# LABORATORY HOOD MANUAL


**DRAKE UNIVERSITY**
**ENVIRONMENTAL HEALTH & SAFETY**

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# I. INTRODUCTION

Laboratory fume hoods are designed to protect laboratory personnel by preventing contaminants such as chemical vapors, dusts, mists and fumes from escaping into the laboratory environment. Laboratory fume hoods also provide lab personnel with a physical barrier to chemicals and their reactions. Fume hoods are evaluated each year to verify their proper operation.

This manual focuses on standard (conventional), perchloric acid and radioisotope fume hoods. Information on other hood types is listed in Appendix B. Please call Environmental Health and Safety (EH&S) at 271-3804 if you have questions regarding recommended hood types or performance criteria of existing hoods.

The purpose of this manual is to provide information regarding:

- How to obtain fume hood service
- The safe use of fume hoods
- Fume hood performance criteria

A glossary of terms used in this manual is provided in Appendix A.

All fume hood installations should comply with the most recent edition of Industrial Ventilation published by the American Conference of Governmental Industrial Hygienists (ACGIH), the American National Standard for Laboratory Ventilation (ANSI Z9.5-1992), the Uniform Mechanical Code, as well as applicable American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) standards, and the National Fire Protection Association (NFPA) codes, particularly NFPA 91 (Blower and Exhaust Systems), and NFPA 45 (Fire Protection for Laboratories Using Chemicals). Where necessary, fume hood testing should conform to ASHRAE 110, “Methods of Testing Performance of Laboratory Fume Hoods.”

# II. FUME HOOD SERVICE

Fume hood service is provided by EH&S and by Facilities Services. ***If you suspect your hood is not performing adequately, call EH&S at 271-3804. If your fume hood requires service, call your Facility Services at 271-3955***

## Fume Hood Service Provided by EH&S

EH&S staff are committed to promoting safe work environments. EH&S inspects fume hoods annually and upon request. Laboratory fume hood inspections include:

***Visual Inspection*** - including airflow indicating alarms where present. EH&S will reset alarms when necessary.

***Face Velocity*** - average face velocity is determined using a calibrated thermoanemometer (with sash set at maximum level indicated by arrows on sash, typically 18").

## Fume Hood Service Provided by Facility Services

If your fume hood requires service, or if you wish to install, move, or upgrade a fume hood (including installing an airflow alarm), submit a work order to Facility Services. This will allow Facility Services staff to locate records for your fume hood and may hasten service of your equipment. For more information, contact the Facility Services at 271-3955 or EH&S at 271-3804.

Facility Services will also contract with a 3rd party to provide certification on all Fume hoods used on campus at least annually.

## Fume Hood Airflow Alarms

Fume hood airflow alarms are increasingly common on new fume hoods and can be installed in fume hoods lacking them. Typically alarms operate by sensing airflow or pressure gradients and trigger visual and auditory alarms when air velocity or pressure falls below a preset value. When a fume hood alarm is triggered, lab personnel should cease any operation which generates dangerous gases or fumes. If the reaction or procedure cannot be halted, the fume hood sash should be lowered to approximately six inches. If the cause of the alarm is not apparent, call EH&S to investigate. In no case should a triggered alarm be turned off or disabled and then ignored.

Additionally:

- To have an airflow alarm set call EH&S at 271-3804.
- To have an airflow alarm installed or replaced, submit a work order to Facility Services
- To disable a Kewaunee Air Alert 600 audible alarm, Press Enter momentarily when alarm is sounding will mute the alarm. When the audible alarm is muted via the Enter button - an Icon (horn with forward slash) is shown on the display. When airflow rises 4 fpm above Low air level for longer than the low air to warning air delay time the Low air alarm resets automatically Please post notice when audible alarm is disabled.
- To disable a Kewaunee Air Alert 300 audible alarm, press Test/Reset Button. Please post notice when audible alarm is disabled.
- To disable any other type of alarm, contact EH&S for assistance.

# III. LABORATORY FUME HOOD SAFE WORK PRACTICES

Safe work practices for conventional, perchloric and radioisotope fume hoods are described in this section. Conventional fume hood practices also apply to perchloric acid and radioisotope fume hoods.

## Conventional Chemical Fume Hoods

Each Drake University employee is expected to promote safety in the workplace and practice safe work procedures. Fume hood users should be able to answer the following questions before using a fume hood:

1. **Has your hood been certified within the last year?**
   Check the certification card on the front panel of each hood.

2. **Is the hood face velocity adequate?**
   Check the certification card posted on the face of the fume hood for the most recent evaluation data. If an airflow alarm is installed, check for alarm light. Check to see that the audible alarm has not been disabled. If an alarm is not installed, check for airflow with a paper strip hung from the bottom of the hood sash. Do not rely on noise from the fume hood to indicate proper operation (blower motor noise may persist even if a fan belt breaks). See also Sash Height and Face Velocity in Section IV - Fume Hood Performance and Condition Criteria.

