# Exhaust Equipment (Fume Hoods, Canopy Hoods, Snorkels, Exhaust Cabinets, etc.)

Exhaust equipment is defined as a ventilated enclosed or open workspace intended to contain, entrain, and exhaust fumes, vapors, or particulates for the purpose of protecting occupants.

## APPLICABILITY

This document provides information on installation considerations, proper use, cleaning, and different types of exhaust equipment.

## RESPONSIBILITIES

**Laboratory Personnel** working with exhaust equipment must follow these guidelines and contact Environmental Health Services for assistance and training as needed.

* Follow proper procedures when using exhausted equipment.
* Know the health hazards of the materials you are working with and become familiar with the signs and symptoms of overexposure.
* Contact Environmental Health Services if an exhausted fume hood has never been certified or certification is more than 1 year old, as indicated by the certification sticker.
* Report any chemical use changes or any questionable operations of exhausted equipment to Environmental Health Services.
* Request an inspection when a process change requires a hood classification or use upgrade.

**Environmental Health Services** (EHS) provides assistance and training on the safe use of exhaust systems upon request with the exception of biosafety cabinets. EHS has a comprehensive program for exhausted laboratory fume hoods that includes preventative maintenance and routine surveys of all exhausted fume hoods throughout the campus. EHS conducts exhausted fume hood certifications, which includes a general inspection, measurements of face velocity and determination of proper sash height positioning.

NOTE that higher face velocities can create turbulence that may cause contaminants to flow out of the hood and into the users breathing zone.

Certification occurs at the following times:

* Following installation/movement of a hood
* Following any maintenance to fume hood or exhaust system components that may affect flow rates
* During annual fume hood inspections

Hoods not passing certification are posted “do not use” and EHS contacts users and/or Facilities Management for repair or maintenance.

