Chemical Fume Hoods

Self-paced Training

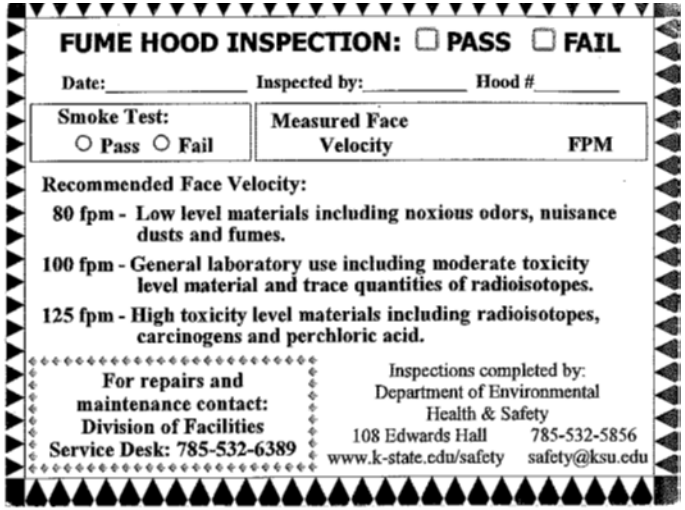
Department of Environmental
Health and Safety

Laboratory Safety

- Before working with chemicals, you should become familiar with the hazards of the materials
- *When possible*, substitute less hazardous materials (less toxic, less flammable, less reactive, avoid strong oxidizers, pyrophorics, etc.)
- Train all new employees about the hazards of the chemicals in the lab. They should review the label and Safety Data Sheets for materials they will work with.
- Know the signs and symptoms of exposure to these chemicals.
- Understand the physical hazards (flammable, conditions of violent or explosive reaction) and communicate this to new staff.
- **Conduct a risk assessment (what-if checklist) of your experiments/processes to discern possible failure points.**

Environmental Health & Safety (EHS)

- KSU EHS conducts annual checks of chemical fume hood performance.
- Contact KSU EHS (safety@ksu.edu or 785-532-5856) if you need a hood checked or have questions about a hood's performance.
- Fume hoods should have an inspection sticker indicating the date it was checked, if it pass inspection and the average face velocity.



FUME HOOD INSPECTION: ☐ **PASS** ☐ **FAIL**

Date:_____ **Inspected by:**_____ **Hood #**_____

Smoke Test: ○ Pass ○ Fail	**Measured Face Velocity** FPM

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

For repairs and maintenance contact:
Division of Facilities
Service Desk: 785-532-6389

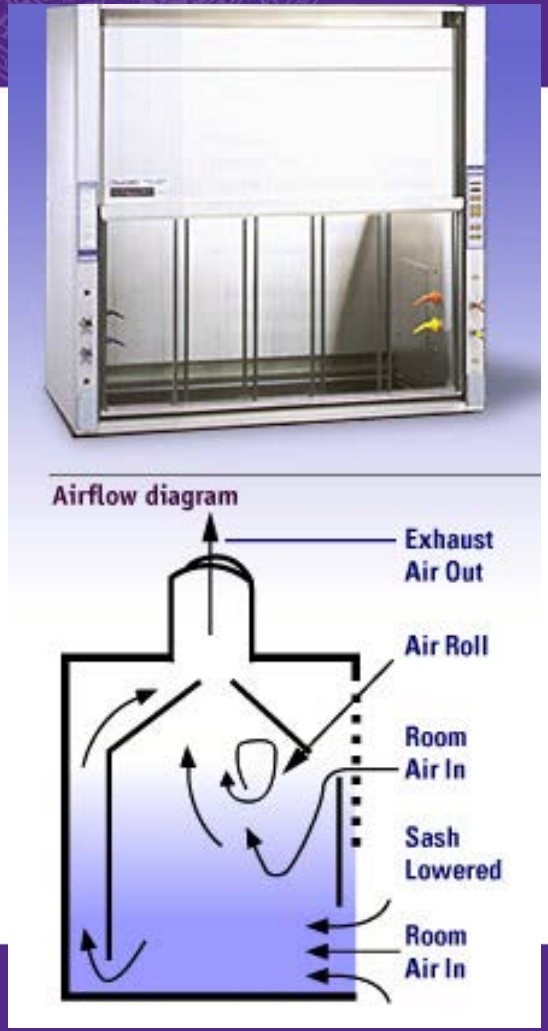
Inspections completed by:
Department of Environmental Health & Safety
108 Edwards Hall 785-532-5856
www.k-state.edu/safety safety@ksu.edu

Engineering Controls

- Laboratory safety engineering controls
  - General laboratory ventilation
  - Localized Exhaust
  - Enclosures
  - Biosafety Cabinets
  - Chemical Fume hoods (containment, enclosure and local exhaust)
    - Use whenever you mix, dispense, prepare or heat chemicals that present a health exposure or other safety risk
    - Use whenever process has the potential for fire, violent reaction or build up of flammable vapors

Chemical Fume Hoods

- Ventilated enclosure
- Protects personnel from chemical hazards
- Captures, contains and exhausts vapors, gases, fumes and particulates
- Physical barrier from chemical splashes and violent chemical reactions
- Does *not* provide:
  - Environmental protection
  - Product protection
- Don't use for work with *regulated* infectious agents



Chemical Fume Hood Types

- Standard chemical hoods
  - variable air volume (VAV)
  - constant air volume (CAV)
- Radioisotope hood
  - Ideally welded stainless steel to prevent absorption of radioactive materials. In order to comply with licensing requirements, radioisotope hoods may require a face velocity of 125 fpm.
- Ductless fume hoods
  - Ductless hoods use activated carbon filtration to adsorb chemical vapors and fumes and recirculate air to the laboratory. Use of these requires approval from EHS.

Variable Air Volume (VAV)

- VAV fume hoods are also known as "*constant **velocity** hoods*".
- VAV fume hoods have a face velocity control, which varies the amount of air exhausted from the fume hood in response to the sash opening to maintain a *constant face velocity*.
- This allows for optimal hood performance regardless of the sash position.
- VAV hoods also provide significant energy savings by reducing the flow rate from the hood when the sash is closed.

Constant Air Volume (CAV)

- The volume of airflow within the hood is maintained constantly.
- All air enters through the sash opening.
- The airflow increases and decreases inversely proportional to the opening of the sash height.

Bypass Hoods

- This type of hood is similar to CAV.
- The only difference is that it has an air bypass that provides an additional source of ambient air when the sash is closed.

Different fume hoods for various applications

- Floor mounted fume hoods
- Acid digestion fume hoods
  - Have special liners of acid resistant materials. Sashes may be made of polycarbonate to resist hydrofluoric acid etching.
- Perchloric acid hood
  - Have wash-down capabilities to prevent the build-up of explosive metallic perchlorates within the exhaust systems.

