Laboratory Ventilation Safety

J. Scott Ward
Labconco Senior Territory Manager

Labconco Corporation

In 1925, Laboratory Construction Company was born. The first product was a Kjeldahl Nitrogen Determination Apparatus. We may have shortened our name, but we've expanded our horizons. We offer 16 different product lines to universities, research centers, hospitals, general laboratories and governmental agencies around the world.

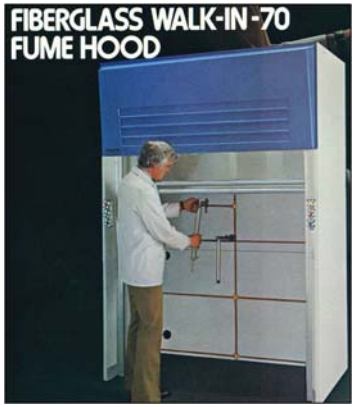
Our Ventilation History

Labconco has been building fume hoods and other ventilation products for over 80 years.

First Labconco Hood 1936

Fiberglass 28 1960

Fiberglass Walk-In 1970s



Variable Air Volume 1980

Anti-Vortex Containment 2002

CFM Minimization 2012

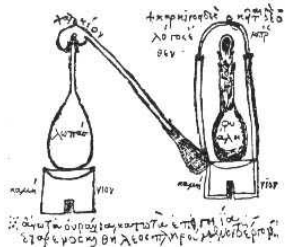
Labconco Corporation

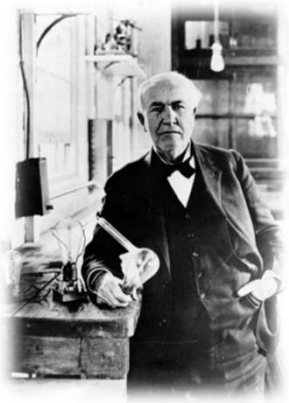
8811 Prospect Kansas City, MO

Fort Scott, Kansas

The History of Fume Hoods

- Alchemists in 1800s
- Thomas Edison Laboratories 1900
  - Fireplace and chimney
  - Shelves outside the window
- University of Leeds, England, 1923
  - Fume Cupboard
- Commercially available in the 1930s





Thomas Edison

University of Leeds, England - 1923

1930s hood

Actual Photo of a Fume Cupboard in Edison Laboratories

Definition of a Fume Hood

A ventilated enclosure where harmful or toxic fumes or vapors can be safely handled while protecting the laboratory technician.

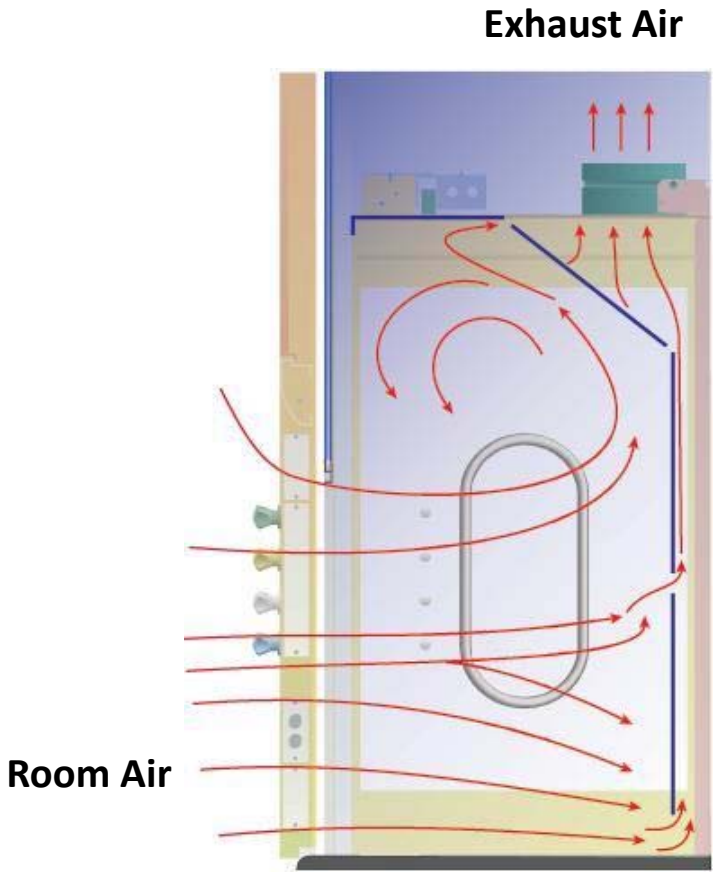
Purpose of a Fume Hood

The primary function of a fume hood is to *capture, contain* and *remove* airborne contaminants.

