

Kansas State University Fume Hood Operation

FUME HOODS

One of the primary safety devices in a laboratory is a chemical fume hood. A well-designed hood, when properly installed and maintained, can offer a substantial degree of protection to the user, provided that it is used appropriately and its limitations are understood.

Fume Hood Face Velocity

Based on a number of studies and the recommendations of several laboratory safety guidance documents, the following face velocity criteria are recommended:

Below 80 feet per minute (fpm): Unacceptable for laboratory use.

80 fpm: Low level materials including noxious odors, nuisance dusts, and fumes.

100 fpm: General laboratory use, including moderate toxicity level material.

125 fpm: High toxicity level materials including radioisotopes, perchloric acid, and carcinogens.

Above 150 fpm: Unacceptable for laboratory use.

How a Fume Hood Works

A fume hood is a ventilated enclosure in which gases, vapors and fumes are contained. An exhaust fan situated on the top of the building or on top of the fume hood pulls air and airborne contaminants in the hood through ductwork connected to the hood and exhausts them into the atmosphere.

The typical fume hood found in Kansas State University's laboratories is equipped with a movable front sash and an interior baffle. Depending on its design, the sash may move vertically, horizontally, or a combination of the two and provides some protection to the hood user by acting as a barrier between the worker and the experiment.

The slots and baffles direct the air being exhausted. In many hoods, they may be adjusted to allow the most even flow. It is important that the baffles are not closed or blocked since this blocks the exhaust path.

The airfoil or beveled frame around the hood face allows more even airflow into the hood by avoiding sharp curves that can create turbulence.

Using Chemical Fume Hoods

A fume hood is used to control exposure of the hood user and lab occupants to hazardous or odorous chemicals and prevent their release into the laboratory. A secondary purpose is to limit the effects of a spill by partially enclosing the work area and drawing air into the enclosure by means of an exhaust fan. This inward flow of air creates a dynamic barrier that minimizes the movement of material out of the hood and into the lab.

The flow of air through the hood results in a negative pressure in the box of the fume hood. This in turn creates a negative pressure in the laboratory. The laboratory should be at a lower pressure than the hallway outside the laboratory. In this manner air always flows from the hallway to the laboratory to the fume hood, thus "dirty" air is always pulled out of the workplace. This is another reason why laboratory doors should always be kept closed; the first reason is to prevent smoke from a fire from getting into the exit egress path (the hallway).

In a well-designed, properly functioning fume hood, only about 0.0001% to 0.001% of the material released into the air within the hood actually escapes from the hood and enters the laboratory.

When is a Fume Hood Necessary?

The determination that a fume hood is necessary for a particular experiment should be based on a hazard analysis of the planned work. Such an analysis should include:

- ✓ A review of the physical characteristics, quantity and toxicity of the materials to be used
- ✓ The experimental procedure
- ✓ The volatility of the materials present during the experiment
- ✓ The probability of their release
- ✓ The number and sophistication of manipulations
- ✓ The skill and expertise of the individual performing the work

GOOD WORK PRACTICES

The level of protection provided by a fume hood is affected by the manner in which the fume hood is used. No fume hood, however well designed, can provide adequate containment unless good laboratory practices are used.

Maintaining the Protective Air Barrier for a Safe Work Area

When you stand in front of a laboratory fume hood, the air passing your body to enter the hood forms a zone of low air pressure directly in front of you which extends into the hood for about four inches. Since contaminants may enter this turbulent area from inside the hood, you should keep all hazardous materials at least six inches inside the hood, behind the protective air barrier (see Figure 1).

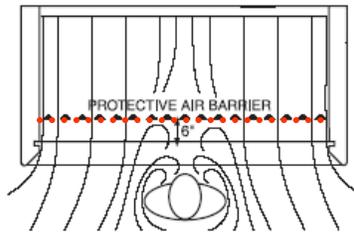


Figure 1. Formation of Protective Air Barrier

The farther behind the fume hood protective air barrier you place the source of contaminants the greater the protection the hood provides you. Therefore, you should place the equipment and contaminants you're using as far back inside the hood as you can (see Figure 2), being careful not to block the lower slot in the rear baffle. You should never place apparatus so far back that you have to put your head into the hood.