Chemical fume hoods

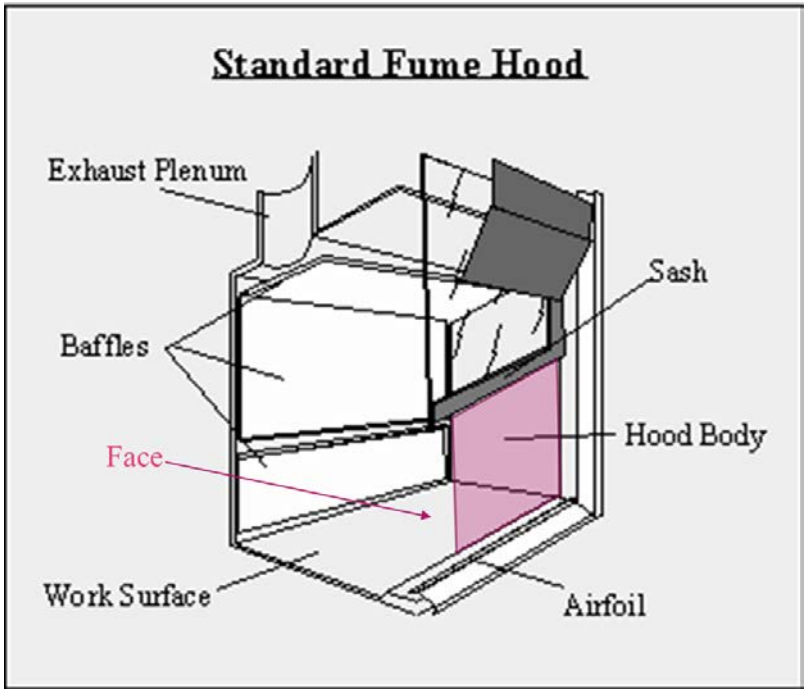
- There are various sash designs
  - Vertical
  - Horizontal
  - Combination

Anatomy of a Fume Hood

- **Hood Body:** The visible part of the fume hood that serves to contain hazardous gases and vapors.
- **Baffles:** Moveable partitions used to create slotted openings along the back of the hood body. Baffles keep the airflow uniform across the hood opening, thus eliminating dead spots and optimizing capture efficiency.
- **Sash:** By using the sash to adjust the front opening, airflow across the hood can be adjusted to the point where capture of contaminants is maximized. Each hood is marked with the optimum sash configuration. The sash should be held in this position when work involving the fume hood is being performed and closed completely when the hood is not in use.
- **Airfoil:** Found along the bottom and side edges, airfoils streamline airflow into the hood, preventing the creation of turbulent eddies that can carry vapors out of the hood. The space below the bottom airfoil provides source of room air for the hood to exhaust when the sash is fully closed.
- **Work surface:** Generally a laboratory bench top, or the floor in the case of a floor-mounted or walk-in hood, this is the area under the hood where work is conducted or apparatus is placed for use.
- **Exhaust plenum:** An important engineering feature, the exhaust plenum helps to distribute airflow evenly across the hood face. Materials such as paper towels drawn into the plenum can create turbulence in this part of the hood, resulting in areas of poor airflow and uneven performance.
- **Face:** The imaginary plane running between the bottom of the sash to the work surface. Hood face velocity is measured across this plane in linear feet per minute (fpm).

Anatomy of a fume hood

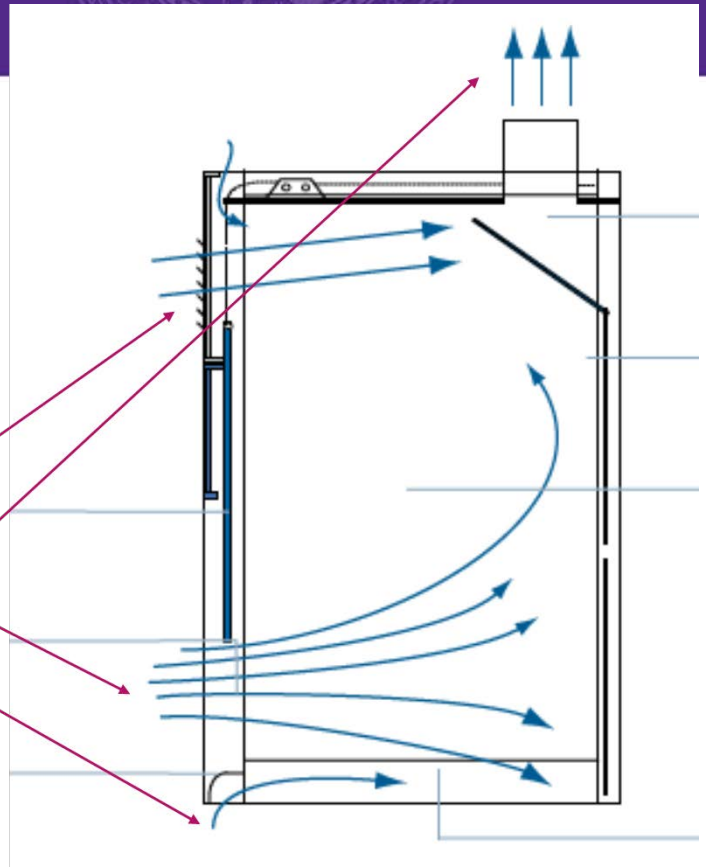
- Know the important basic fume hood parts



Anatomy

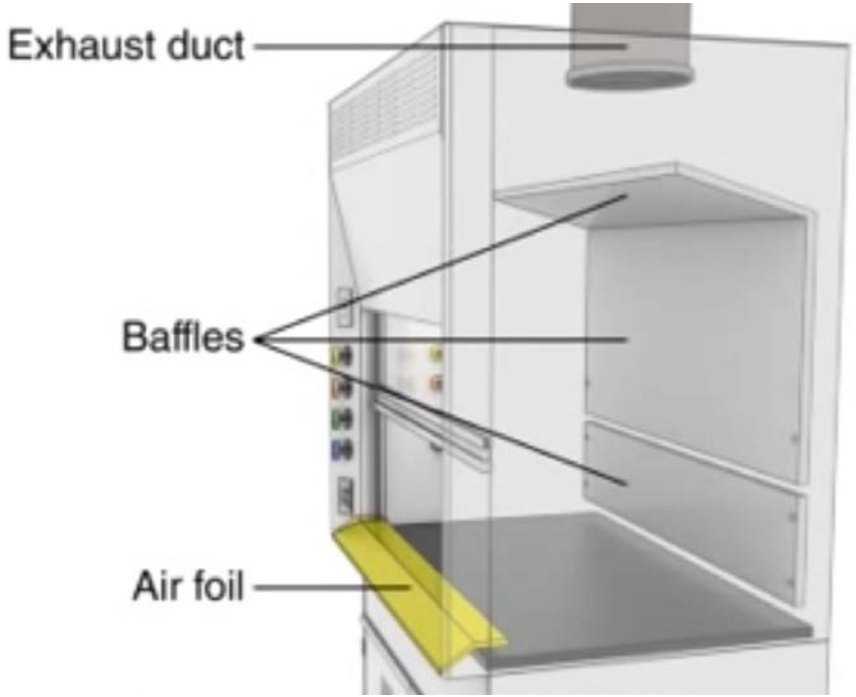
Function

- Air flows in through the **face** (when the sash is open). This is measured in linear feet per minute (FPM)
- Air flows under the **airfoil** as well.
- Air also flows through a "**by pass**" even when the sash is down.
- Exhausts through ductwork and is carried out of the building to specially designed exhaust stacks on the roof (these are not filtered).