Face Velocity

Definition:

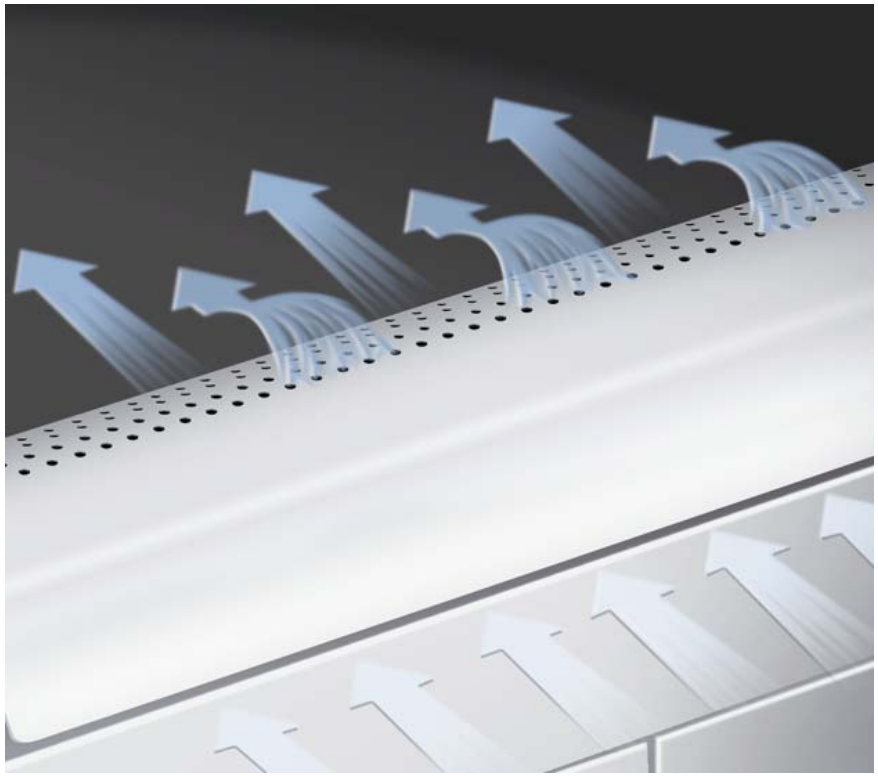
Airflow into a hood is achieved by an exhaust blower which "pulls" air from the laboratory room into and through the hood and exhaust system. This "pull" at the opening of the hood is measured as face velocity.



Air Volume

Air volume passing through a fume hood is generally equal to the area of the sash opening multiplied by the average velocity desired. For example, if 100 feet per minute (fpm) is required and the hood has a sash opening of 7.5 square feet, then the hood's air volume is 750 (7.5 x 100) cubic feet per minute (CFM).

Design Components



Air Foil

Aerodynamic sash opening directs airflow into hood and across work surface with minimum turbulence helping to ensure fume containment.

Design Components

The SASH controls the area of the fume hood which is open. It protects the operator and controls hood face velocities. Glass options include tempered or laminated.

