Guidance note to accompany CS CoP004 – Local Exhaust Ventilation

1.0 General safety guidance

The most important item of equipment used to protect the laboratory worker from exposure to hazardous chemicals used in the laboratory is the fume cupboard. A fume cupboard is basically a fire and chemical resistant box (enclosure) with one open side at the front (face) this is covered by a usually vertical opening window (sash) which gives the users access to the inner working surfaces. Functionally it works by drawing large volumes of air into the cupboard through the face; this is then extracted from the top of the cupboard via ductwork to the external of the building, thus airborne contaminates originating from chemicals inside the cupboard are prevented from escaping from the sash by the inward flow of air and the operator is protected from harmful exposure.

In addition to protecting the worker from exposure to toxic or unpleasant airborne agents fume cupboards also act as an effective containment for accidental chemical spills.

2.0 Installation and design

Details of the design requirements for a basic fume cupboard for installation in this University can be found in CS CoP004 Local Exhaust Ventilation, section 1.4 installation and design. Where particularly hazardous acids (e.g. hydrofluoric acid) are being used, or corrosive vapours or gases may be produced the need for a fume cupboard with built in water wash down or scrubbers must be considered.

Many fume cupboards are now of the 'dynamic low flow' type, which design of internal baffles allows for full containment at a much reduced face velocity (0.3m/s versus the normal 0.55m/s) thus this design of cupboard allows for much reduced make-up air and reduced extract fan sizing resulting in lower running costs and a lower carbon footprint. However, care must be taken when deciding upon this type of fume cupboard, dependent on the hazards being contained. This is covered in the Laboratory ventilation policy and guidance developed by the Sustainable Labs Steering Group.

In particular fume cupboards must not be sited;

- On heavy pedestrian traffic routes. (vortices formed behind a walking person may overcome the cupboards face velocity whereby contaminants are pulled out of the cupboard into the vortices)

- Adjacent to doors. (turbulence caused by the opening/closing of doors may affect the cupboards containment capability)

- Adjacent to opening windows. (wind blowing through open windows may affect the cupboards containment capability, especially if coupled with the effects of opening doors)

- Directly opposite the open end of a u-shaped laboratory bay. (in the case of fire/explosion within a fume cupboard workers have been trapped in the bay, their exit being blocked by the fire)

3.0 Safe use of fume cupboards

- Chemicals, or chemical by-products, that are very toxic, or carcinogenic, by inhalation should be worked with only in a glove box, or other sealed system, the appropriate mechanical control having been chosen as a result of thorough and documented risk assessment.

- The extract fan must be on at all times when the fume cupboard is in use for experiments and when it contains volatile compounds.

- When being used for experimental purposes, each fume cupboard must be under the management and control of one person.

- Use only fume cupboards that have been tested for adequate face velocity and containment within the last 14 months and have visible verification of such testing posted on the sash screen, or adjacent to it.

- Keep hazardous chemicals and any reactions at least 15cm behind the plane of the sash.

- Never insert your head inside an operating fume cupboard to check a procedure, remember the barrier between clean and contaminated air is the plane of the sash.

- Always work with the sash in the lowest practicable position and always close the sash when leaving the fume cupboard unattended.

- Do not clutter fume cupboards with unnecessary equipment, or store bottles of chemicals within them as this may restrict the airflow and affect containment. Where possible raise equipment that is to remain in the fume cupboard on racks, etc., so that air can flow freely underneath it.

- Do not use a fume cupboard as a store, even temporarily, for chemical solvents or reagents as they may well increase the fire loading and explosion potential in event of accident.

- It must be possible to close the sash quickly without any risk of disturbing apparatus in the fume cupboard.