Anatomy

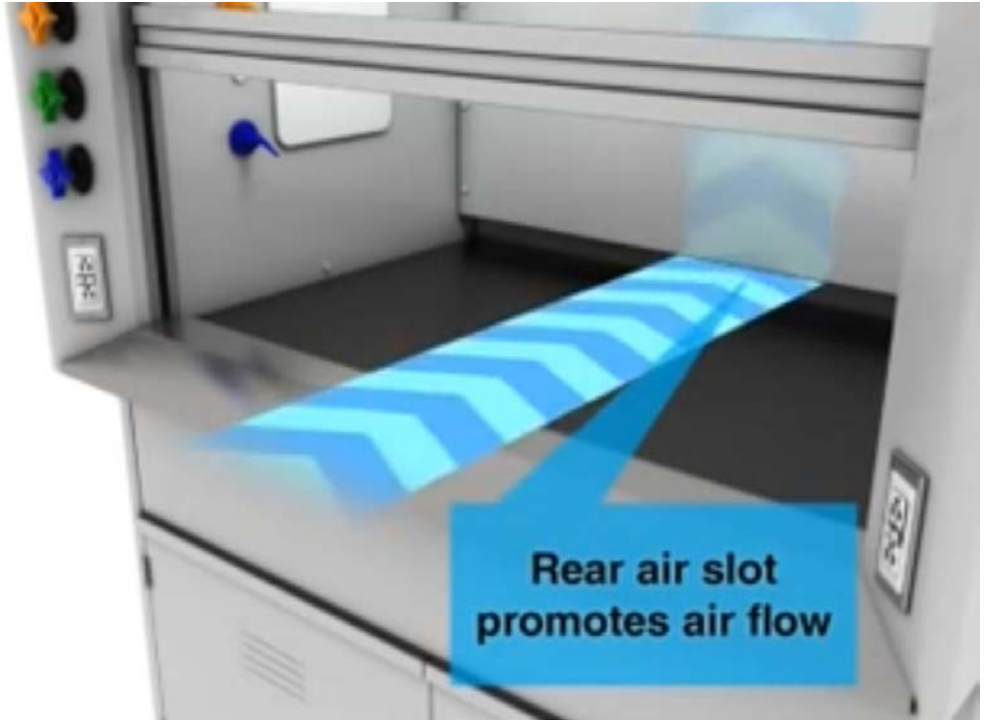
Baffles



Proper Use

Baffles

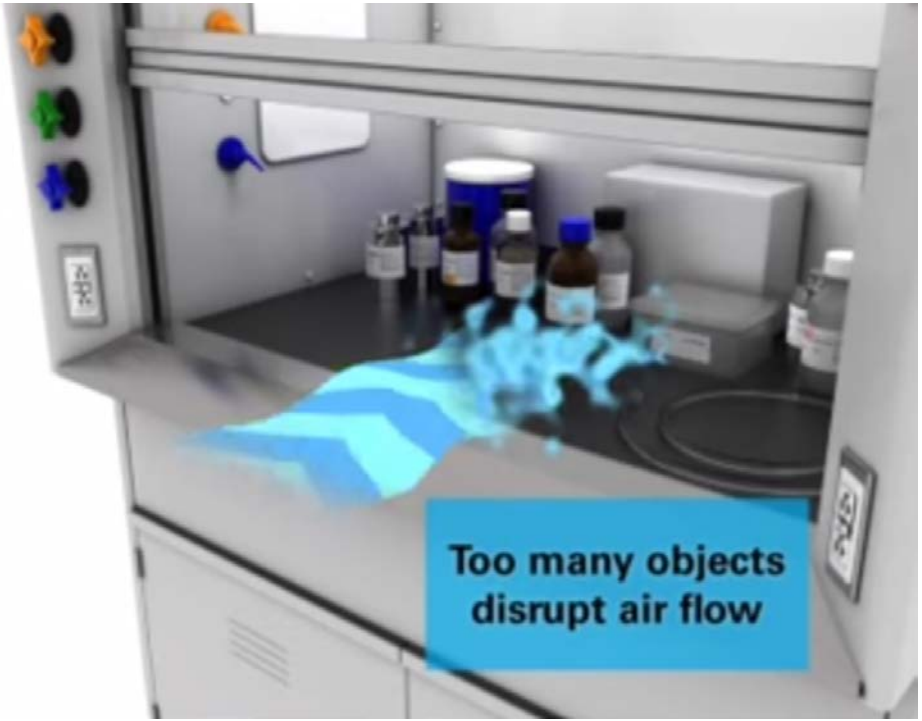
- Moveable partitions used to create slotted openings along the back of the hood body.
- Baffles keep the airflow uniform across the hood opening, thus eliminating dead spots and optimizing capture efficiency.



Proper Use

Baffles

- Storing things against the back lessons the efficacy of the hood for containing contaminants.



Proper Use

Blocked baffle air slot

- Affects performance

Proper Use

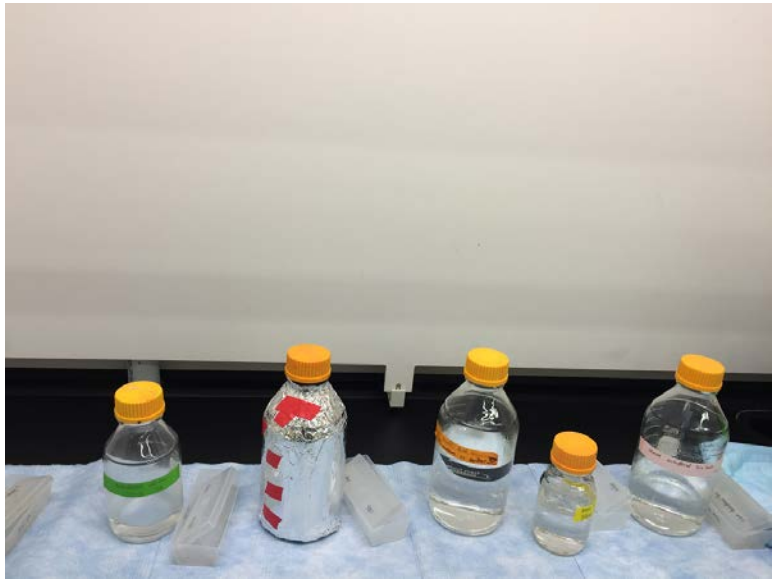
Blocked baffle air slot

- Moving these boxes only a few inches away from baffles measurably improved hood performance.

