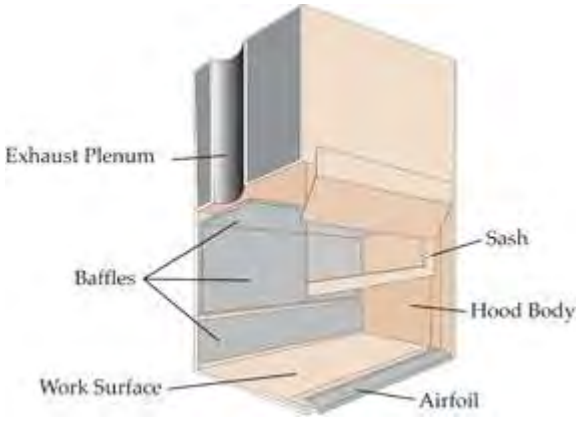
Fume Hood Course Content

Introduction

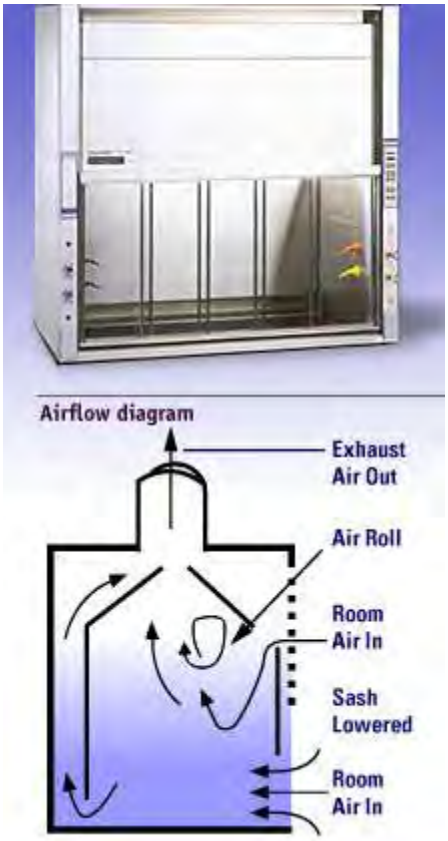
Chemical fume hoods are the primary engineering control used in the laboratory to protect against the inhalation of hazardous vapors and gases. A fume hood is a partially enclosed workspace that is exhausted, in most cases, to the outside of the building. An efficiently working fume hood minimizes a person's exposure to airborne contaminants and prevents them from reaching the breathing zone. It also provides protection from unanticipated fires, explosions, and chemical splashes.

Optimum airflow, or face velocity, of a chemical fume hood is 80-120 feet per minute. This range allows the hood to properly contain and exhaust contaminants, reduces the chance for escape of fumes via turbulence and outside air movement. Face velocities below 80 fpm are likely to allow contaminants to escape from the hood and face velocities above 120 fpm can cause excessive turbulence and can also allow contaminants to escape.

The typical fume hood is made up of the following components:



- **Hood body**- The visible part of the chemical fume hood that serves to contain hazardous vapors & gases
- **Sash** –A sliding glass door or panel on the front of the hood that opens to allow access to the inside of the hood.
- **Airfoil** – located along the bottom "lip" of the hood, the airfoil streamlines airflow into the hood and helps prevent turbulence that could cause vapor or gases to escape. When the sash is completely closed, the airfoil provides a source of air from the room for the hood to exhaust. It is important to note that removing the airfoil can cause turbulence and loss of containment
- **Work Surface** – The benchtop or floor area where apparatus and equipment needed for experiments are placed.
- **Baffles** – The adjustable slates along the back of the hood body. They create openings along the back of the hood that help keep the airflow uniform across the sash opening.
- **Exhaust plenum** –Helps to distribute airflow evenly across the face of the hood.
- **Face** – the plane that runs from the bottom of the sash to the work surface. This plane is where the face velocity of the hood is measured.