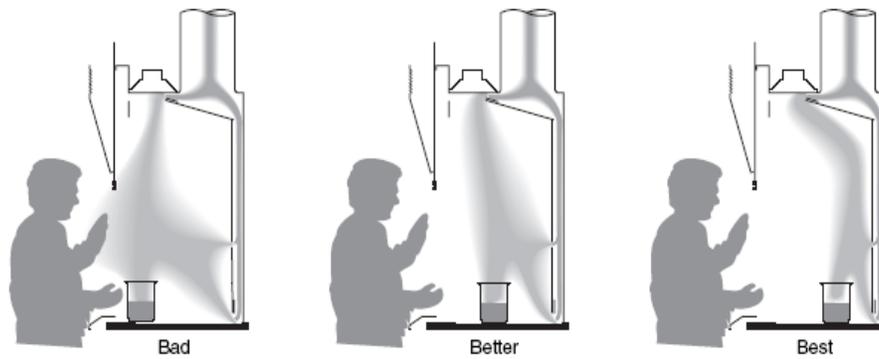


Figure 2. Effect of placement of contaminate source

Large containers or equipment such as furnaces, incubators, microwaves and oil baths often interfere with air flow inside the fume hood by causing reverse flows and dead spots which may allow contaminants to escape from the hood. Putting large, bulky equipment you are using on legs will help reduce reverse airflows by allowing air to circulate beneath the equipment (see Figure 3).

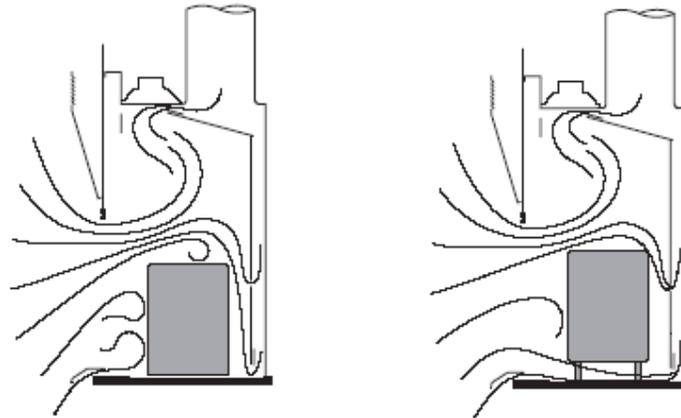


Figure 3. Effect of large equipment

The fume hood should not be used for storage of chemicals and apparatus. You should remove all but the containers and equipment you're actually using from the hood.

The air velocities used to provide containment in fume hoods are relatively low and the air flow patterns are easily disrupted. You should avoid making rapid movements while working at the hood or walking past the hood.

When you're working at your fume hood, you should always open the sash only as far as you need to for access to your work area. The highest you should ever have your sash is 18 inches from the base, any higher and the fume hood becomes ineffective. Make sure the sash is covering your face.

The lowered sash increases the distance (see D in Figure 4) between your breathing zone and the area where contaminants may escape. Also, the smaller hood face area makes the hood less susceptible to room drafts and other external air disturbances. The sash also protects you by replacing part of the protective air barrier with a solid barrier against contaminants and splashing chemicals.

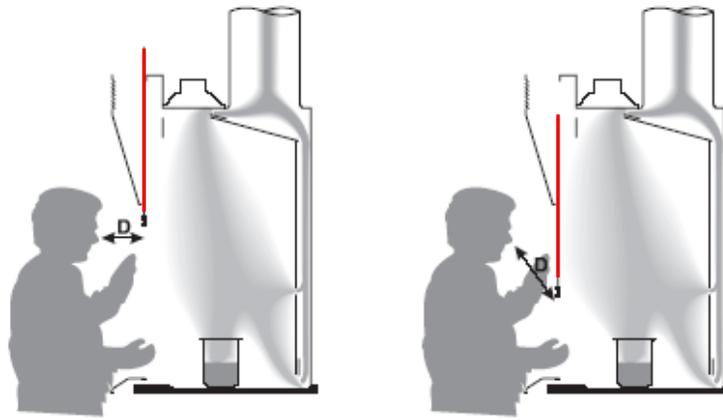


Figure 4. Effect of lowering the sash

If your hood has horizontal sashes, be sure they're all in place when you're working with contaminants inside the hood. Operating the hood with any of the sashes removed reduces the protection they provide by decreasing the velocity of the air entering the hood face.

The hood should have a sash stop with manual override to limit sash travel or should be marked for a safe sash height. The sash stop should not let the sash travel above 18 inches. The sash should not be raised above this point while contaminants are being generated within the hood.

If you don't need continuous access to the equipment inside the fume hood, you should close the sash completely (see Figure 5). The closed sash will protect you from the flying debris of a small explosion or runaway reaction. It will eliminate the effects of room drafts or other adverse air currents.