Proper Use

Baffles

- Keep items away from **baffles** as shown in this image.
- Keep materials, containers, and equipment a few inches away from the very back of hood.
- Visually inspect the baffles (openings at bottom, top or sides) to ensure these are not obstructed.

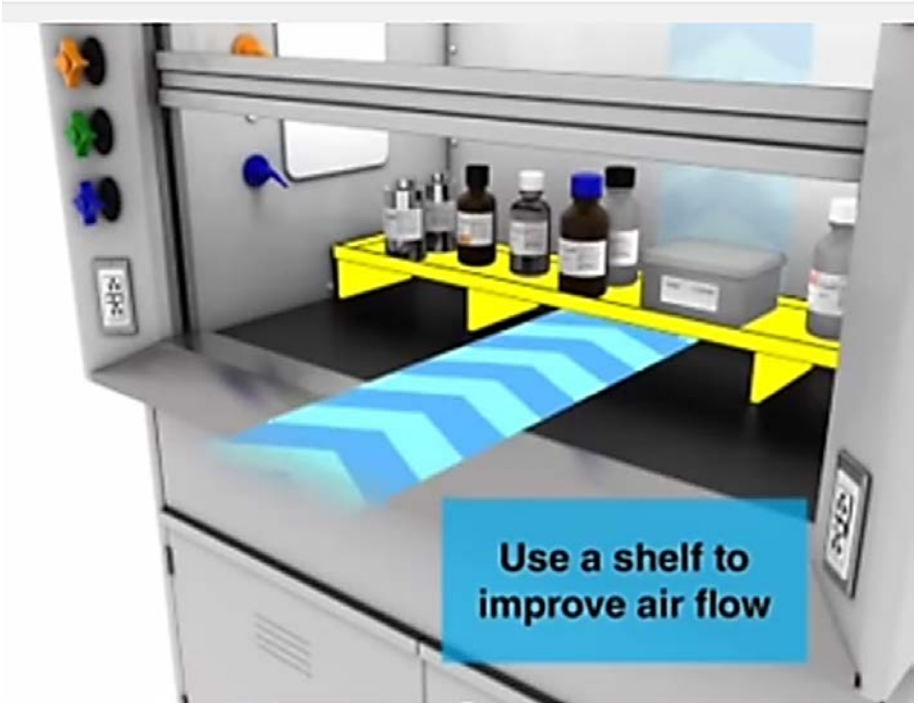


Proper Use

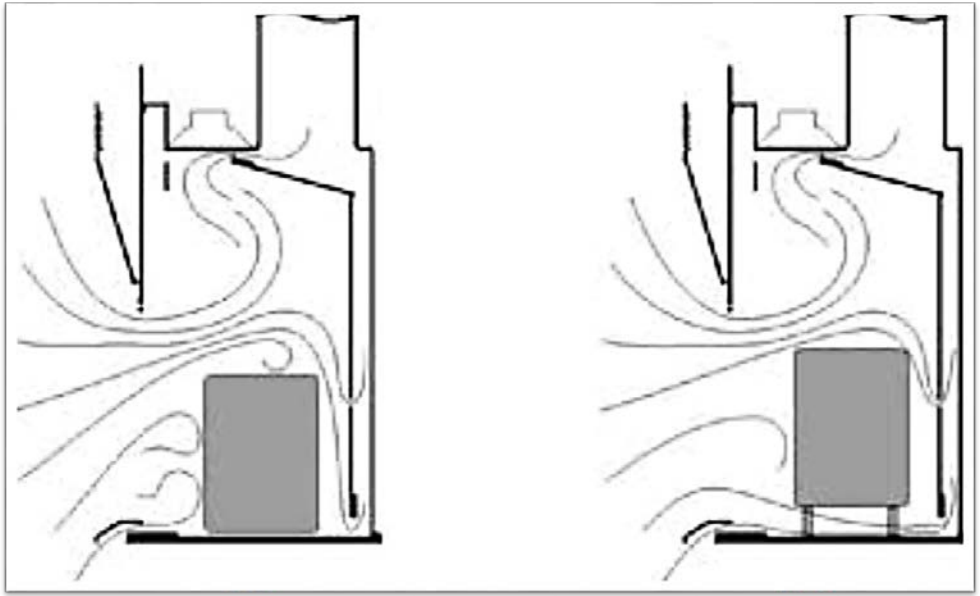
Baffles

- Raise larger items or equipment up to allow air to flow under and around items in the hood towards the baffles
  - Two inches up
  - On blocks, rack or shelf

If equipment is already equipped with footing, additional raising is probably not needed.



