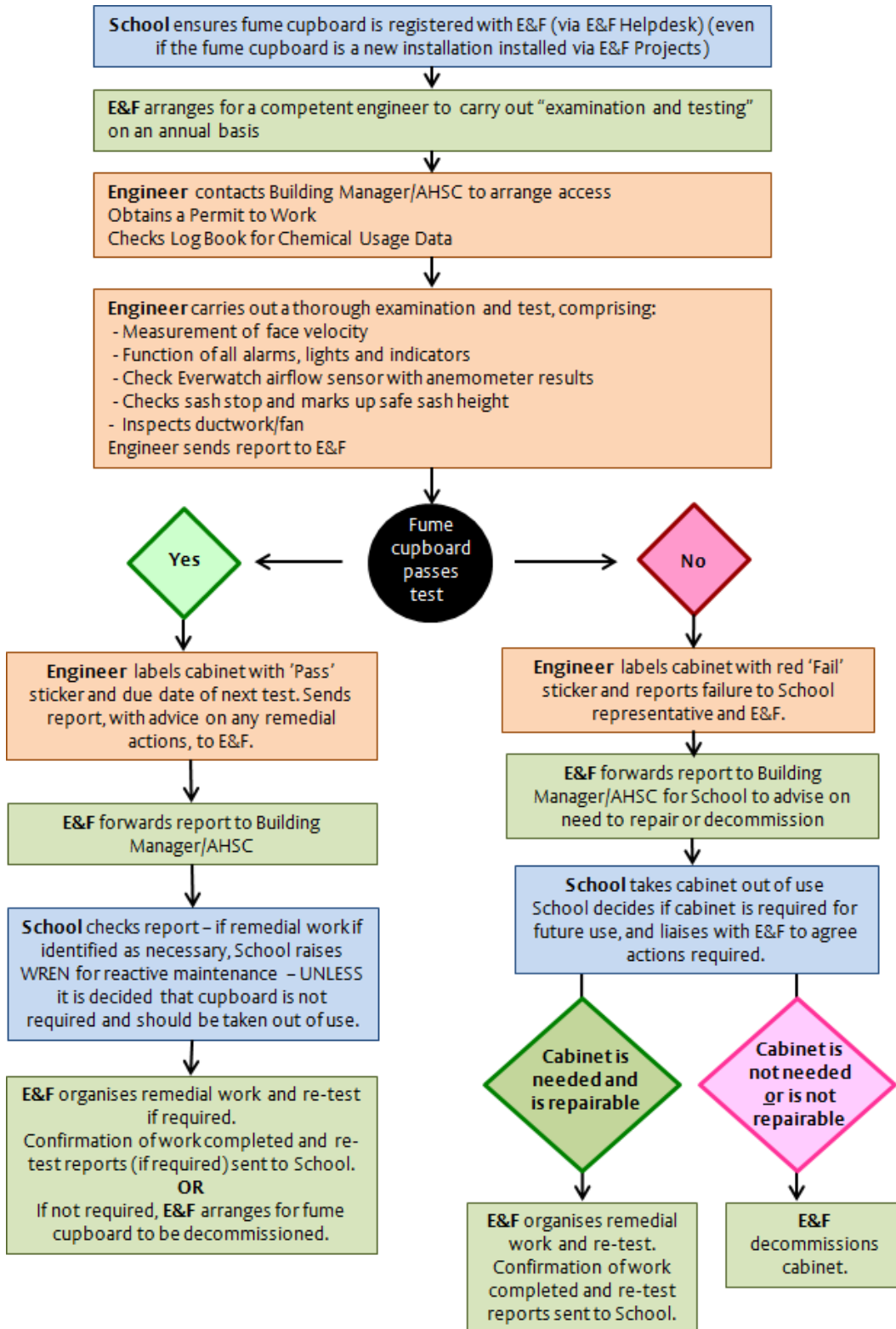
In mixed or shared extract stack systems, an assessment of the need to restrict the use of certain substances must be undertaken to prevent the mixing of incompatible substances in the extract ducting and stack.

8 FUME CUPBOARD LOG BOOK

All fume cupboards must be accompanied by a log book. This log book is to include:

- Instructions for use, including limitations (where applicable)
- Usage data (see Appendix 3)
- Copy of user tests and performance measurements (e.g. face velocity)
- Copies of annual inspection and test results for the last 5 years
- Copies of maintenance records
- Detailed technical information for service providers and maintenance/repair engineers.