## TYPES OF Exhaust Equipment

* **Fume Hoods**: Enclosed ventilated workspace vented to the outside of the building or containing filters and venting back into the working space. Typically used for flammable, toxic, or reactive materials or products or mixtures with uncharacterized hazards. Fume hoods exhaust toxic, flammable, noxious, or potentially hazardous fumes and vapors by capturing, diluting, and removing these materials.
  + **Standard Exhausted**: Vented directly to the outdoors and is designed to efficiently remove hazardous fumes, gases, and vapors. The face velocity of a standard fume hood is inversely related to the open face area, allowing a constant volume of air to be exhausted. If the sash is lowered, the inflow air velocity increases.
  + **Bypass Exhausted**: Vented directly to the outdoors and is designed to efficiently remove hazardous fumes, gases, and vapors. Bypass fume hoods are also called "balanced air" or "constant volume" fume hoods. As the sash is lowered, true bypass fume hoods allow constant exhaust volumes that help keep the system balanced. Constant exhaust volumes also eliminate the problem of high face velocity as the sash is lowered and helps to conserve energy.
  + **Variable Air Volume**: Requires technically proficient design, installation, and maintenance. Maintains a constant face velocity as the sash changes and may lower exhaust volume when fume hoods are not in use (ex: after hours etc.).
  + **Auxiliary Exhausted**: Vented directly to the outdoors and is designed to efficiently remove hazardous fumes, gases, and vapors. Auxiliary air fume hoods are also known as "supplied air" hoods. They use an outside air supply for 50% to 70% of the hood's exhaust requirements. This type of hood is designed to reduce utility costs and conserve energy. The face velocity of an auxiliary air fume hood may vary.
  + **High Performance:** Also known as low-flow chemical fume hoods, are of superior design to allow operation with a lower intake velocity for use with chemicals or radiological agents. These hoods use less air volume and can save energy by utilizing decreased amounts of tempered air from cooling and heating systems.
  + **Perchloric Acid:** The use of perchloric acid requires specialized fan sets, ductwork, and wash-down systems. Wash-down systems rinse the entire length of the exhaust duct, the baffle, and the interior hood panels. The water spray is used periodically or after each use to remove any perchloric acid or organic material that may have accumulated. The fume hood should be located on the building’s top floor to minimize duct length and avoid horizontal duct runs. EHS must be consulted to determine if this type of fume hood is required. Volumes and protocols must be reviewed.
  + **Walk-in hoods:** These fume hoods have single vertical sashes or double vertical sashes and an opening that extends to the floor. These hoods are typically used to accommodate large pieces of equipment.
* **Radioactive Material:** A radioisotope fume hood may be needed if high level labeling or specific radioisotopes such as Iodine will be used. A radioisotope fume hood requires a dedicated fan and ductwork usually made of welded stainless steel to ensure against absorption. Special filters may be required depending on the isotope and volume in use. Consult with EHS early in the project to determine if a radioisotope hood is necessary.
  + **Ductless:** Used for materials that are compatible with the built-in filtration system, in controlled quantities, and under controlled conditions. Not suitable for particularly hazardous substances. Prohibited for general use and approved only on a case-by-case basis.
* **Canopy Hoods**: Open ventilated spaces vented to the outside of the building or containing filters and venting back into the working space. Canopy hoods are horizontal above the workspace but do not have walls surrounding the workspace. Used for ventilation of heat, steam, low or nontoxic material with vapor densities less than air. Heat, odor, and contaminants can be drawn directly past the user’s breathing zone.
* **Flow Benches\Walls**: Open ventilated spaces vented to the outside of the building or containing filters and venting back into the working space. Flow benches\walls pull air across the workspace towards the wall.
* **Fume Exhaust Duct Connections (Snorkels, Elephant Trunks, Flex Ducts)**: Open ventilated equipment that can be moved over a specific workspace. These are moveable so they can be placed over small work areas and pull air across the workspace. Examples include discharges from gas chromatographs and over bulking containers.
* **Biosafety Cabinets**: Enclosed ventilated workspace vented to the outside of the building or containing filters and venting back into the working space. **Contact Biosafety for any concerns with Biosafety Cabinets.**
  + **Recirculating (A1, A2):** Biological material and nanoparticle use. These are filtered within the equipment.
  + **Recirculating (B1):** Biological materials, nanoparticles, and minute amounts of volatile chemicals. These are filtered within the equipment.
  + **Exhausted (B2):** Biological materials, nanoparticles, and minute amounts of volatile chemicals. These are filtered through a filter bank that may be used for more than one cabinet and released outside.
* **Environmental Rooms**: Used for materials that require special environmental controls. Usually nonhazardous amounts of flammable, toxic or reactive chemicals. These rooms may have **zero** air changes depending on their use.
* **Glove Box**: Positive pressure for specialty environments. Negative pressure for highly toxic materials. May be used for inert environments for reactive chemicals. The major advantage is user protection.
* **Laminar Clean Flow Bench**: Has filtered air before entering the enclosure. This helps reduce contamination of samples inside the containment.
* **Clean Bench**: Air is filtered through a HEPA filter so that air entering the enclosure is clean and particle free. It does not provide protection to personnel.
* **Downdraft Table**: Typically used for perfusions with paraformaldehyde, work with volatile, low, or moderately hazardous material with a higher vapor density than air where access is needed from more than one side.

## PERFORMANCE

Building air supply is balanced with building and equipment exhaust. This balance is performed with doors closed and equipment running. Propping doors open can have a detrimental effect on the exhaust equipment in the room and since exhaust equipment is often connected to other exhaust equipment it can negatively affect the air balance in other rooms and equipment. Because of this, do not block supply or exhaust air and keep laboratory and fire doors closed.

Installed filters can impact the air flow if they are not properly maintained and replaced as required. As these filters are used, they can reduce air flow and be less effective at removing particles/vapors from the air before being released to the environment.

Ensure sufficient aisle space in front of equipment. Exhaust equipment shall be located so that their containment performance is not adversely affected by swinging doors, ventilation diffusers, pedestrian traffic, other ventilation equipment, or any other sources of cross draft. Makeup air shall be introduced at the opposite end of the laboratory room from the exhaust equipment, and flow paths for room HVAC systems shall be kept away from exhaust equipment locations, to the extent practical. Due to the chance for fires or explosions, equipment ideally should be located towards the back of a laboratory, away from primary and secondary exits.

Fume hood exhaust systems shall not have local on/off or high/low control; exhaust fans shall run continuously. Exceptions through EHS may be granted.

When a fume hood is certified it will bear a hood certification sticker, which indicates testing date, inspector’s initials, and classification. Also, the hood will be marked with adhesive arrows which indicate the proper sash height position. A hood that has failed will be closed for use and a sign stating CAUTION! Do Not Use as a Chemical Fume Hood. It is very important that a closed hood not be used.