Raising items improves flow



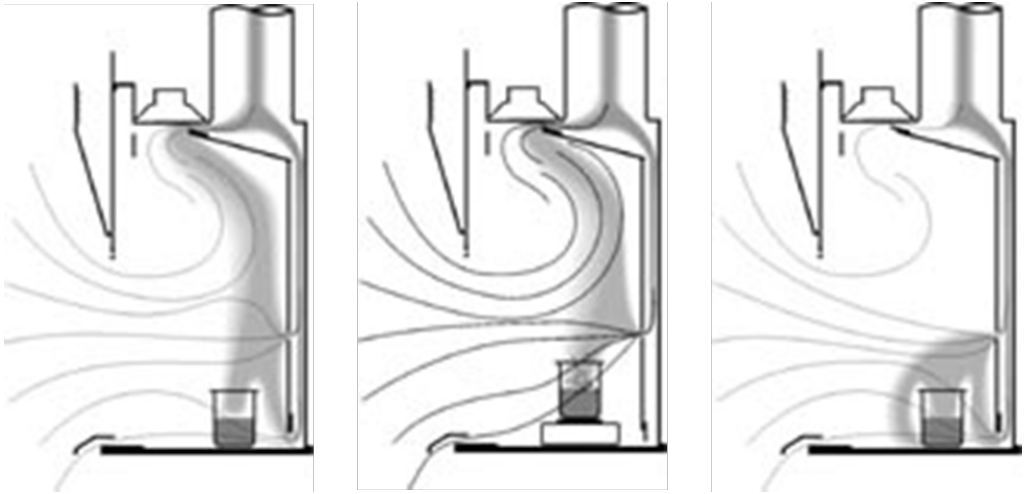
Proper Use

Raising materials can be done using various devices or methods

Proper Use

Baffles

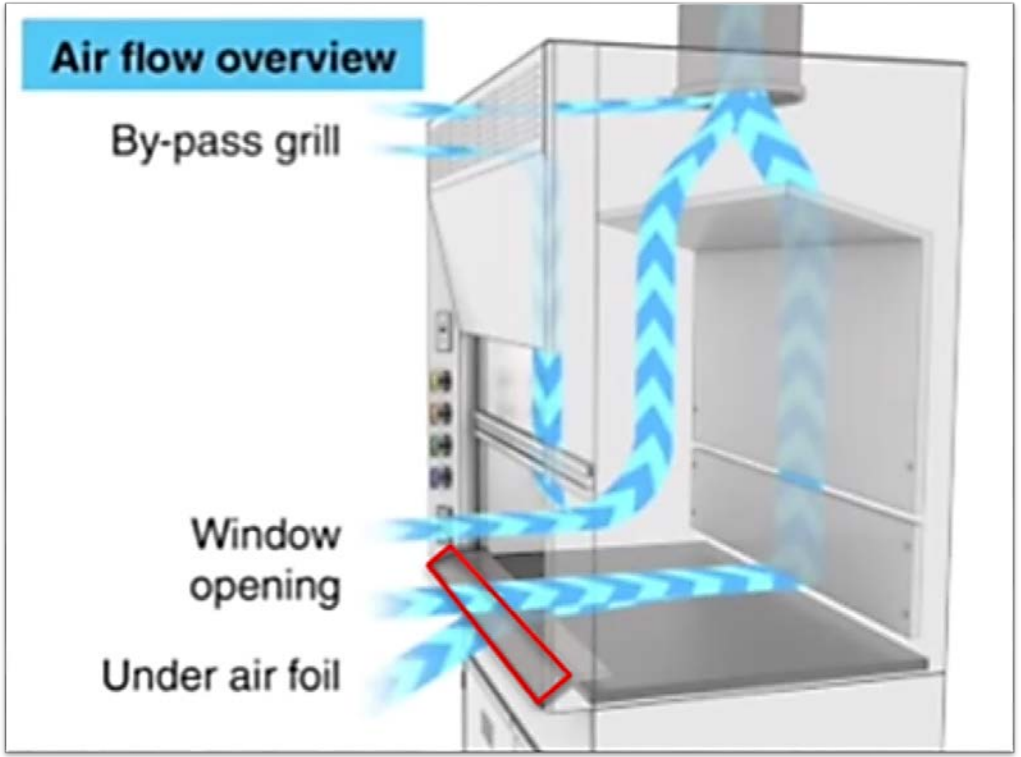
- Can be adjusted by qualified staff (contact EHS).
- Minimize lower slot opening for high temperature equipment or process and when working with light volatiles.
- Upper slot is minimized for work with heavy vapors and denser gases.



Anatomy

Airfoil

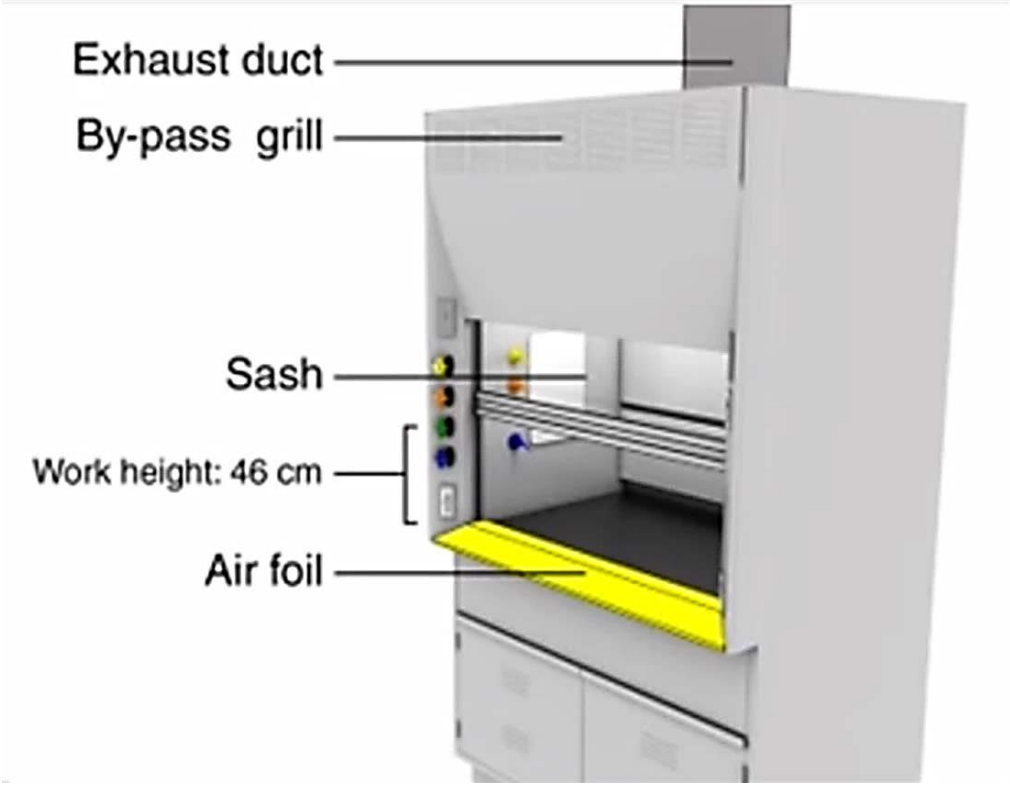
- Air flows into the hood through the **face** (or "window")
- through the **by-pass,** and
- *across and under* the **airfoil**



Anatomy

Functions

- Like the by-pass, the airfoil allows airflow into hood when sash is down
- **Airfoil streamlines airflow to avoid turbulence that can cause contaminants to escape the hood.**



Proper Use

When the **airfoil** is covered:

- You can see that smoke is not moving inward
- This also affects the inflow at other areas of the face that are not covered
- Keep items off the top of the airfoil when hood is in use.
- Do not store large items under airfoil
- Don’t remove or alter the airfoil
- Work with airfoil in-place and down

Proper Use

Airfoil

- Cords, cables, tubing on the airfoil affect performance.
- Run electrical cords under the airfoil instead of on top of it.

