USER'S GUIDE TO FUME HOODS

Procedures for Increasing the Effectiveness of Laboratory Hoods

Revised December, 1998

A laboratory fume hood system is designed to protect the operator from undesirable substances being used, so its most important function is containment. While users have little control over a system which is already in place, they can greatly increase or decrease its effectiveness by the way the hood is used. The purpose of this document is to make those who use hoods aware of some of the factors which contribute to the effectiveness of a hood system.

Hood Basics

There are a wide variety of fume hoods on campus and some of these suggestions may not be applicable to all systems. The basic structure of a fume hood is not unlike a conventional fireplace and chimney combination. They usually have dampers which permit ventilation of the laboratory when the hood is not in use. In some cases, hoods with vertical sashes are designed to automatically exhaust about the same amount of air from the room even when the sash is closed. In other cases, the hoods have dampers which change the ratio of room air which goes through the hood compared to that which bypasses the system.

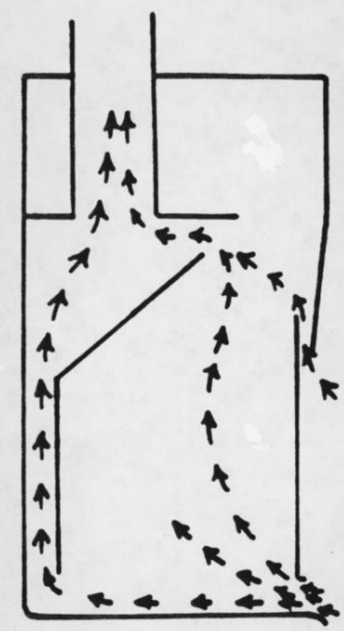

Figure 1. Fume hood system
Side view

As shown in Figure 1, most hoods have an arrangement of movable panels, called baffles, with openings or slots at their edges. Air exhausted from the hood is drawn out through the slots. The slots are always at the top and the bottom with some systems having a middle adjustable slot or slots on the vertical edges of the baffles. The ratio of air which is drawn into the top and bottom slots can be varied by repositioning the baffles. Hood manufacturers claim that the upper exhaust slot should be opened when working with lighter than air vapors and the lower exhaust slot should be used to collect heavier than air vapors. Experts dispute this claim as a useful concept, noting that, except in unusual circumstances, the amount of material mixing with the air has minimal effect on the density of the mixture. You should check the setting of the upper slot. This should be between one-half and three-quarters of an inch. If this setting is not fully open, efficiency can drop by a large factor due to turbulence in the upper portion of the hood. The bottom slot is usually open one to four inches depending upon the design of the hood.

Good Work Practices and Changes You Can Make

Keep the Sash Down

For hoods which have a movable front sash, keeping the opening as small as reasonably possible usually increases the flow rate through the aperture and enhances effectiveness. The sash also operates as a safety shield. It is strongly recommended that the hood sash be closed to within one or two inches when not in use. In many cases, such a practice not only saves energy, but can increase efficiency of other hoods on the same system.

Have an Airfoil Installed

A source of undesirable turbulence results when air entering the hood impacts on the front edge of the floor of the hood. This effect can be minimized by the installation of an airfoil along the front edge of the hood as shown in Figure 1. Experiments conducted in the Chemistry Department showed a significant decrease in turbulence when such devices were installed. These devices are relatively inexpensive (around $100) and can be purchased for existing hoods through fume hood suppliers. Contact the Purchasing Department for vendors selling these devices. These devices are simple enough to be fabricated on campus; if you are interested, call the Sheet Metal Shop at 255-4752.

Use an Airflow Indicator

It is possible that without the knowledge of the user, the fan motor may not be operating, with the result that the individual does not have the protection expected from the system. Inexpensive (around $100) flow monitors which serve as indicators are available from scientific supply houses. These are listed under air flow monitors, manometers and vaneometers. A simple telltale consisting of an eight-inch narrow length of light material will also serve this purpose.

Keep Laboratory Doors and Windows Closed

In closed buildings, ventilation and fume hood systems are usually designed on the assumption that doors to the laboratory and windows will be in the closed position. If the doors and windows are left open, unplanned air flow patterns may degrade the efficiency of a hood.

Limit Traffic

Pedestrian traffic in front of the hood induces turbulence and can overcome the capture of vapors and pull them back out of the hood and into the operator's breathing zone. A painted line or length of tape placed on the floor of the room two feet away from the hood will discourage traffic this close to the hood.

Reduce Clutter

The effectiveness of a hood system is increased by achieving even, laminar airflow across the deck or bench surface of the hood The presence of objects in the hood tends to increase turbulence, so the more cluttered the working surface, the lower the efficiency and the less protection you have. For this reason, the number of objects in a hood should be kept to a workable minimum. In particular, keep the number of chemicals stored in a hood as low as possible. Not only does such storage decrease hood efficiency, but it also increases the possibility and seriousness of accidental fires. Solvents should be placed in vented cabinets rather than wasting useful and expensive hood space. When circumstances dictate such storage of chemicals, they should not be placed near the exhaust slots or in the front six inches. Shelving constructed of noncombustible materials may be placed in a hood as long as the bottom shelf is several inches off the deck of the hood and as long as it is placed in a way that does not interfere with the flow of air through the hood.