- The sash should be kept closed during an experimental procedure which might 'run away' and cause an explosion.
- Appropriate hazard warnings must be displayed.
- The rate of release of toxic or flammable vapours must be minimised by experimental design.
- Always ensure that the space below the fume cupboard sill is kept clear of obstruction so as to ensure optimum airflow and thus containment.
- Never override the sash stops to work within a fume cupboard when harmful chemicals are in use, the design containment can only be assured at the sash stop height of 500mm.
- Never use a fume cupboard that is suspected to be malfunctioning, or override a warning indicator and always report any malfunction immediately to the Lab/Building Manager.
- Do not write or affix copious notices to the sash screen as this may obscure clear view of safety critical processes.
- An exception to the previous is if Hydrofluoric Acid (HF) is being used as part of a process within a fume cupboard and the process is to be left unattended, in this case always close the sash window and ensure that a notice informing that HF is being used is attached to the sash window.

4.0 Environmental protection

In addition to considerations as to the suitability of a particular fume cupboard as a means of protecting the laboratory worker, all users of fume cupboards are reminded that it is a legal requirement under the Environmental Protection Act to use the best practicable means for preventing the emission into the atmosphere of noxious or offensive substances, and for rendering harmless and inoffensive such substances as may be so emitted. Just as you should never flush a laboratory waste down the drain, you should never intentionally send noxious waste up the fume cupboard stack.

In this connection, it must be stated that, where at all practicable, a fume cupboard should not be used as primary containment for a recognised experimental hazard. It should instead be regarded as a second (or even third) line of defence, capable of dealing with an unexpected breach of the primary containment (condensers, traps, scrubbers, etc.) built into the user's experimental setup, to prevent the escape of noxious or offensive fumes, vapours, etc.

In order to prevent, or minimise the risk, of the entry of noxious fumes or gases into adjacent buildings, or indeed re-entry into the building of source, the terminals of fume cupboard stacks should ideally be at least 3m above the building roof line and

that of adjacent buildings. In practice, because of the complex nature and differing dimensions of University buildings, it may not be possible to achieve the 3m ideal above adjacent buildings. In such cases consideration must be given to ensuring that discharge fumes do not re-enter buildings by observing airflow patterns using a smoke generator. If re-entry appears to be a problem the need for chemical/particulate filters in the extract ducting must be considered.

5.0 Recirculatory fume cupboards

Fume cupboards which recirculate air from the cupboards interior, through active charcoal filters, back into the laboratory are commercially available. Users should be aware of a paradox in the design of these devices, namely, arranging adequate air velocity through the face of the cabinet whilst ensuring sufficient residence of the contaminant in the filter to allow absorption. Since a practical design will need to be a compromise of these features, some equipment will fail, in practice, to remove contaminants from the workplace air. For this reason, recirculatory fume cupboards are not generally recommended, and their use should only be considered in exceptional rather than general circumstances and, in particular, where the fume has a nuisance rather than a toxic value, or where the work would normally be carried out on the open bench.

If the purchase and use of recirculatory fume cupboard is proposed the following points must be considered;

- The cupboard must conform to British Standards BS 7989: 2001.
- Maintenance of recirculating fume cupboards is not the responsibility of Estates Department, but that of the purchasing School. Schools must ensure that a maintenance agreement with a competent engineering company is in place, that includes 14 monthly inspection and test, and that this test includes a filter integrity test.
- The filter designed must be such as to absorb all the chemicals that will be used.
- The cupboard should have a filter saturated warning/alarm.
- The cupboard must have a warning/alarm given of low air flow.
- Are there any circumstances where de-sorption can occur due to preferential absorption of another chemical at a later stage, or due to lack of dwell time of a contaminant in the filter?
- What is the containment of the fume cupboard and are there any limitations?
- What is the standard for average face velocity?

- If contemplated, is it safe to use sources of heat in the re-circulating fume cupboard?
- How is a saturated filter to be safely changed?
- How is the contaminated filter to be safely disposed of?

Users should take steps to ensure that the standard of supervision, training, system of work and record keeping will always be such that there would be no risk at any time of the fume cupboard being used for work involving chemicals for which the fitted filters are unsuitable, or when a filter is saturated, or for work with different chemicals at different times which might produce within the filter a combination which constitutes a hazard.

Document version

Version number	Summary of change	Date and by whom
V1.0	**Reviewed version of old CS CoP004 Fume Cupboards, which was replaced by CS CoP004 Local Exhaust Ventilation, and is now published as a Guidance Note.**	**06/02/2023 C Schmid**

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