Appendix A.4.1. Safe Fume Hood User Guide

Fume hoods are devices designed for work with toxic or hazardous chemicals with the effect of safely capturing the harmful gases, vapors, and fumes generated and exhausting them to the outside air. The fume hood is very effective if installed and used properly and maintained in good working order. Fume hoods are not just fixtures but are installed into the ventilation system of a building and so affect the ventilation of the entire building and the exhaust at the stack. As a result, fume hood function and proper installation not only affects your safety but the safety of others in the building.

The primary parts of the fume hood are:

Face – The face of the hood is the opening where air capture takes place.

Sash – The sash is the glass "window" that travels in the plane of the hood face that opens or closes the hood and protects the user during use.

Baffles – The baffles are located in the back of the hood and direct air in the appropriate direction. The baffles can also be adjusted to account for different vapor densities of chemicals (heavier than air and lighter than air).

Duct – The duct connects the hood to the ventilation system and exhausts to the outside air.

Air foil – The air foil is fixed to the bottom front edge of the hood and is a vent that keeps a minimum gap open at all times but more importantly gives aerodynamic properties that allow better, less turbulent air flow and better capture.

Function:

As the user works at the sash, the air is drawn in at a laminar (even) flow and ideally at about 0.5 m/s. With regard to capture, we are only concerned with velocity because this is what actually carries vapors and particles. The air volume is of more concern to the designers of the ventilation system. The air is drawn around the baffles and up to the duct like a chimney. The space around the baffles (slots) can be adjusted so air flow is concentrated at desired areas of the hood. For instance, if a chemical of high vapor density is being used, such as Chloroform, then the baffles may be adjusted to draw more air from the bottom of the hood where the vapors are expected to collect. Standard baffle setup (middle selection) is recommended for most operations with a variety of chemicals and other configurations may be explored if the work is mainly a specific application. It is important for there to be at least a 2.5-5 cm opening for the rear lower baffle since many vapors handled in hoods are heavier than air.

Types of Hoods

Variable Air Volume (VAV) – VAV hoods maintain a constant velocity as the sash moves but changes the volume of air. This can be done by a variety of methods including changing motor speed or closing or opening baffles in the duct. This is desirable since lower sash heights results in less air being used, which translates into substantial energy savings on heating and cooling.

Standard or Bypass –With standard hoods the volume of air changes as the sash moves so that as the sash is lowered the velocity increases. Bypass hoods are the same design but have a vent in the top so that as the sash is lowered and the sash opening is closed, it simultaneously opens the top (bypass) vent. In this way, even though the sash opening is getting smaller, the proportion of air volume flowing through the face is smaller and the velocity remains more constant. This does not save as much energy as a VAV hood, but performs better than a standard hood.

Auxiliary Air – These hoods not only draw air but also have a blower that injects air at the face of the hood. These hoods are no longer used much on campus and their performance is not as good as VAV and bypass hoods.

Ductless hoods – These hoods are not ducted to outside air but remove contaminants from the air and return it back to the room. The contaminants may be removed by a variety of means such as HEPA air filters, carbon adsorption or catalyst reactions filters. The filters should be changed on a schedule according to the manufacturer and the appropriate filter should be used for the particular contaminant being removed. It is vital that these units work properly since the air is reticulated and exposure is eminent. In order to select the best filter and to make sure the unit is working properly, the EH&S Industrial Hygiene group must conduct a consultation with the lab and evaluate each chemical used in that hood. If any new chemicals are introduced, LS/LSS should be called to evaluate that chemical. It is recommended that ductless hoods not be purchased unless the benefits outweigh the hazards and inconvenience because potential for problems. Also, ductless hoods are not indicated when using many liquid, non-aqueous chemicals since the vapors of these chemicals are heavier than air and ductless hoods do not generally have a rear baffle. As a general rule the use of ductless hoods is not recommended.

Clean hoods – Clean hoods are sometimes called laminar hoods but these should not be confused with the type of hood mentioned below. These hoods are safety devices designed to bath the work area with HEPA filtered air to protect sensitive processes from contamination. They are commonly used in clean rooms. These hoods draw the majority of air through a filter and drop the air gently from the top of the hood into the work area and draw only a small percentage of air through the face of the hood (about 10%). The result is face velocities that are lower than other hoods, however, the hood is designed to capture well in this fashion. Due to this style of capture, it is important to have a visual capture test (such as a dry ice test) done on these hoods at least annually.

Biosafety Cabinets (BSC) – These units are used for biological applications to remove potentially infectious agents such as microbes and spores. The air is passed through a HEPA filter and back into the room. The filter removes small particles but not vapors and gases, so BSCs should not be used with chemicals (a little Ethanol or Isopropanol for decontamination is OK). It is the responsibility of the lab to have these tested and certified by a third party on an annual basis.