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(Air is pulled in to the body of the hood through the opening of the sash and the airfoil. It travels back through the baffles and up through the top of the hood. The air is then exhausted out if the hood and building through ductwork.)

Types of fume hoods and their function

There are several types of fume hoods that are located within labs at UK. Each providing a unique function by design.

- Constant Air Volume (CAV)/ Conventional Hood –The volume of airflow within this type of hood remains constant. All air enters through the sash opening. As one lowers or raises the sash the velocity of the airflow increases and decreases respectively. It is very important to properly position the sash in order to maintain the optimum face velocity (80-120 feet per minute).
- Bypass Hoods – This type of hood is essentially the same as a conventional/CAV hood. The only difference is that it has an air bypass above the sash that provides an additional source of room air when the sash is closed. The bypass area becomes exposed as the sash is lowered, which reduces the rate of increase in the face velocity and reduces the chance for turbulence and loss of containment. As with the conventional/CAV hoods, it is important to properly position the sash in order to maintain a face velocity of 80-120fpm.
- Auxiliary Air Hood – This type of hood is similar to the bypass hood. The difference being that the source of the bypass air does not come from inside the lab but from a dedicated duct that brings in air from outside of the building. While this type of hood saves energy by reducing the amount of air-conditioned or heated room air exhausted through the hood, it can cause discomfort for those working in or around the hood. It is important to remember to close the sash when the hood is not in use. This will allow the unconditioned air to bypass through the hood and reduce the effect on the temperature and humidity in the lab
- Variable Air Volume (VAV) – These hoods are very sophisticated and have the ability to maintain a constant face velocity as the height of the sash is lowered and raised. The exhaust volume is adjusted when the sash is moved so that the average face velocity is maintained within set parameters. The sash of a VAV hood should be closed when not in use in order to conserve energy.

(Most hoods on campus are standard VAV hoods)

- Radioactive Hood – Any of the above listed hoods can also be used for radioactive materials. The only stipulation is that the interior work surface must be impervious (usually stainless steel). In some cases, the hood is also required to have a filter at the hood outlet that Radiation Safety is able to monitor.

(Radiation Safety will mark hoods with the above sticker
if they are approved for radioactive materials use)

- Perchloric Acid Hood – Perchloric acid will vaporize when heated above ambient temperatures. Once vaporized, it may condense in the hood, ducting, and fan components. These condensed vapors are corrosive and can react with other collected materials to form explosive perchloric salts and esters. To minimize the corrosive and reactive effects of these compounds, perchloric

acid hoods are built with welded stainless steel hood surfaces, ductwork, and fans and are equipped with a wash down system. This system should be used after each use of heated perchloric acid. Any materials that are deposited within the system are washed away which prevents the buildup of percholrates. Perchloric hoods must be used if perchloric acid is to be used above ambient temperature or at concentrations above 72%.

(Always use a perchloric acid hood when heating perchloric acid.)

- Ductless/Recirculating hood – These hoods filter air through HEPA or charcoal filters and then discharge the filtered air back into the laboratory. They may not be used without approval of Occupational Health & Safety and Environmental Management.

(Ductless hood)

- Vertical vs. Horizontal Sash Hood – Horizontal hoods are the most common and have sashes that move up and down. Vertical hoods have sashes that move left and right.

(Horizontal Sash)

(Vertical Sash)

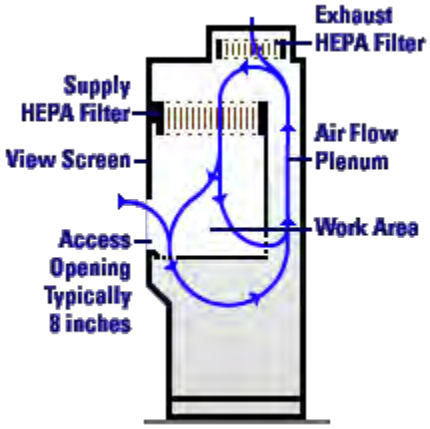
- Walk-in hood – Walk-in hoods, also called floor mounted hoods, have two or four sashes and reach from floor to ceiling. They can be either vertical or horizontal.