Safety Sash: Physical Barrier

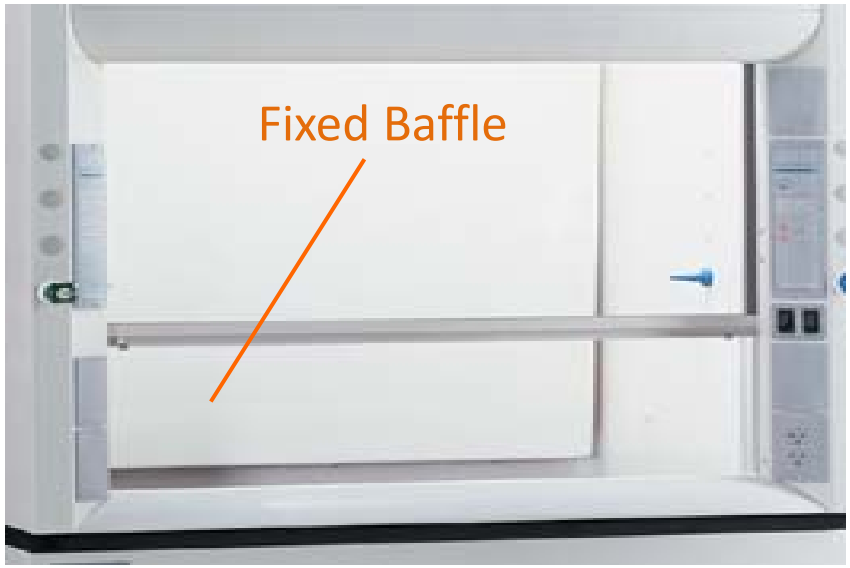
Vertical-rising sash

Horizontal-sliding sashes

Combination (vertical and horizontal sashes)

Design Components

The BAFFLE controls the pattern of the air moving into and through the fume hood Baffles are either fixed (left photo), or adjustable (right photo).