3. **Is the work six inches back from the sash?**
   Setting work back six inches from the plane of the sash reduces influence of drafts from people, doors, air supply diffusers, etc.

4. **Is housekeeping good?**
   Materials (supplies, equipment, etc.) in the fume hood typically reduce hood efficiency. Therefore, it is prudent to remove all materials not required for the task at hand.

5. **Does the sash slide easily?**
   The fume hood safety-glass sash protects the user in case of fire or explosion as well as from fumes during routine operations. A sash that is difficult to move will not likely be set at optimal working heights.

6. **Is the sash at the proper height?**
   The fume hood sash should be kept at or below the "keep sash below this level" sticker on each hood (see Figure 4). If your hood does not have this sticker, please call EH&S. Sash openings of less than 12 inches may cause undesirable drafts in the fume hood.

7. **What do I do if a fire occurs in my hood?**
   Be certain you know where your fire extinguishing equipment is located and that it is appropriate for the materials being used. Dial 911 if you are not confident that you can safely extinguish a fire.

8. **Is the fume hood baffle properly set?**
   Some fume hoods have multiple baffle settings. Under most conditions, your fume hood will be most effective set in the "average" or "heavier than air" positions. The "lighter than air" setting should be used only for hot operations or when fumes are known to be less dense than air. Figure 1 illustrates common baffle locations.

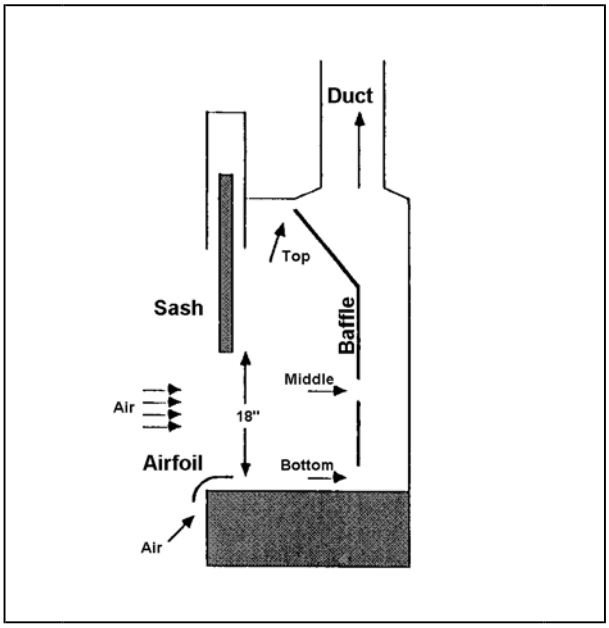


***Figure 1. Common Baffle Locations***

## Other Prudent Fume Hood Practices

Other prudent practices relating to laboratory fume hood usage are listed below. These items should be reviewed by all Drake University personnel **prior to** using fume hoods.

- Do not put your head in the hood when contaminants are being generated.

- Hoods should not be routinely used as a waste disposal mechanism for volatile materials. If a flammable storage cabinet is not available, the hood may be used to store volatile waste waiting to be picked up by EH&S. The volatile waste must be in proper containers, closed and have proper labeling.

- Do not store chemicals or apparatus in the hood. Store hazardous chemicals in an approved safety cabinet.

- Place any heat generating equipment in the rear of the hood to minimize the effect of convection currents on the airflow in the hood.

- Keep the slots in the hood baffle free of obstruction by apparatus or containers.

- Place large apparatus to the rear of the hood and raise it off the surface with two to three inch blocks to allow airflow under the object and into the lower rear baffle.

- Minimize foot traffic past the face of the hood.

- Keep laboratory doors and windows closed.

- Do not position fans or air conditioners in a manner that will direct airflow across the face of the hood and interfere with containment.

- Do not block air supply vents or exhausts in the room.

- Do not remove the hood sash or panels except when necessary for apparatus setup. Replace sash or panels before operating.

- Do not place electrical receptacles or other spark sources inside the hood when flammable liquids or gases are present. No permanent electrical receptacles are permitted in the hood unless approved by the manufacturer.

## Perchloric Acid Hoods

In addition to the prudent practices for standard fume hoods, the following additional procedures should be implemented when using perchloric acid:

1. **Use perchloric acid only in perchloric acid hoods.**
   Perchloric acid salts are unstable and may explode with impact. Primarily for this reason, perchloric acid may not be used in standard fume hoods, which lack automatic wash down systems. Any exceptions to this should be approved by EH&S.