(Horizontal Walk-in hood)

(Vertical Walk-in hood)

- Biosafety Cabinets & Clean Benches - Don't mistake them for chemical fume hoods.
    - BSCs: have an inward airflow just like chemical fume hoods. They protect the user and product and are designed to contain biological hazards (particles) not chemical fumes & vapors. Most BSCs will not be vented to the outside. Rather, they filter the exhaust air through a HEPA filter.

(Copyright of the Eagleson Institute)
(Biosafety Cabinet (BSC))



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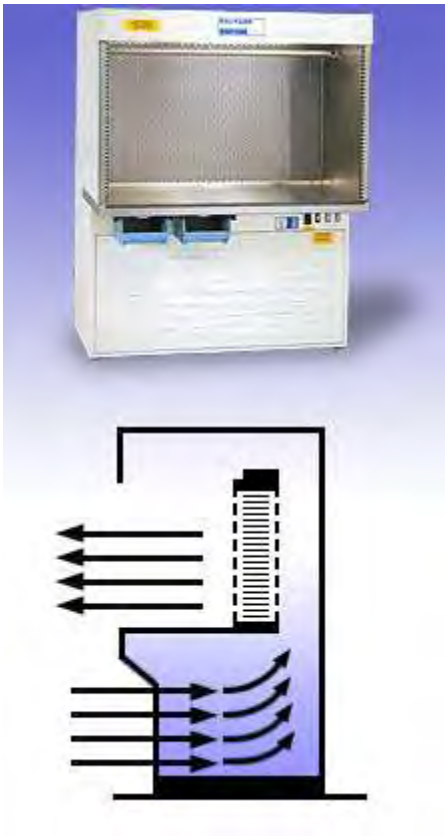
(Biosafety Cabinet Airflow)

    - Clean Benches: typically provide only product protection by creating a unidirectional airflow through a HEPA filter. The discharged air goes directly into the workroom.



(Copyright of the Eagleson Institute)
(Clean Bench Airflow Movement)

Fume hood flow monitors

Monitors are attached to many of the hoods at UK. Their function is to provide the user of the hood with important information concerning airflow & face velocity. Monitors will alarm and alert the user when there is a problem with the airflow. Listed below are the types of monitors that are located within different labs at UK and what there specific lights and buttons mean and do.

Fume Hood Flow Monitors
Reference Guide

<u>Crown Controls</u>
-Red light constantly on- air flow problem
-Red & Yellow light on- hardware failing
-Red flashing- emergency activated, depress emergency button to return to normal
-Yellow light – air flow not controlled, usually when sash is closed or nearly closed
-Green light- Normal air flow
-Digital display- indicates face velocity in ft./min., and will flash “alarm” or any other mechanical problem that activates the alarm or hinders the hoods performance (Note: Many of the crown monitors on campus do not have a digital readout)

Locations - Ag Science North, ASTeCC, Ag Science South (Garrigus), Chem/Phys

Phoenix Controls

-Standard operation light on- normal flow

-Standby operation light on- setback operation, lower flow rate

-Emergency exhaust- puts the hood in full exhaust by opening the damper, it should only be pushed when there is a spill inside the hood; depress to reset to normal velocity

-Caution flow alarm- loss of control of face velocity

-Emergency button- used in event of emergency, depress when conditions are safe to return to normal operation

-Mute button- silence audible alarms automatically reset when alarm condition ceases

-Digital display- indicates face velocity in ft./min. (Note: Some monitors do not have a digital readout)

*Some models are equipped with motion sensors (proximity monitors) that go into energy saving mode when no one is at the hood. They may alarm when the lights are turned off indicating that the sash needs to be lowered to save on energy cost.