NO

YES

Proper Use

Work Surface

Breathing Zone

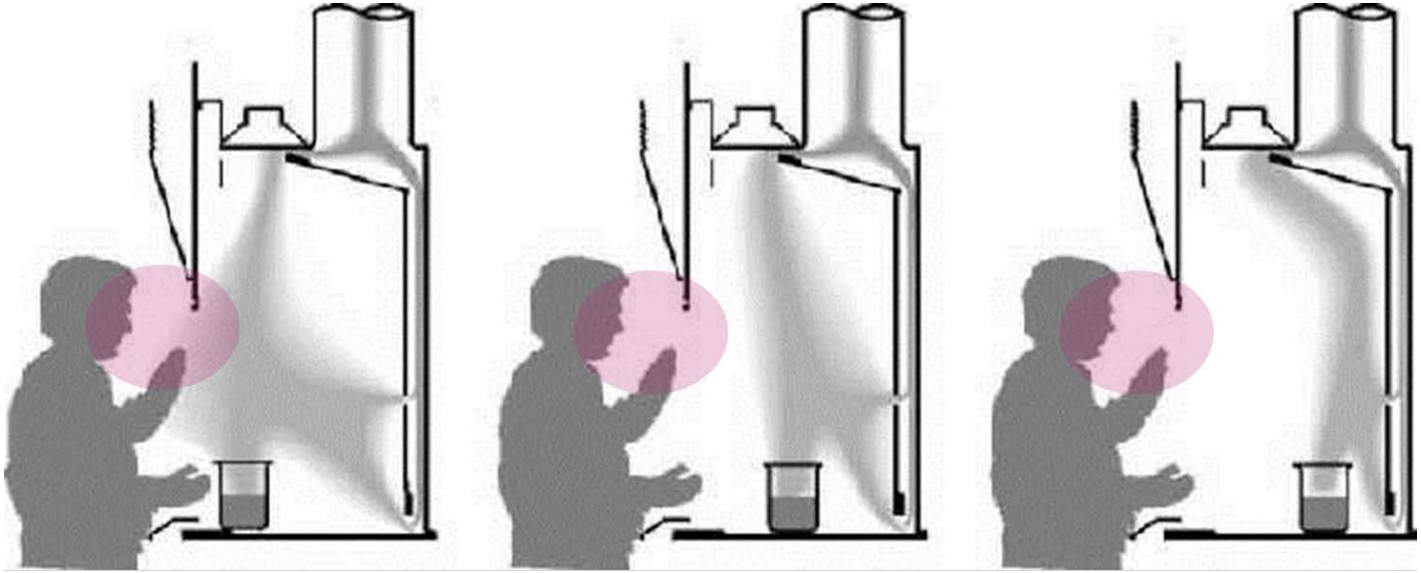


Image: Baylor/kewaunee.com (altered)

Proper Use

Work Surface

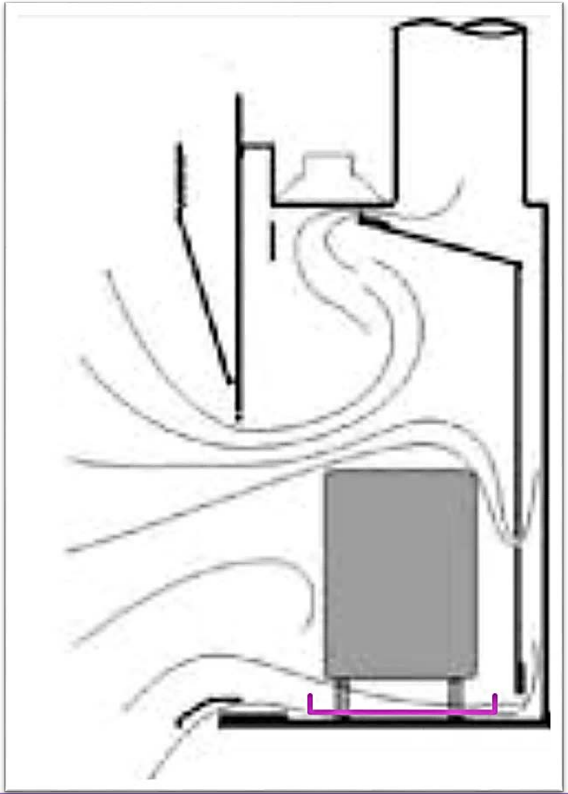
- Place all items at least **6 inches inside** the hood (6” in from sash)
  - Mark a line with tape 6” inside on work surface
  - Keep all chemicals and equipment behind that line during procedures.
  - This helps keep vapors from escaping the hood when lab air currents (e.g., people walking past the hood, etc.) interfere with air flowing in at the face of the hood.

Image: Labconco

Proper Use

Work Surface

- Consider all things placed in the hood and how they might impede performance
  - This image provides an example of a shallow tray under raised equipment that could defeat the purpose of raising the equipment.
- If you are unsure, call EHS and we will smoke the set up to see how airflow is altered/not altered in your specific set up.



Proper Use

Sash Height

- The optimal sash height for proper performance is usually 12-18 inches from the work surface.
- The optimal sash height should be marked on your hood with an arrow or indicated with a sticker such as the one in the image.
- Sash stops should also be installed on hoods to stop the sash at 18 inches.
- Work with sash at this height or lower.

Proper Use

Sash Height

- Never raise the sash above marked height while working with hazards in the hood
- When you raise the hood above this, the hood will not contain contaminants properly.