2. **Use perchloric acid hoods exclusively for perchlorate work.**
   Never use organic materials in a hood designed specifically for perchloric acid. Perchlorates are considered to be fire and explosive hazards when associated with carbonaceous material or finely divided metals. They react violently with benzene, charcoal, olefins, ethanol, sulfuric acid and reducing materials. If perchlorates have accumulated in the perchloric acid fume hood, use of organics may create fire and explosion hazards.

3. **Use the perchloric acid hood water wash down regularly, preferably after each use.** Inspect hood for any salts that may accumulate (even where automatic wash down is employed). Remove deposits with water.

4. **Do not leave unnecessary organic materials in hood.** Fires and explosions may occur when perchloric acid contacts rags, sawdust, alcohol, cellulose, etc.

5. **Be particularly cautious when using perchloric acid with strong dehydrating agents, for example, acetic anhydride or sulfuric acid.** Under some conditions, particularly when using hot, concentrated materials, these agents may form dangerously explosive anhydrous perchloric acid.

6. **Apparatus used in perchloric hoods should be free of organic coatings and lubricants.**

7. **Spark producing apparatus (including electrical outlets) should not be used inside a perchloric acid hood.**

8. **Before maintenance on hood baffle, duct, fan, or other hood system components, have EH&S check for presence of perchlorates.**

9. **Perchlorate hoods, ductwork and fans should be labeled with caution labels available through EH&S (Figure 2).**

10. **Use no more perchloric acid than necessary.**


***Figure 2. Perchloric Acid Caution Sticker***

## Radioisotope Hoods

Along with the work practices for standard fume hoods, the following additional procedures should be implemented when using radioisotope hoods:

1. **Use radioisotopes only in hoods designed for that purpose.**
   EH&S recommends radioisotope hoods have stainless steel interior surfaces.

2. **Label hood, ductwork and fan with radiation caution labels available through EH&S (Figure 3).**

3. **Contact EH&S at 271-3804 for residual activity determination prior to servicing the hood.**


***Figure 3. Radioisotope Caution Tag***

# IV. FUME HOOD PERFORMANCE AND CONDITION CRITERIA

This section describes the operating performance criteria (primarily sash height and airflow face velocity) and physical condition criteria EH&S has established for laboratory fume hoods. In addition, several other factors may affect the operating performance of laboratory hoods such as the location of the hood in the lab, make-up air, weather conditions outside, etc.

## Sash Height and Face Velocity

All laboratory hoods on campus have been labeled with a colored arrow sticker (Figure 4) indicating the maximum safe sash height for the hood. The sash should not be raised above this height because it may compromise the safety of lab personnel. The color of the arrow sticker corresponds to a hazard rating system for recommended face velocities (See Figure 4 - Sash Height Arrow Stickers and Figure 6 - Hazard Rating System).

Drake fume hood policy dictates that:

- Where possible, face velocity will be set at 100 feet per minute (fpm) with sash at 18". For High Performance Low Flow Fume Hoods Face Velocity will be set at 80 fpm.

- Fume hoods with face velocities less than 100 fpm for standard fume hoods and 80fpm for low flow fume hoods and greater than 60 fpm (measured using an 18” sash height) should be serviced but may be used with extreme caution (including maintaining the sash at the lowered sticker arrow level) until servicing has been completed.

- Fume hoods with face velocities below 60 fpm at 18" sash height should not be used until repairs are made and EH&S confirms acceptable face velocities.

It is important to remember that face velocity is not the only factor contributing to hood performance. Work practices and make-up air also affect performance.

Fume hoods will be inspected and certified at least annually. If it is suspected that a laboratory hood is not operating properly, EH&S will perform an inspection on request. When the inspection is completed the certification Card (located on the face of every fume hood) is updated. The front of this card is reproduced as Figure 5. A hazard rating is determined by the average face velocity of the hood. Only materials that are within the limits of that rating should be used in the hood. The hazard rating scheme is printed on the back of the certification card and is reproduced as Figure 6.

Standard Laboratory hood face velocity should be about 100 feet per minute (fpm) and High Performace Low volume Hoods at 80 FPM, at the highest working sash height which is marked with a colored arrow sticker. Working sash height should be no higher than 18” and generally no lower than 12”. Face velocity may be as low as 60 fpm or as high as 150 fpm depending on

the chemicals used in the hood. There should be less than +/-10% variation in point-to-point velocity with the sash in any given position.

Higher face velocities do not necessarily offer more protection. They can result in decreased protection due to turbulence around the worker's body causing the release of contaminants from the hood. Generally, face velocities in excess of 150 fpm should bereduced.