Work Far Into the Hood

You can substantially increase your protection by putting experimental materials as far back into the hood practicable. By moving a fume source from the plane of the hood face back six inches into the hood's interior, the capture rate for volatile materials can be greatly improved. Operations should not be carried out within six inches from the plane of the sash and as a useful reminder, paint a line or place a strip of tape at this six-inch limit. However, in attempting to work as far back in the hood as possible, you should realize that the concentration of escaping vapors falls off very rapidly from the plane of the sash outward. Therefore, one's face should not be within the plane of the sash.

Other Considerations

Explosions

The glass sash offers protection from accidents and, when possible, it is safest to keep the sash between your face and the experiment. But the glass face is not designed to protect against explosions. When an explosive hazard is present, rounded safety shields should be placed between the operator and the experiment and as close as possible to the plane of the hood sash. Full face protection should also be used in such circumstances. Evaporations and digestions involving perchloric acid must not be carried out in hoods which were not designed for that purpose. Perchloric acid can condense in the duct work and result in an explosion hazard.

Exhaust

Care should be taken with the use of paper products, aluminum foil and other light weight materials within the hood. For example, a single piece of Kleenex, if sucked into the exhaust ducts, can potentially cause a profound deterioration in the velocity of air flowing into the hood.

Drains

Run water in hood drains at least once a week if the drains are not normally used. This is to prevent the drain traps from drying out and possibly perturbing airflow in the system.

Power Outages

In case of a loss of power, the hood sash should be lowered to within an inch or so of the closed position so the chimney effect will keep some air flowing into the hood. Electric powered devices in the hoods should be disconnected to minimize accidents when the power is restored.

Adjustments to the Hood System

Get Assistance for Mechanical Changes

Venting of laboratory apparatus (e.g., vacuum pumps and storage cabinets) into the face or side of a hood can disrupt the design flow and lower efficiency. When such venting is deemed necessary, the connection should be further along the exhaust ducts of the hood system rather than into the face of the hood. To avoid the possibility of disrupting the efficient operation of the system, such installations should not be undertaken without consultation with Facilities Engineering, EH&S and the appropriate technical shops.

Likewise, installation of a new fume hood cannot be undertaken without the possibility of seriously disrupting the existing ventilation system and at times making other hoods in the building much less efficient. You should never consider doing this work yourself.

Environmental Health and Safety's Role

Environmental Health and Safety performs annual testing of fume hoods on campus. If the existing inspection sticker on your fume hood indicates a year or more has passed since we last inspected that hood, please call us. If your fume hood doesn't have an inspection sticker or if you have questions concerning the hood’s operation, contact Environmental Health and Safety at 255-8200 for air flow measurements or questions.

Please remember all fume hood purchase requests need prior review and approval through our office. We can also provide information regarding the selection, purchase and inspection requirements for laminar flow, biosafety, and portable fume hoods.

Mechanical Problems

If your fume hood suddenly seems to stop working and you suspect mechanical problems, ask your building coordinator to call Customer Service. If maintenance workers are going to be working on your hood system, you should remove all chemicals from the hood.

Points to Remember

Many advisory notices of this sort are read but forgotten over time. To emphasize the more important operating factors, remember the following:

1. Make sure the hood is working (telltale indicates airflow).
2. Keep the sash as low as practical--sash is a safety shield.
3. Keep lab equipment one inch off work surface.
4. Keep hood free from clutter--don't block baffle openings.
5. Work at least six inches into hood.
6. Minimize rapid movements in front of hood.

Training programs on the safe use of fume hoods are available from Environmental Health and Safety.

Additional Information

For additional information on fume hoods and laboratory ventilation systems please see the following:

ANSI/AIHA Standard Z9.5-1992, *Laboratory Ventilation*. A paper copy of this document is available at the EH&S office at 125 Humphreys Service Building.

Cornell University Design and Construction Standards, "15010 Laboratories." Available by request from EH&S or at http://cds.pdc.cornell.edu/DesignStandards/Mechanical/15010-Laboratories.htm

ANSI/ASHRAE Standard 110-1995, *Method of Testing Performance of Laboratory Fume Hoods*. A paper copy of this document is available at the EH&S office at 125 Humphreys Service Building.

"Fume Hood Evaluation Procedures," as used by EH&S for testing fume hoods at Cornell.

"The Dry Ice Capture Test as Performed on Fume Hoods at Cornell," as used by EH&S for determining the ability of a hood to capture vapors and fumes.

"Cornell EH&S Fume Hood Shell Selection Guide," developed to help lab staff and designers select the appropriate fume hood.