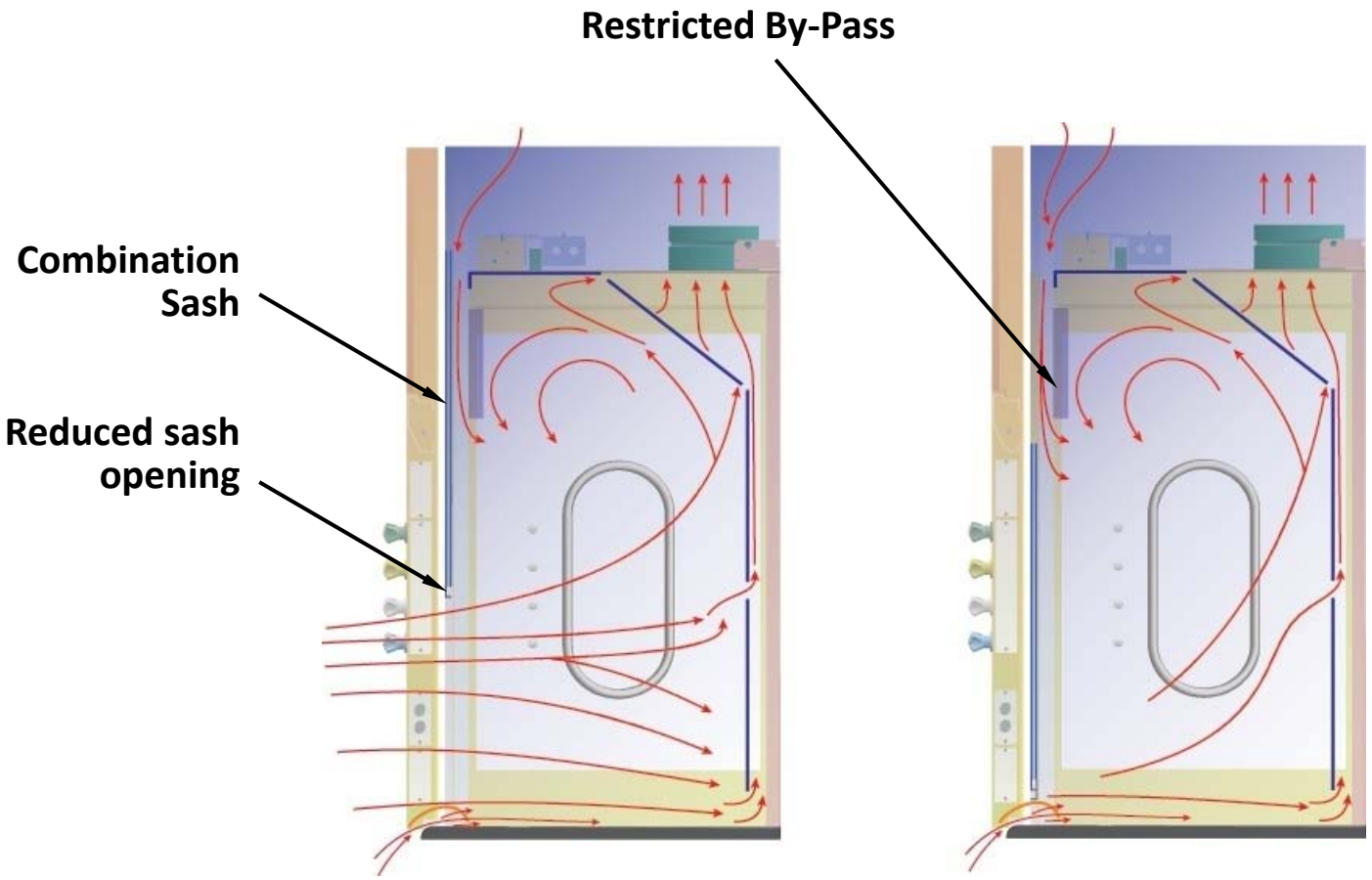


Liner Materials

Liner material should be determined by application and types and concentration of chemicals being handled within the hood and exhaust system.

- Epoxy-coated steel
- Fiberglass reinforced polyester (FRP)
- Glass reinforced cement (GRC)
- Stainless steel (Type 316 or 304)
- Polypropylene
- Polyvinyl chloride (PVC)
- Solid composite panel (polyresin)

Reduced Air Volume (1950-1960s)