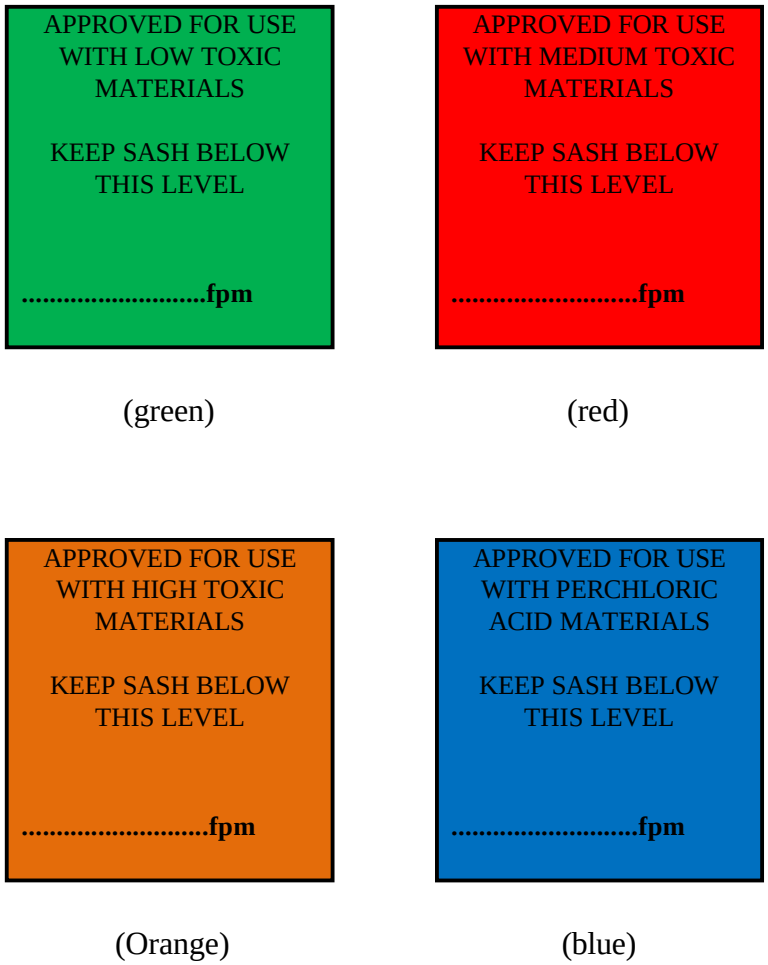


***Figure 4. Sash Height Arrow Stickers***

**Drake University Environmental Health and Safety**

**LABORATORY HOOD CERTIFICATION**

**Building_____ Room_____ Fan Location_____ Exhaust No. _____**

| Date | Average Face Velocity | Rating | Sash* Height | Smoke Trace | Inspector's Initials | Remarks |
|---|---|---|---|---|---|---|
| 8/31/15 | 90 fpm | medium | 18” | Passed | CDN | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**(See back for rating)**

***SET SASH TO MATCH ARROW ON HOOD FRAME**

***Figure 5. Laboratory Fume Hood Certification Card (front)***

| Recommended Face Velocities For Standard Fume Hoods (measured with sash at 18") | | |
|---|---|---|
| **Rating** | **Appropriate Chemicals** | **Face Velocity** |
| **LOW (green label)** | **Combustibles; irritants** | **60-75 fpm** |
| **MEDIUM (red label)** | **Common lab chemicals; toxic vapors; flammables; radioisotopes** | **75-100 fpm** |
| **HIGH (orange label)** | **OSHA specific standards; special requirements** | **100-150 fpm** |
| **PERCHLORIC ACID (blue label)** | **Perchloric Acid** | **125-150fpm** |

| Recommended Face Velocities For High Performance Low Volume Hoods (measured with sash at 18") | | |
|---|---|---|
| **Rating** | **Appropriate Chemicals** | **Face Velocity** |
| **LOW (green label)** | **Combustibles; irritants** | **55-70 fpm** |
| **MEDIUM (red label)** | **Common lab chemicals; toxic vapors; flammables; radioisotopes** | **70-80 fpm** |
| **HIGH (orange label)** | **OSHA specific standards; special requirements** | **80-150 fpm** |
| **PERCHLORIC ACID (blue label)** | **Perchloric Acid** | **N/A** |

*Figure 6. Laboratory Fume Hood Certification Card (back)*

## Location

The location of the laboratory hood with respect to the rest of the laboratory furniture and equipment has a direct influence on the performance of the hood. Laboratory hoods should be located away from the following:

- A single means of access to an exit or high pedestrian traffic areas (because of fire and explosion hazards).
- Operable windows and doors due to cross drafts (especially if the door swings away from the hood).
- Disruptive air supply to the room.
- The face of another hood positioned directly across an aisle.

Ideally, hoods should be located at the rear of a laboratory where they can be isolated from the rest of the lab. The best location for a laboratory hood is shown in Figure 7.