Appendix 1: Flow chart of ducted fume cupboard thorough examination and testing process



Appendix 2: Training requirements for fume cupboard users

SUBJECT	ITEM COVERED		COMPETENCY ASSESSED		
	YES	NO	YES	NO	N/R
1 This CoP has been issued.					
2 Control panels, alarms and indicators – what they all mean					
3 Safe operating parameters (face velocity)					
4 How to turn the fume cupboard on and off					
5 The importance of lowering the sash to the lowest possible position when working at the cupboard					
6 The importance of shutting the sash whenever the operator does not need access to within the cupboard					
7 Techniques to avoid disrupting the airflow					
8 Local rules on whether the fume cupboard can be left on or not					
9 Permitted equipment allowed within the cupboard					
10 Local rules on restrictions on use of particular cupboards					
11 Dealing with waste within the fume cupboard - do not let it accumulate or use the fume cupboard for waste storage					
12 Restrictions on what work can be carried out in recirculation fume cupboards					
13 Dealing with spillages within the fume cupboard					
14 Emergency actions – what to do if the power or airflow fails					

15	Routine cleaning of the cupboard after use					
16	Principles of airflow, performance testing and containment testing					
17	Who to report to if the fume cupboard is 'out-of-test'					
18	Do not use if the fume cupboard is 'out-of-test', does not have any indication of test status, or has a red 'fail' label					
19	Operating fume cupboards in an energy efficient manner, whilst maintaining safety standards					

Both trainer and trainee agree that the above training has been fully completed and that the trainee is considered to be competent to use the fume cupboard for the specific project/work.

POSITION	NAME	SIGNATURE	DATE
Trainer			
Trainee			

Appendix 3: Record of fume cupboard usage (log book)

YEAR		IDENTIFY THE MATERIALS IN THIS COLUMN
This fume cupboard [insert ref] has been used with the following materials:		
Radioactive material		YES/NO If yes.....
Chemical Hazard Flammable	R7 May cause fire R8 Contact with combustible material may cause fire R9 Explosive when mixed with combustible material R10 Flammable R11 Highly flammable R12 Extremely flammable R14 Reacts violently with water R15 Contact with water liberates extremely flammable gases R17 Spontaneously flammable in air R30: Can become highly flammable in use	YES/NO No further details required
	Chemical Hazard Harmful	R20: Harmful by inhalation R21: Harmful in contact with skin R22: Harmful if swallowed R65: Harmful: may cause lung damage if swallowed R66: Repeated exposure may cause skin dryness or cracking
Chemical Hazard Irritating	R36: Irritating to eyes R37: Irritating to respiratory system R38: Irritating to skin R43: May cause sensitisation by skin contact	 No further details required

Chemical Hazard Explosive	R1: Explosive when dry R2: Risk of explosion by shock, friction, fire or other sources of ignition R3: Extreme risk of explosion by shock, friction, fire or other sources of ignition R4: Forms very sensitive explosive metallic compounds R5: Heating may cause an explosion R6: Explosive with or without contact with air R16: Explosive when mixed with oxidising substances R18: In use, may form flammable/explosive vapour-air mixture R19: May form explosive peroxides R44: Risk of explosion if heated under confinement	YES/NO
		No further details required
Chemical Hazard Toxic	R23: Toxic by inhalation R24: Toxic in contact with skin R25: Toxic if swallowed R26: Very toxic by inhalation R27: Very toxic in contact with skin R28: Very toxic if swallowed R29: Contact with water liberates toxic gas R31: Contact with acids liberates toxic gas R32: Contact with acids liberates very toxic gas	YES/NO If yes.....
Chemical Hazard Corrosive	R34: Causes burns R35: Causes severe burns	YES/NO
		No further details required
Chemical Hazard Carcinogenic,	R33: Danger of cumulative effects R39: Danger of very serious irreversible	YES/NO If yes.....

<p>Mutagenic, Other serious health risks</p>	<p>effects</p> <p>R40: Limited evidence of a carcinogenic effect</p> <p>R41: Risk of serious damage to eyes</p> <p>R42: May cause sensitisation by inhalation</p> <p>R43: May cause sensitisation by skin contact</p> <p>R45: May cause cancer</p> <p>R46: May cause heritable genetic damage</p> <p>R48: Danger of serious damage to health by prolonged exposure</p> <p>R49: May cause cancer by inhalation</p> <p>R60: May impair fertility</p> <p>R61: May cause harm to the unborn child</p> <p>R62: Possible risk of impaired fertility</p> <p>R63: Possible risk of harm to the unborn child</p> <p>R64: May cause harm to breast-fed babies</p> <p>R67: Vapours may cause drowsiness and dizziness</p> <p>R68: Possible risk of irreversible effects</p>	
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Appendix 4: Version control

VERSION	KEEPER	REVIEWED	APPROVED BY	APPROVAL DATE
X.X	H&S	Every four years	XXXXX	XX/XX/XX
X.X	H&S	Annually	XXXXX	XX/XX/XX