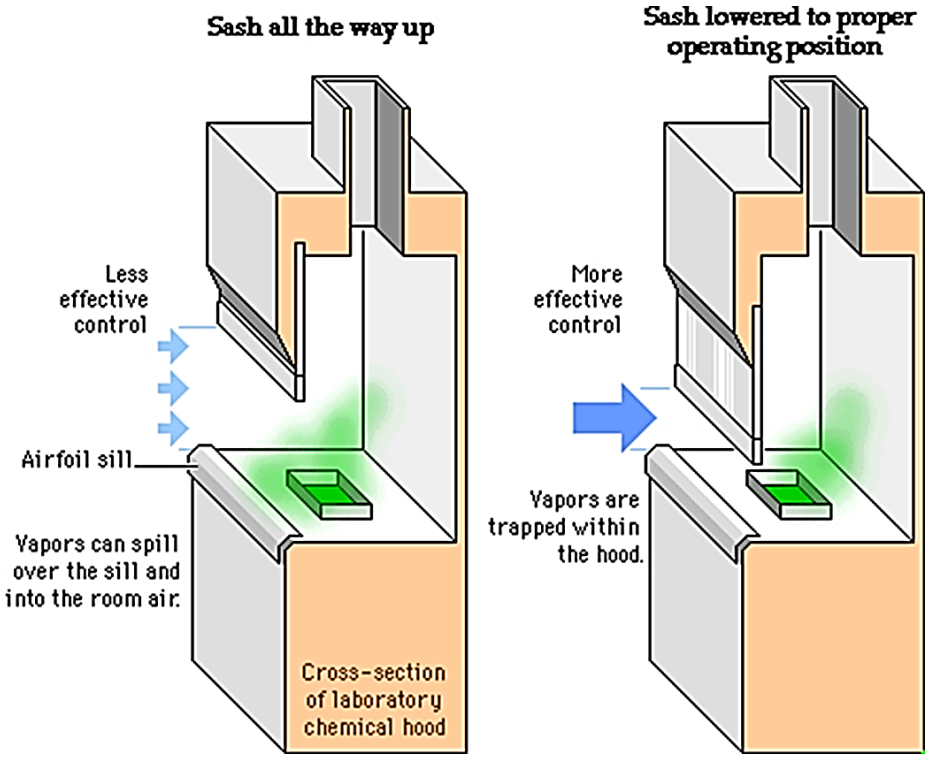


Image: NMSU

Proper Use

Sash Height

- Keep as low as possible when working
- Keep sashes completely closed when “hands-on” experiments are not in progress or hood is unattended.
- Fume hood sashes are made of fire and explosion ***resistant*** glass.
  - The sash acts as a barrier and can protect the fume hood user from any splashes, flying glassware, and fires that can occur in the hood.

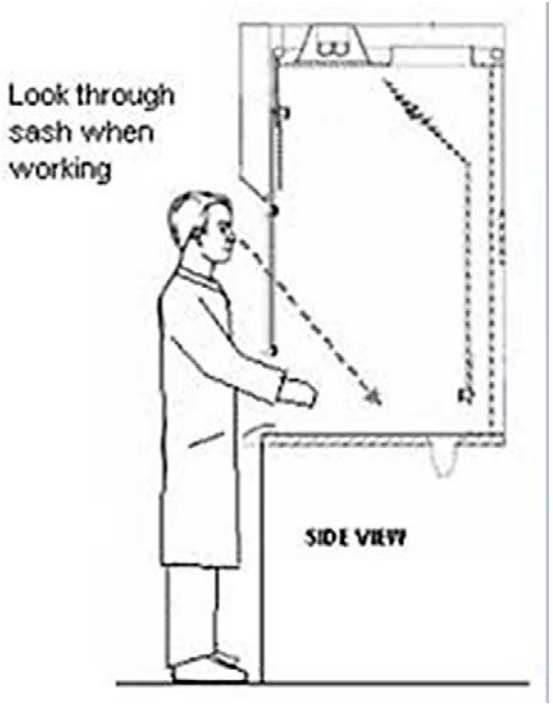


Image: NMSU

Proper Use

Sash

- The sash and hood are NOT explosion proof.
- If you will work with materials that pose an explosion hazard, contact EHS for guidance.
- Depending on the work being done, you may need to work in an enclosure with an inert atmosphere.

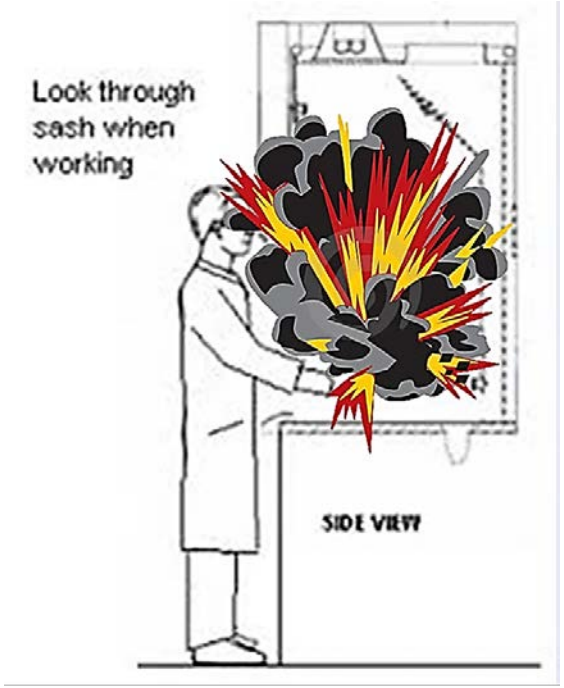


Image: NMSU

Proper Use

Sash Height

- **When sash is in the full-open position** (for set ups only):
  - No open containers of volatile chemicals present in hood
  - No aerosol generation processes
  - Close containers of toxics and other products that can spill
  - No open flames
  - Shut off gas lines in hood where feasible
  - Wear protective clothing and safety googles/glasses (face shield and googles if splash from breakage/spill is possible)
- Always avoid placing head and torso into the hood space

Images: UTexas

Hood Use Guidelines

- Consider how air flows into the hood and work in movements that are least likely to interfere with this flow
- Do not make quick motions into or out of the hood. Use deliberate in and out movement rather than sideways motions.
- Lower and raise the sash gently to avoid turbulence that can pull contaminants out of the hood.
- Do not place fans near the hoods
- Don’t use the fume hood as a storage cabinet

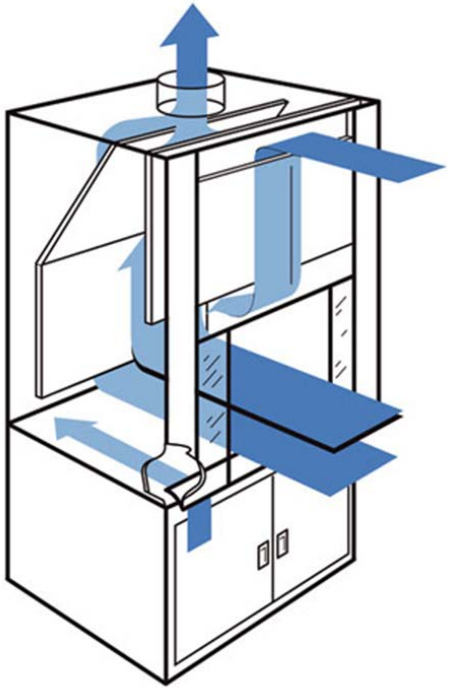


Image: Baker

Guidelines

- The hood is not a substitute for personal protective equipment.
  - Wear gloves, safety glasses, lab coat, long pants/skirt and shoes that fully cover your feet.
  - **If working with extremely flammable materials, ensure the lab coat is flame resistant and properly laundered to avoid damaging these properties.**
- Clean chemical residues from hood surfaces after each use.
- Some processes or chemicals can not be safely used in standard hoods (e.g. perchloric acids, volatile radioisotopes, high pressure reactions or with frequent heating/mixing of certain strong acids*)

**Contact EHS for assistance.*

Be Aware

- Hoods have flow rate monitors and alarms.
- Flow alarms typically warn the user audibly when the hood drops below a certain face velocity.
- If the flow rate monitor alarms, contact Facilities Customer Services at 785-532-6389.
- Know your system.