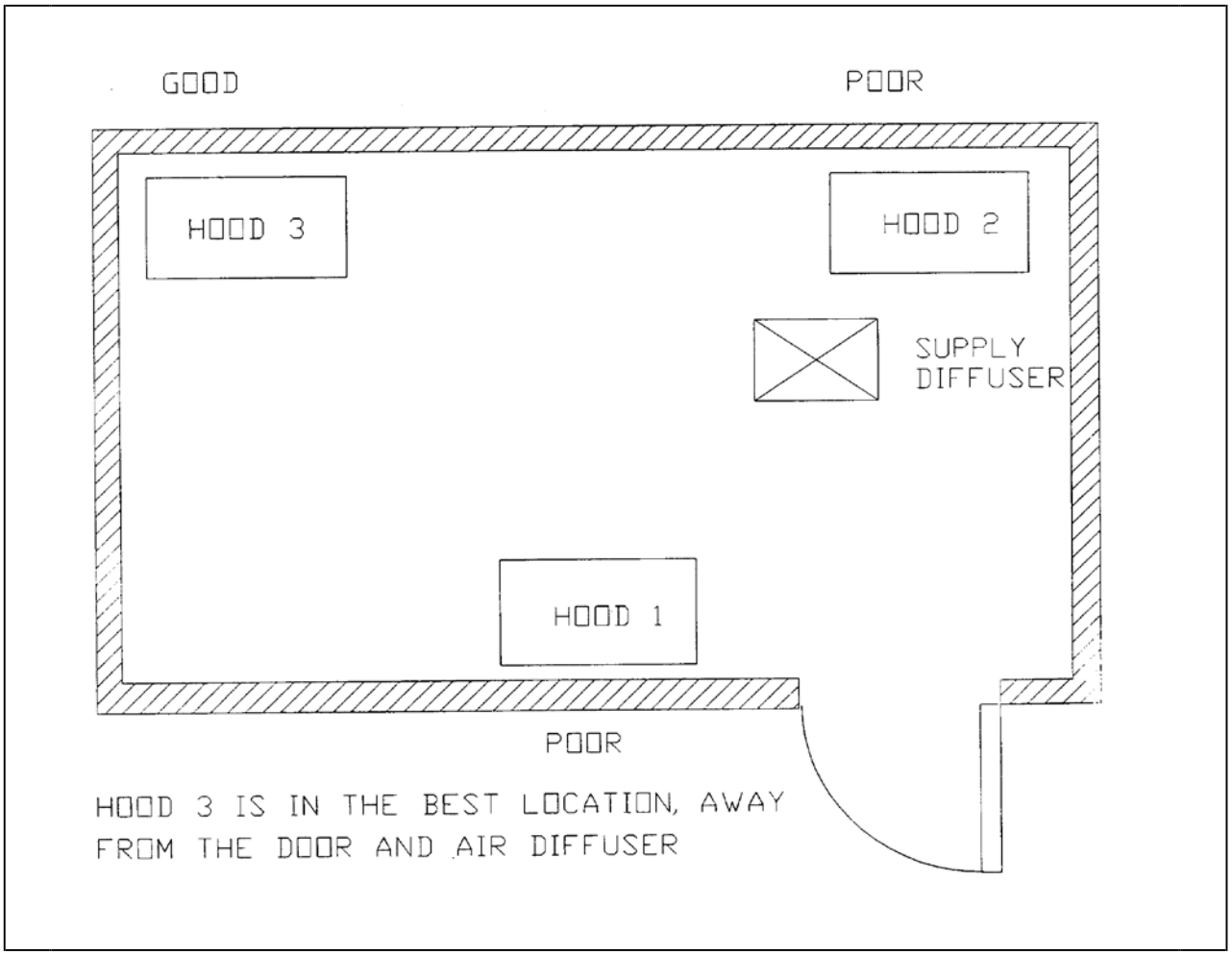


***Figure 7. Proper Laboratory Hood Location***

## Laboratory Supply Air

Make-up or supply air has a significant effect on hood performance. Different types of supply systems have different requirements for supplying air to the lab without detracting from the performance of the laboratory hood. Some recommendations for supply air systems include the following:

- Perforated ceiling panels provide a better supply system than wall grilles or ceiling diffusers, and permit a greater concentration of hoods in a lab. Panel supply air velocity should be no more than 2/3's of the operating hood face velocity.

- Ceiling diffusers should not be located immediately in front of the hood face. Deflecting supply air from the quadrant of the diffuser blowing at the hood face should result in better hood performance. Terminal throw velocity at the exit vane of the diffuser should be 0.5 to 0.7 of the hood face velocity.

- Wall grilles or registers are not recommended by ACGIH (American Conference of Governmental Industrial Hygienists) for new facilities. However, in existing facilities, the wall grilles should have double deflection louvers set for maximum deflection.