## SAFETY HAZARDS

* **Item Breakage**
* **Sharps**
* **Reactions**
* **Spills**
* **Over pressurization – Bursting Containers**
* **Explosion – Chemical**

## Safety Precautions

* All exhausted equipment is not appropriate for all types of work. Ensure that hazardous chemicals are used in the proper type of exhausted equipment. For example, use perchloric acid only in fume hoods specifically designed for perchloric acid.
* Use exhausted equipment when working with chemicals or procedures that may produce hazardous fumes or vapors.
* Know how to properly operate the exhausted equipment before beginning work. Inspect the equipment before starting each operation.
* Place equipment and chemicals at least six inches behind the fume hood sash.
* Do not allow paper or other debris to enter the exhaust duct of the equipment.
* Do not store excessive amounts of chemicals or equipment in the enclosure.
* Do not block the baffle area.
* Elevate any large equipment or stock at least 1.5 inches to allow proper ventilation around the items.
* Wear appropriate personal protective equipment.
* Do not alter/modify the equipment or associated duct work.
* Clean up all spills immediately.
* All laboratory hoods are part of a mechanical exhaust and/or electrical system that is subject to failure. An emergency plan, based on the type of work being done in the equipment, should be prepared in case the exhaust or electrical systems fail. The emergency plan should be kept near the lab entrance door.
* Exhaust equipment should not be considered a ventilated storage cabinet. Any items, such as hazardous waste containers and other nonessential equipment placed in the equipment will create some turbulence or block airflow. Keep only those items necessary for the experimental procedure in the enclosure. Clutter disrupts the airflow, reducing its capture efficiency.
* Keep the equipment closed when not in use.
* Keep head outside of the fume hood.
* Hang a small (approximately ¼ X 4 inch) piece of Kimwipe, or similar lightweight material, from the bottom of the hood sash in the corner and away from ignition sources. The Kimwipe should be drawn in when the fume hood is operating normally and will hang straight down when the hood is operating marginally, or not at all.
* Do not allow chemicals to go down cup sinks. This is a violation of city regulations.
* Faucets can become corroded in acid or basic atmospheres and not work properly. Chemicals may also react violently with water.
* Ensure gas lines are not corroded and working properly before use. Note that fire and explosion hazards may exist in the equipment.
* No writing on the equipment except for equipment notes or procedures (never on sash).
* Never write on the sash. The sash provides two layers of safety. One is the ability to closely monitor the process and the other to protect the user in case of explosions, bursting containers etc. It acts as a safety feature like the windshield in your car. You need to clearly see in and protect occupants from flying debris.
* Be certain the equipment is “ON” and is operating properly when in use.
* Maintain the sash at the lowest comfortable operating height. During normal operations the sash should be at or below the maximum sash opening indicators. For hoods with more than one window sash, only one sash should be open at a time. The only time the sash should be completely open or past the maximum sash opening indicators is while setting up equipment, cleaning etc. when no chemical hazards are in use.
* Keep the inside of the hood clean and uncluttered.
* Do not rely on the fume hood to protect you from splashes or projectiles – WEAR SAFETY GLASSES.
* Dual usage of fume hoods is prohibited. A hood “packed” from chemical storage is not conducive to safe research or experimentation. The hood interior must be non-restrictive and allow generous amounts of space to work in as designed.
* Equipment may be installed with alarms, sensors, controls, and gauges. Understand what these are for and how to respond. Work should not be performed until the situation is corrected.
* Always use splash goggles and wear a full-face shield if there is a possibility of an explosion or eruption.
* Work slowly and remove arms slowly to reduce eddy currents that disrupt the containment.
* Never use fume hoods as a canopy to draw heat away. This creates air flow disruptions.

## PERSONAL PROTECTIVE EQUIPMENT

The following minimum personal protective equipment is required when working with/in exhaust equipment:

* Appropriate gloves for the chemicals in use
* Lab coats
  + The **Body** must be protected with pants (no cuffs), lab coats, and closed-toe shoes.

* Safety glasses

## CLEANING

Personnel must be thoroughly familiar with the properties and safety considerations of the chemicals in use. Laboratory personnel must:

* Always wear proper personal protective equipment appropriate for the chemicals and use proper cleanup solution/material to clean the equipment.
* Complete cleaning of all surfaces should be performed at least 2 times a year.