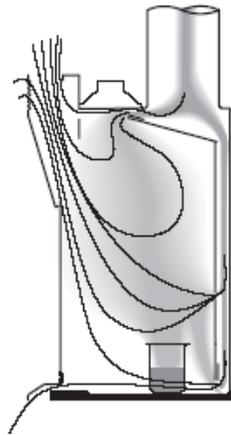


Figure 5. Airflow through By-Pass with sash closed

CHEMICAL FUME HOOD TESTING PROCEDURES

Testing Procedure with a calibrated air flow meter

1. Position the sash so that the fume hood opening is open up completely or where the sash stop is located.
2. Divide the fume hood opening into equal square foot sections.
3. Measure the velocity of the air at the center of each of the square foot sections, in the plane on the sash thickness. This is accomplished by placing the probe of the device at the center of each square just inside the sash plane (see Figure 6). Allow the device meter

reading time to stop fluctuating. When a constant reading is shown on the device, write this reading down.

4. Take the average of the measured readings by adding all measured velocity readings together and dividing this total by the number of readings.

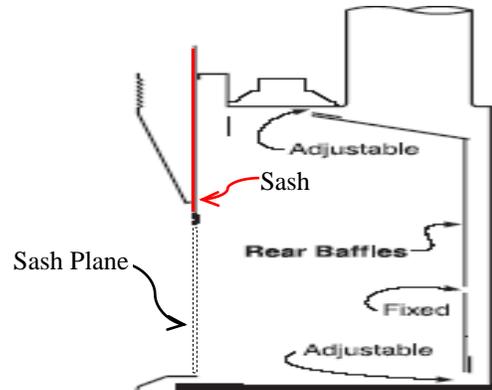


Figure 6.

Use of Visible Smoke in Examining Hood Performance

"Smoke" will follow the path of the air with little deviation allowing the visualization of the airflow through the fume hood. Read the MSDS for the smoke prior to use.

- A. Procedures while sash is completely closed:

Generate smoke along all four sides of the sash. Ninety five percent of the generated smoke plumes should be pulled into the fume hood through the upper and the lower edges of the sash. Smoke will be partially pulled through the sash side edges. If this occurs, this indicates that the hood exhaust fan is pulling air into the hood enclosure.

- B. Procedures while sash is open fully or until it reaches the sash stop:

Generate smoke while gradually moving your hand along the horizontal direction at a level from the hood base equal to 1/3 the height of the hood opening. If all smoke is pulled in by the hood then the hood passes. If any smoke escapes outside, the fume hood fails the smoke test.

Determining Whether the Fume Hood Passes the Inspection

1. The average face velocity with the sash open fully or until it reaches the sash stop must be between 80 fpm and 150 fpm.
2. For use with radioisotopes the average face velocity should be between 125 to 150 fpm. Special considerations can be given by the Radiation Safety Officer to allow face velocities as low as 100 fpm.
3. Generated smoke for the smoke test must not escape from the hood.

Yearly Tests

Environmental Health and Safety personnel will inspect the fume hoods in your department once a year. The inspector will post a sticker with the measured face velocity, whether it passed the smoke test and if the fume hood passed or failed the inspection (see Figure 7).

FUME HOOD INSPECTION: <input type="checkbox"/> PASS <input type="checkbox"/> FAIL			
Date: _____ Inspected by: _____ Hood # _____			
Smoke Test: <input type="radio"/> Pass <input type="radio"/> Fail	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">Measured Face Velocity</td> <td style="text-align: right; vertical-align: bottom;">FPM</td> </tr> </table>	Measured Face Velocity	FPM
Measured Face Velocity	FPM		
<p>Recommended Face Velocity: 80 fpm - Low level materials including noxious odors, nuisance dusts, and fumes. 100 fpm - General laboratory use, including moderate toxicity level material and trace quantities of radioisotopes. 125-150 fpm - High toxicity level materials including radioisotopes, perchloric acid & carcinogens.</p> <p style="text-align: center;">Department of Environmental Health & Safety 108 Edwards Hall Tel: 532-5856 Web: http://www.k-state.edu/safety/</p>			

Figure 7. Fume hood inspection sticker

REPAIRS AND MAINTENANCE

Prior to any repairs or maintenance on laboratory fume hoods, the laboratory personnel must remove materials and equipment from the fume hood as well as clean the interior of the fume hood. Facilities Maintenance personnel will not service fume hoods that have not been made safe by laboratory personnel.