## Other Fume Hood Criteria

Other fume hood criteria and conditions such as a broken or difficult to operate sash, excessively turbulent hood airflow, and excessive equipment and supplies in the fume hood may also affect fume hood performance. These items will be noted during a hood evaluation and cited on EH&S's "WARNING" sheet for corrective action (See Figure 8).

## Substandard Performance and Operating Criteria

When a fume hood does not meet regulatory or generally accepted performance or condition criteria, the hood will be tagged with a (yellow) "WARNING" sheet explaining the problem. This sheet will indicate whether or not the hood may be used prior to servicing (See Figure 8).

# WARNING

This Hood Does Not Meet Minimum Performance Requirements.

_____ This hood may be used with extreme caution prior to servicing.

_____ This hood must not be used until service is complete.

To have a hood serviced contact 271-3955 (Facility Services)
To have a hood checked after service contact 271-3804 (EH&S)

**Identified Problems:**

_____ Improper airflow - refer to evaluation card
_____ Broken sash glass
_____ Sash difficult to operate or sash cable is broken
_____ Turbulence
_____ Equipment/items in hood blocking airflow
_____ Alarm inoperable (if applicable)
_____ Other _____

| | Activity | Signature | Date |
|---|---|---|---|
| Lab Personnel | Contacted Facility Services | _____ | _____ |
| Facility Services | Fume Hood Serviced | _____ | _____ |
| Lab Personnel | Contacted EH&S to Re-certify the Fume Hood | _____ | _____ |

This sheet will be removed by EH&S after corrections have been made and the hood has been re-tested.

***Figure 8. Minimum Performance Warning***

# APPENDIX A

## GLOSSARY

**Auxiliary Air** - supply or supplemental air delivered near the outside face of a laboratory hood to reduce room air consumption.

**Baffle** - a panel or panels located at the rear of the hood interior that aid in distributing the flow pattern of air moving into and through the hood.

**Bypass** - an airflow-compensating opening that maintains a relatively constant volume exhaust through a laboratory hood regardless of the sash position and that functions to limit the maximum face velocity as the sash is lowered.

**Canopy Hood** - a suspended ventilating device used only to exhaust heat, water vapor, odors and other non-hazardous materials. This is not a laboratory hood and generally is not effective for exhausting toxic or flammable materials.

**Capture Hood** - a ventilating device that can be positioned to pull in contaminants that are produced outside of the hood. A sufficient velocity called the capture velocity is necessary to "grab" the contaminant and move it into the hood. They are generally used in welding and grinding operations.

**Capture Velocity** - the air velocity at the hood face necessary to overcome opposing air currents, and to contain contaminated air within the laboratory hood.

**Damper** - device installed in a duct to control airflow volume.

**Deflector Vane** - an airfoil-shaped vane along the bottom of the hood face which directs incoming air across the work surface to the lower baffle opening. The opening between the work surface and the deflector vane is open even with the sash fully open.

**Ductless Hoods**- hoods that pass air from the hood interior through an absorption filter and then discharge the air into the laboratory. They are only suitable for use with nuisance vapors and dusts that do not present a fire or toxicity hazard. This type of hood has very limited uses and needs specific approval by EH&S.

**Face Opening** - the hood opening or the plane of the inside surface of the sash. This area is used to calculate the square footage of the hood opening, and face velocity is measured in this plane.

**Face Velocity** - the rate of flow or velocity of air moving into the laboratory hood entrance or face, usually expressed in feet per minute (fpm).

**Glove Box** - enclosure used to confine and contain hazardous materials with operator access by means of gloved portals or other limited openings; this enclosure is not a laboratory hood.

**Hood Interior** - the volume enclosed by the side, back, and top enclosure panels, the work surface, the access opening (called the face), the sash or sashes, and the exhaust plenum, including the baffle system for airflow distribution.

**Laboratory Hood** - a ventilated, enclosed work space intended to capture, contain, and exhaust fumes, vapors, and particulate matter generated inside the enclosure. It consists basically of side, back, and top enclosure panels, a work surface or counter top, an access opening called the face, a sash, and an exhaust plenum equipped with a baffle system for the regulation of air flow distribution. Laminar flow cabinets and biological safety cabinets are not laboratory hoods.

**Make-Up-Air** - air needed to replace the air taken from the room by laboratory hood(s) and other air exhausting devices.

**Sash** - a movable, transparent panel or panels set in the hood entrance used to form a protective shield and to control the face velocity.

**Variable Air Volume (VAV) Hood**- a hood that maintains constant face velocity regardless of sash position. Constant face velocity is maintained by means of a sensory device, either a hot-wire anemometer or a sash position sensor.