Safety Guidelines for fume hoods

• Keep the sash as low as possible to minimize the risk of exposure. The sash acts a safety shield and protects your face, so you should be looking through the sash to perform your work. The green arrows are a good guideline for sash position, but sash height should be adjusted depending on the height of the person using the hood.

• If an airfoil is not installed on your hood, consider having one installed. This will provide more laminar air flow and better capture of contaminants.

• Always use an airflow indicator. This is a small piece of crepe paper (or similar) attached to the bottom of the sash that blows with the air current. This is the only way to know for certain that air is flowing through the hood in the proper direction. The indicator should be blowing into the hood (sometime the flow is reversed by accident during maintenance). Please note, an airflow indicator only indicates the direction of airflow and does not indicate whether the fume hood has the proper face velocity.

• Keep lab doors and windows closed. These extra sources of inlet air can: affect the performance of the hood, cause turbulent air currents in the room or cause the room to loose its negative pressure.

• Limit traffic near hoods when in use. Pedestrian traffic or fast movement in front of hoods can cause turbulence and can negatively affect the capture ability of the fume hood.

• Reduce clutter and do not store large amounts of chemicals in the hood. Excess clutter and chemicals can impede airflow especially to the lower openings. Necessary bottles and equipment should be elevated a 2.5-5 cm to allow airflow underneath to the rear baffles (a small shelf or blocks of some kind will work for this). Excess chemicals can be a hazard in themselves due to their properties. Store chemicals in cabinets or on shelves, except for the chemicals you need immediately for the work at hand.

• Work at least 15 cm into the hood from the plane of the sash. This will reduce the risk of eddy currents blowing vapors back at you and will maximize capture ability of the hood.

• If hoses or cords must be inserted through the face of the hood, run them underneath the airfoil so the sash can close completely.

Other considerations

• If there is a potential for an explosion hazard due to the chemicals you are using or the experiment you are conducting, special shielding should be used in addition to the sash.

• Protect against blockage of ducts. Lightweight materials such as aluminum foil or tissues can be sucked into the vents and reduce the performance of the hood.

• Run water in hood drains periodically so they do not dry out. Open drains can possibly affect airflow and can cause nuisance odors.

• In a power outage, lower the sash to within 2.5-5 cm so the chimney effect will keep some air flowing into the hood and contain any vapors.

• Other than sash height and baffle adjustment, never make changes to the hood without the advice of LSS.

• If other apparatus requires venting, the exhaust should not be injected into the face of a hood but rather should be ducted to the ventilation system. This kind of work should be cleared through Operations and Technical Services.

• Whenever you are not using the fume hood, always close the sash of the hood as low as possible. Closing the fume hood sash provides added protection of better capture ability of any chemicals being stored in the hood as part of an experiment and also greatly enhances energy conservation measures for the laboratory.

Visual Capture Test (Dry ice test)

A visual capture test is the surest way to tell if your fume hood is capturing properly so you may choose to conduct your own to see how well your hood is performing. EN 14175 provides a procedure to supplement face velocity with a visual test for capture called a dry ice test.

Procedure:

SAFETY: Dry ice is extremely cold and can burn the skin on contact. Also, dry ice generates CO_2 gas as it warms and in an enclosed space can produce an oxygen deficient environment. Employees must read the dry ice (M)SDS and be aware of the hazards before handling any dry ice.

<u>The face velocity for the hood should be tested first followed by the dry ice test:</u>

• Eye protection and insulated gloves should be worn when conducting this test.

• Weigh dry ice, grind it up using the grinder, and place it into our insulated container. Put our account number on the clipboard and you information. Always use protective gloves and eye protection when handling dry ice.

• The sash should be positioned at 45 cm. Fill the stainless steel bowl to the black line (about half-way) with hot water. Put a 5 or 6 pellets of dry ice into the bowl and wait a few seconds. Place the bowl into the center of the hood, with the edge of the bowl 15 cm from the plane of the sash and wait a few seconds. If the hood is too crowded, place the bowl as close to 15 cm back as you can.

• Observe for about 15 seconds. If no vapors or a trivial amount of vapors break the plane of the sash then the test passes. If however, vapors consistently break the sash plane, then the test fails.

• Challenge the hood during the test by reaching into the hood or crossing in front of the hood to create possible eddy currents. You may also move the bowl closer to the hood face and operate any equipment while testing. These actions can simulate actual conditions encountered by the worker and may give indication of what could contribute to leakage. This information can be considered in your assessment.

• Make sure all doors are closed and test for negative pressure by cracking the door open and putting the dry ice near the opening outside the door. The vapors should be sucked into the room.

• When disposing of the dry ice pour the left over pellets into the sink holding the bowl next to the side. Try not to let the pellets go into the drain since it could freeze the trap and burst the pipe.