Locations MRISC, Combs, Med Science, Wethington Building, Plant Science, HSRB, BBSRB, CAER

Hamilton Industries (model 54L259)

-Pilot light is on (yellow) when functioning properly
-Red alarm light lit when hood is in flow alarm
-Test button allows user to make sure the alarm is audible
-Silence button silences audible alarm
-Alarm must be in “on” position to sound (controlled with a key)

Locations Hospital (Clinical labs)

Fisher Hamilton SafeAire 54L0335

-Green light on- normal operation

-Yellow light on- caution, airflow in set caution zone between low and normal

-Red light lit- alarm, high or low air flow, audible alarm will sound

-Digital display- indicates face velocity in ft./min. (Note: Some monitors do not have a digital readout)

-EMERG PURGE- Puts hood in full exhaust by opening the damper, should only be pushed when there is a spill inside the hood; depress to reset to normal

-TEST RESET- Will temporarily silence alarm

Locations KTDRC

TSI SUREFLOW Model 8650

-Green light on- normal operation

-Yellow light on- caution

-Red light on- alarm, air flow is too high or too low, audible alarm will sound, digital display will indicate the type of alarm.

-Digital display- actual face velocity in ft/min

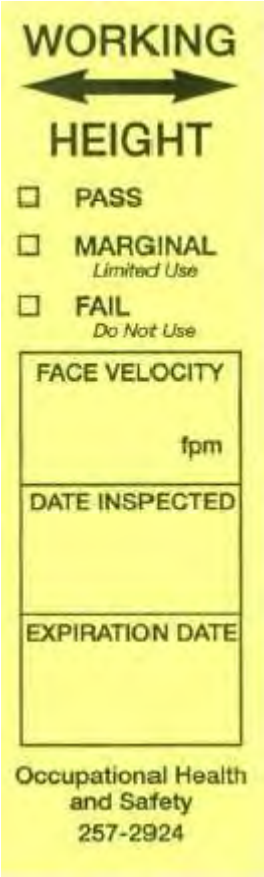
-Emergency- Opens dampers and puts hood in full exhaust, increasing velocity, the red alarm light will flash and the alarm cannot be silenced. Depress the RESET button to put hood back in normal operation

-Mute- depress once to silence alarm, alarm will stay silenced until hood returns to normal operation. If additional problems occur, audible alarm will sound again.

Locations Combs, Pharmacy

Fume hood safety and guidelines

All chemical hoods at the University of Kentucky should have face velocities between 80-120 feet per minute (fpm) with the sash at the recommended working height. Working heights are most commonly 12 or 18 inches and will be marked with a bright yellow fume hood sticker showing where the sash must be positioned and the measured face velocity.



It is suggested that the hood sash be lowered or closed when not in use. As a general rule, the hood should not be used with the sash fully open. Sometimes the face velocity of the hood may fall outside the passing range of 80-120 fpm. Please refer to the following table for marginal and failing hood information and ranges.

Face Velocity Range (fpm)	**Status**	**Use Restrictions**	**Additional Info**
121-150	Marginal	No Restrictions	The fume hood will need to be adjusted to 80-120 fpm for university energy conservation standards.

60-79	Marginal	Restrictions depend on the types of substances used and or stored in the hood.	One may contact OHS for advice on hood use until this adjustment can be made.
Below 60 and above 150	Failing	This hood should not be used for any chemical manipulations.	The fume hood will be closed and marked as failing. It will be reopened once fixed by PPD and recertified by OHS.

If a hood is failing, a sticker will be placed on the hood to warn personnel in the lab of its status and to seal the sash as to prevent use.

While the chemical fume hood is a very effective engineering control, it does not provide absolute containment or protection. This is true in respect to materials with very low exposure limits in the low parts per billion range. However, adequate protection can be provided by an efficiently working hood in a properly ventilated room. Certain work practices are required for the hood to have this efficiency. The following work practices are required at a minimum. More stringent practices may be necessary in some circumstances.