**Walk-in Hood** - enclosure hood that is designed with openings from floor to ceiling to accommodate large equipment.

# APPENDIX B

## OTHER HOOD TYPES

### Hood Types

Exhaust hoods can be grouped into three main types: enclosure, capture and receiving. Enclosure hoods surround the point of emission either completely or partially. Laboratory fume hoods are a common type of enclosure hood and are the focus of the main part of this manual. Capture hoods "grab" air contaminants that are generated from a point outside the hood. Receiving hoods exhaust materials that are "directed" into the hood. These three types of hoods are illustrated in Figure B-1.

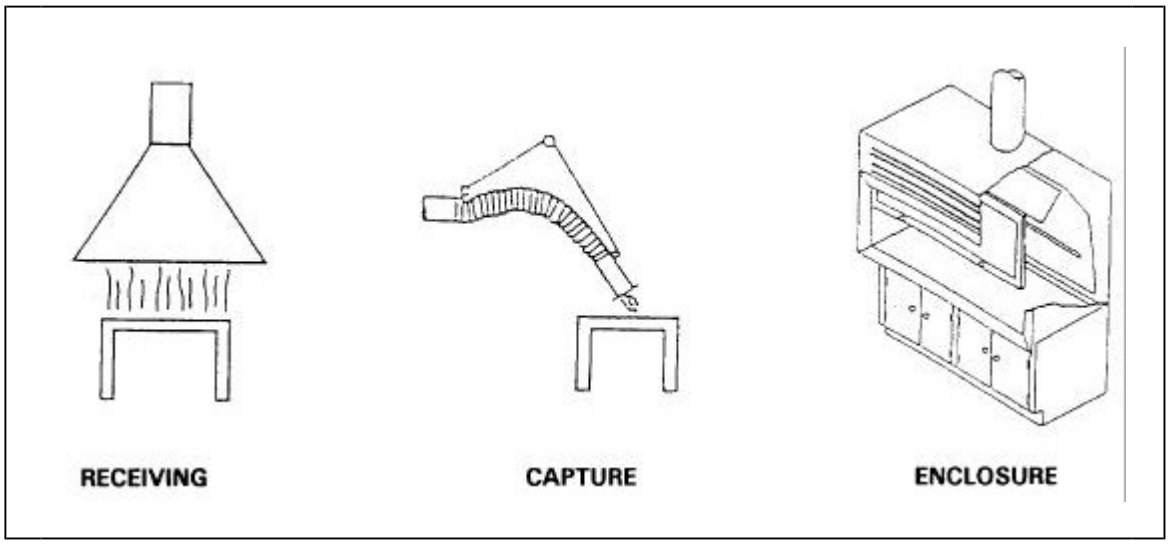


***Figure B-1. Types of Hoods***

**Ductless Hoods** -Ductless hoods are another type of enclosure hood. Ductless hoods pass air from the hood interior through an absorption filter and then discharge the air into the laboratory. These types of hoods are only suitable for use with nuisance vapors and dusts that do not present fire or toxicity hazards. These types of hood have very specific uses and need approval from EH&S.

**Capture Hood** - Capture hoods are ventilating devices that can be positioned to pull in contaminants that are produced outside of a hood. A sufficient velocity called the capture velocity is necessary to "grab" the contaminant and move it into the hood. They are generally used in welding and grinding operations. An example of a capture hood would be a snorkel hood used to ventilate a welding bench. Appropriate capture velocities for different conditions of use are listed in Appendix C.

Plans for capture type hoods are reviewed by Facility Services and EH&S. Contact Facility Services (271-3955) when selecting this type of hood. EH&S does not certify capture hoods; however, EH&S staff can assist in evaluating hood effectiveness.

**Receiving Hood** - Receiving hoods are devices generally used to exhaust heat, water vapor, odors and other non-hazardous materials. They are not a laboratory hood and generally are not effective for exhausting toxic or flammable materials.

An example of a receiving hood would be a canopy hood used to ventilate an autoclave. Plans to install receiving type hoods are reviewed by Facilities Services and EH&S. Contact the Facility Services (271-3955) when selecting this type hood. EH&S does not certify receiving hoods, but can assist in evaluating hood effectiveness.

**Biological Safety Cabinet** - Biological safety cabinets are special safety enclosures used to handle and contain pathogenic microorganisms or chemotherapeutic agents. Biological safety cabinets are **not** laboratory fume hoods. Biological safety cabinets provide protection for the product and also protect laboratory personnel by utilizing vertical airflow. Most biological safety cabinets in use should be Class II Type A or Type B2. Class II Type A cabinets recirculate approximately 70% of the exhaust air back into the cabinet's work area. Type B2 cabinets exhaust 100% of the air and are always hard ducted to the outside. Type B2 cabinets may provide protection for limited amounts of chemical usage, provided they are constructed of suitable materials, are properly maintained to ensure containment and will meet the requirements of this manual. Figure B-2 shows a typical biological safety cabinet. When purchasing a biological safety cabinet, contact EH&S (271-3804) for assistance in choosing the appropriate type for your work.