Be Aware

- Don’t rely solely on the monitor.
  - Feel for airflow or use tissue to test (be careful not to allow tissues to flow into the exhaust intake)
- Listen for weird noises and call Facilities Customer Services (785-532-6389) if something sounds wrong or different.
- Don’t use hood during a power outage or HVAC failure.

Be Aware

- Cross check velocity readout on the flow monitor against the average face velocity (“Avg Face Vel”) listed on the inspection sticker.
- How different is it from what it reads on the flow monitor?
- If the sash is at the indicated height and the monitor reading differs *significantly* (≥20% or >20 fpm) from the sticker fpm, the hood may not be operating correctly or the monitor may need calibration.
  - Report to EHS or Facilities (also report if sash is not functioning as designed – as it may need a adjustment)

Be Aware

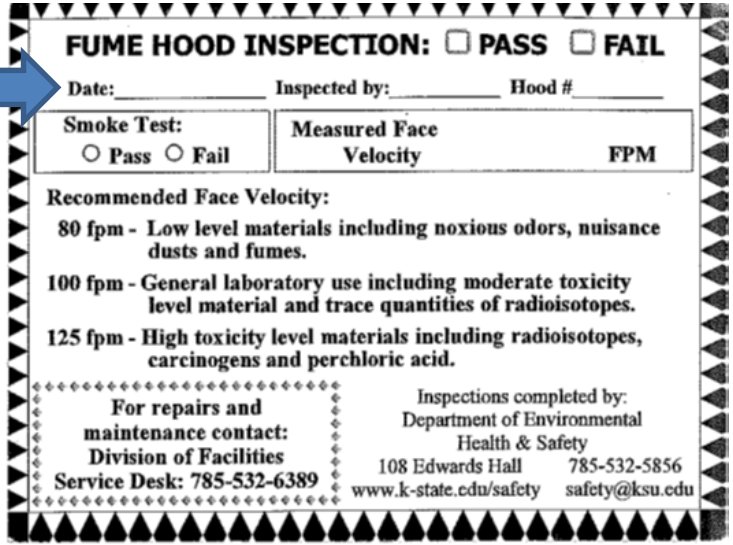
- Don’t use the hood if there is low or no airflow
  - Check the face velocity readout on the monitor outside of the hood to ensure it is reading within ≤20% of the velocity indicated on the fume hood sticker.
    - Do not use the hood if it reads **65 fpm** or below.
    - Call Facilities or EHS for assistance and mark the hood “**do not use**” or “**out of service**”

Be Aware

- Don’t use the hood if it has a deficient hood sticker.

Be Aware

- Call EHS if hood is past the retest due date
  - More than 12 months since test date



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Date:_____ **Inspected by:**_____ **Hood #**_____

Smoke Test: ○ Pass ○ Fail	**Measured Face Velocity** **FPM**

Recommended Face Velocity:

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Service Desk: 785-532-6389

Inspections completed by:
Department of Environmental Health & Safety
108 Edwards Hall 785-532-5856
www.k-state.edu/safety safety@ksu.edu

Limitations

- Higher face velocities (>120 fpm) may be needed when working with:
  - High acute toxicity
  - Human carcinogens
  - Reproductive hazards
  - Extremely low permissible exposure level or immediately dangerous to life or health
- A fume hood may not be sufficient protection for extreme hazards.
  - Isolators or glove boxes may be options for high hazard work or materials.

Hood Performance

- Many things affect performance
  - Don't place large objects directly under the hood
  - Don't hang objects such as lab coats on the front of the hood
  - Avoid placing heat generating equipment close to hoods (e.g. blast furnace, oven, fridge, etc.)
  - Don't place large items directly in front of the hood

Lab Ventilation

- Many things can disrupt air patterns in the lab space, which can affect fume hood performance and general ventilation.
- Things that can affect the laboratory ventilation in general include:
  - Leaving doors propped open
  - Storage close to ceiling (may also interfere with fire sprinkler effectiveness).
  - Excessive heat generating equipment
  - Crowded storage conditions in general
  - Covering or altering supply or exhaust grills

New Fume Hoods

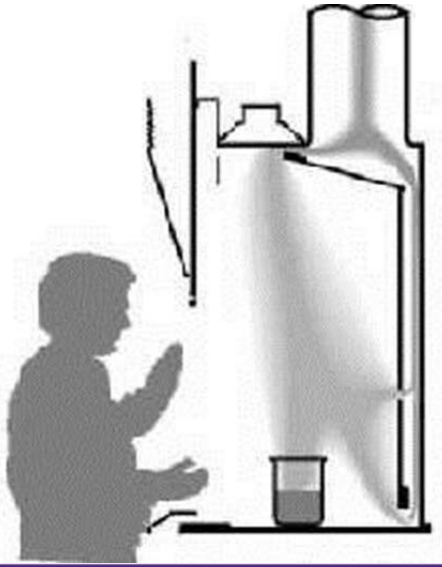
- New hoods or hoods that are relocated require a commissioning certification that involves conducting an ASHRAE 110 test.
  - This test criteria uses a part per million acceptable level of a tracer gas outside of the hood and smoke testing.
- This certification is conducted by a qualified contractor.
- If you are purchasing a fume hood or moving one, contact EHS for selection guidance and work with the University Facilities Management team to coordinate installation.
- Prior to purchase, check with Facilities Management to ensure that the ventilation system will accommodate the hood.

Emergencies

- If there is a release, spill or fire in the hood:
  - Close the sash (if safe to do so)
  - For spill (not fire), hit the purge button if provided
  - Contact the KSU Police (call 911 from campus phone or dial 785-532-6412) and request EHS assistance.
- If your clothing catches fire:
  1. Rip off lab coat (unless fully engulfed, then go to step 2).
  2. Stop, drop and roll
  3. Use emergency shower and remove affected clothing while under the shower.

Overview

- Keep sashes closed (**completely lowered**) when “hands-on” experiments are not in progress or hood is unattended.
- Never raise the sash above working height while working in hood.
- Place items 6” inside the hood.
- Keep containers closed that are in the hood unless they are being actively used.
- Keep things off the airfoil (off surface and out from below it).
- Keep larger items toward the back of the hood.
- Don’t block baffles.
- Don’t use out of service hoods and report any concerns.



Call EHS if you have questions or concerns: 785-532-5856 (main)

For emergencies or after hours, University Police (call 911 from campus phone or 785-532-6412)

Thank you!

Training videos

- Labconco:
  - www.youtube.com/watch?feature=player_embedded&v=q2Pp3wge2j8 (<4 minutes – specific to airflow patterns)
  - www.youtube.com/watch?v=yqU5bGP0i5I (<7 minutes – humor - provides general guidelines)
- Darthmouth
  - www.youtube.com/watch?feature=player_embedded&v=nlAaEpWQdwA (<8 minutes - helpful flow animations and available in various language translations [note: different work surface distance recommended, theirs 9", ours ≥6"])