- Any and all operations & experiments that generate air contaminants above the exposure limit must be conducted inside a hood
- Operate the hood at the proper sash height. This is indicated by an arrow on the yellow sticker affixed to the front side of the hood. When the sash is placed at the proper working height, it will also provide a barrier against any unanticipated explosions, fires, spills, or splashes.

GOOD

(This person is using the fume hood at the certified working height. They are also wearing gloves, safety glasses and their lab coat as additional protection against spills, splatters and explosions)

BAD

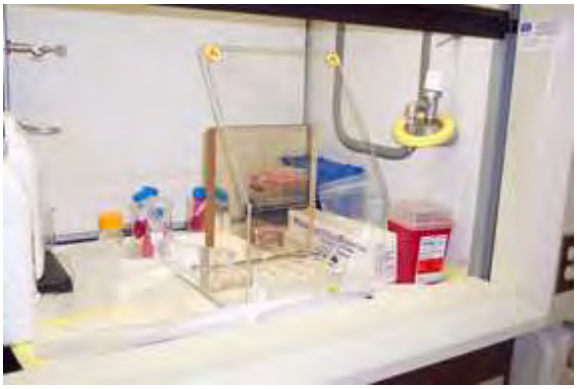
(This person is not using the fume hood at the certified working height. They are not wearing any personal protective equipment which is even more important when someone is not using the fume hood correctly.)

- Do not position air vents or fans so as to direct airflow across the face of the hood.
- All apparatus should be a minimum of 6 inches back from the face of the hood.
- Do not put your head in the hood when contaminants are being generated.
- Fume hoods are not to be used as a waste disposal mechanism except for very small quantities of volatile materials.
- Do not store excessive amounts of chemicals or apparatus in the hood. This can greatly impair its performance.

- Be sure that the hood is on when in use. (A simple way to make sure that the hood is pulling in air is to tape a Kimwipe® to the bottom of the sash. If it is not pulled back towards the inside of the hood, it may not be on or may be broken and need to be checked by OHS)

- Fume hoods may not adequately contain hazardous solids in powder form. Please contact OHS for guidance if you are planning on using them.
- The slots of the baffles along the back of the hood should be kept free of obstruction. No more than 25% of the bottom slot should be blocked.

- Foot traffic past the hood should be kept to a minimum when in use.
- Laboratory doors and windows should be kept closed. (Except when the lab is designed for them to be open)
- Do not remove the hoods sash or panels except when it is necessary to set-up apparatus. They must be replaced before any operations begin.
- Do not place any spark source (i.e. electrical receptacles) inside the hood when flammable gases or liquids are present.
- Permanent electrical receptacles are not permitted in the hood.
- If there is a chance of explosion or eruption, use an appropriate barricade or shield.



- All chemical hoods should have spill protection lips along the front of the hood. If your hood has a cup sink, it should have a lip as well.
- If the hood sash is supposed to be partially closed for operation, the hood should be labeled as so. The appropriate closure point should be clearly indicated.
- It is suggested that all large equipment be elevated 1-2 inches above the working surface of the hood. This reduces the amount of baffle blockage and maintains the hoods performance.
- If perchloric acid will need to be heated above ambient temperatures or is used at a concentration above 72%, one must use a specifically designed hood for this process. (Please refer to the definition of perchloric acid hoods in the previous section if this rule applies to you)

Certification and contact information

Occupational Health and Safety measures the face velocity of every chemical fume hood on UK's campus annually. The associated PPD or building operator is notified when repairs are needed to restore any marginal or failing hood to a passing range or to fix any monitor or general issues associated with the hood. Once repairs have been made, OHS is notified by PPD and the hood is rechecked and

recertified if passing. If you work in a lab with a chemical fume hood and notice a problem with the air flow, monitor, or general function of the hood, please contact an OHS safety technician at 257-3827.

If you are interested in additional lab safety or chemical hygiene training, please see here.