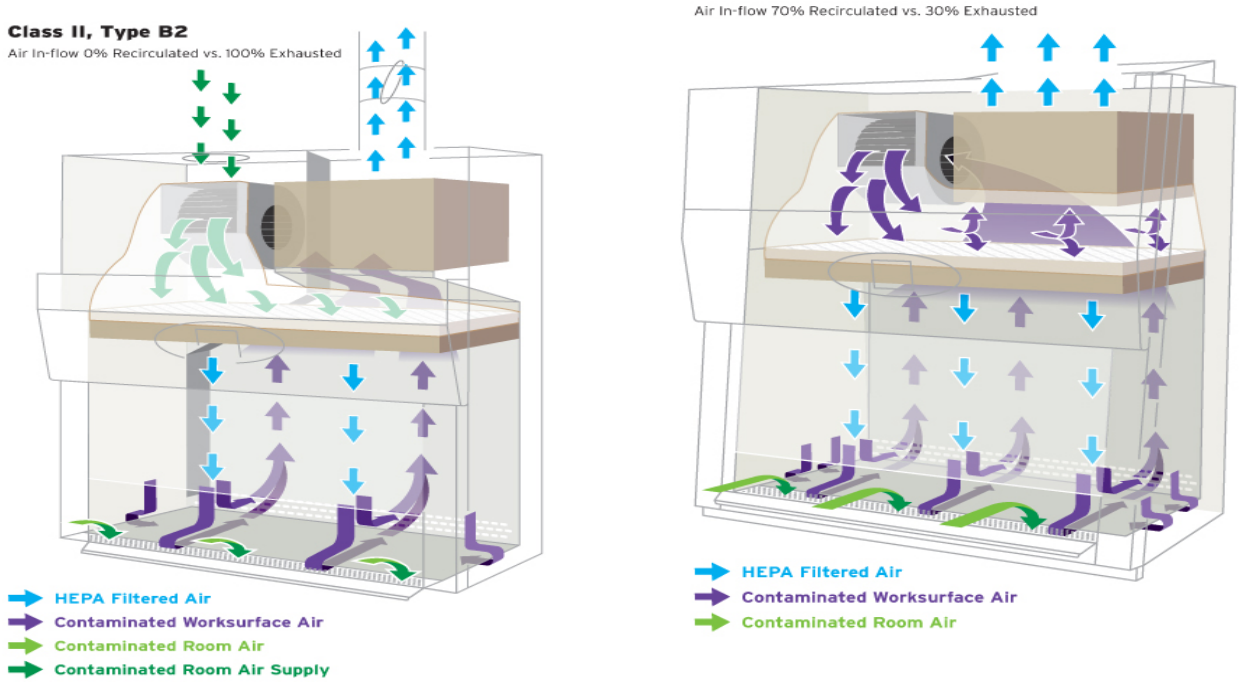


***Figure B-2. Biological Safety Cabinet***

**Laminar Flow Cabinet** - Laminar flow cabinets (or “clean benches”) are ventilated, partially enclosed cabinets primarily intended to provide "clean" airflow over the work surface by use of laminar airflow methods. This "clean" airflow provides protection for the product. Laminar flow cabinets do not provide protection for laboratory personnel and should not be used for storage or manipulation of infectious or toxic materials. Infectious or toxic materials should be handled in biological safety cabinets so that both product and employee safety needs are met. Laminar flow cabinets are **not** laboratory fume hoods and should not be subject to extensive chemical usage. A laminar flow cabinet is shown in Figure B-3.

***Figure B-3. Laminar Flow Cabinet***

# APPENDIX C

## ACCEPTABLE RANGE OF HOOD CAPTURE VELOCITIES

### RANGE OF HOOD CAPTURE VELOCITIES

| Condition of Contaminant Dispersion | Example | Velocity (feet/minute) |
|---|---|---|
| Released with practically no velocity into quiet air | Evaporation from tanks; degreasing; etc. | 50-100 |
| Released at low velocity into moderately still air | Spray booths; intermittent container filling; low speed conveyor transfers; welding; plating; pickling | 100-200 |
| Active generation into zone of rapid air motion | Spray painting in shallow booths; barrel filling; conveyor loading; crushers | 200-500 |
| Released at high initial velocity into zone of very rapid air motion | Grinding; abrasive blasting; tumbling | 500-2000 |

In each category above, a range of capture velocities is shown. The proper choice of values depends on several factors:

| Lower End of Range | Upper End of Range |
|---|---|
| Room air currents minimal or favorable to capture | Disturbing room air currents |
| Contaminants of low toxicity or of nuisance value | Contaminants of high toxicity |
| Intermittent, low production | High production, heavy use |
| Large hood-large air mass in motion | Small hood-local control only |