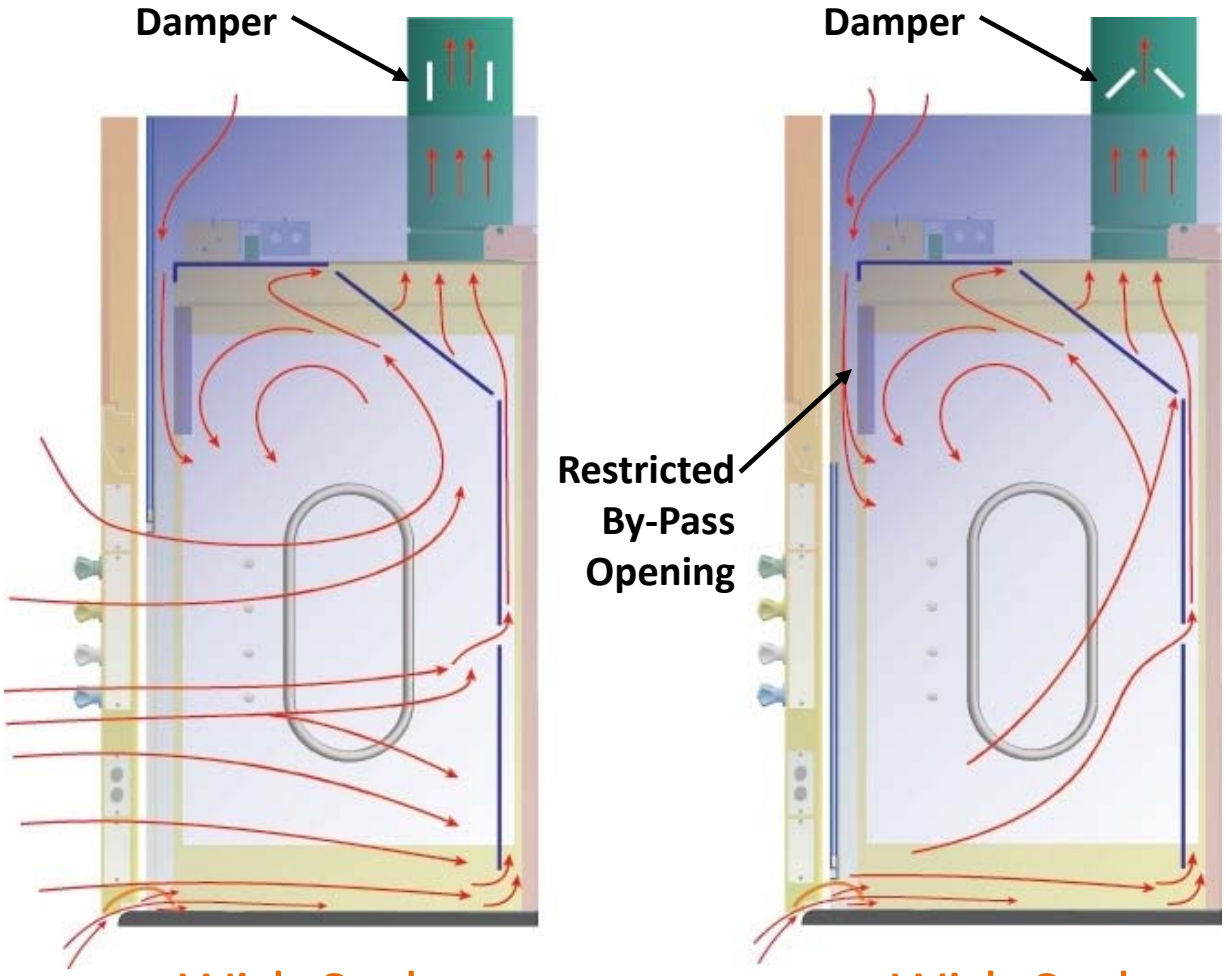
With Sash Open

With Sash Closed

Variable Air Volume Fume Hood

Variable Air Volume hoods maintain the pre-selected face velocity proportional to the sash opening while monitoring hood conditions for safety.

Variable Air Volume (1980s)

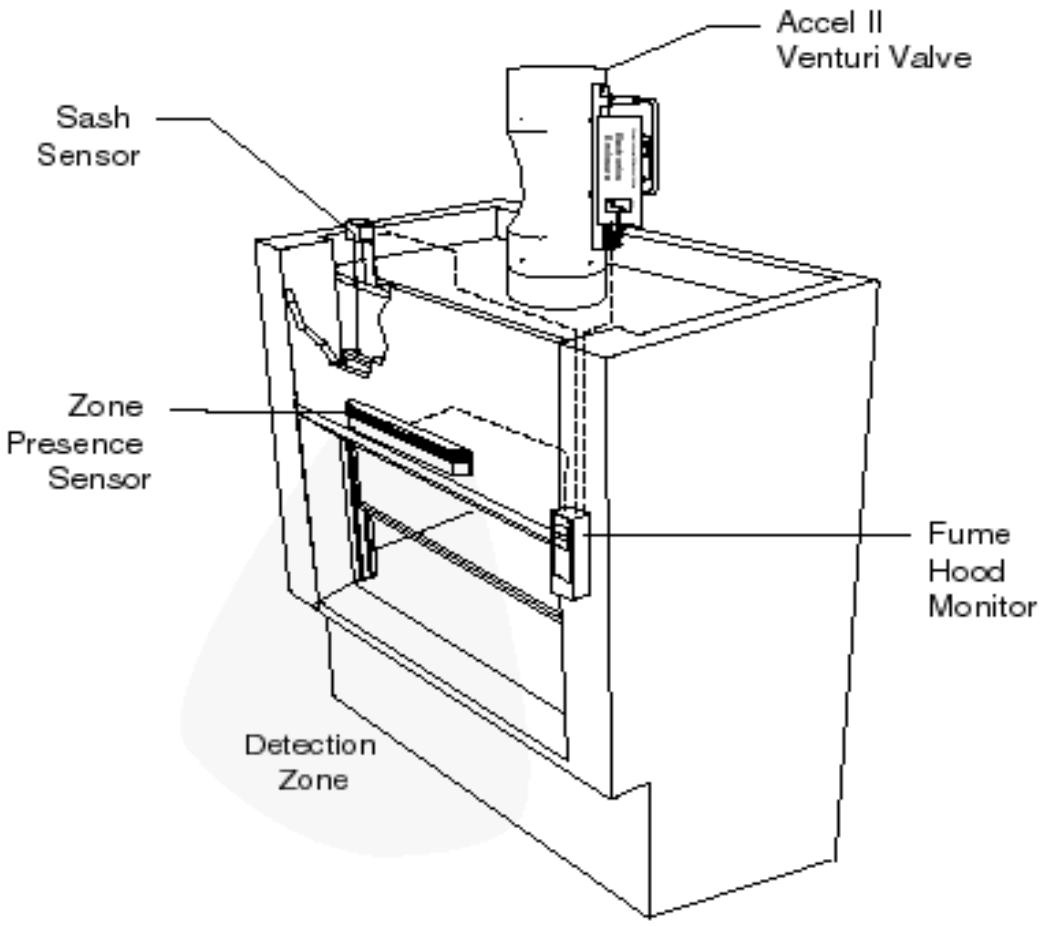


With Sash Open

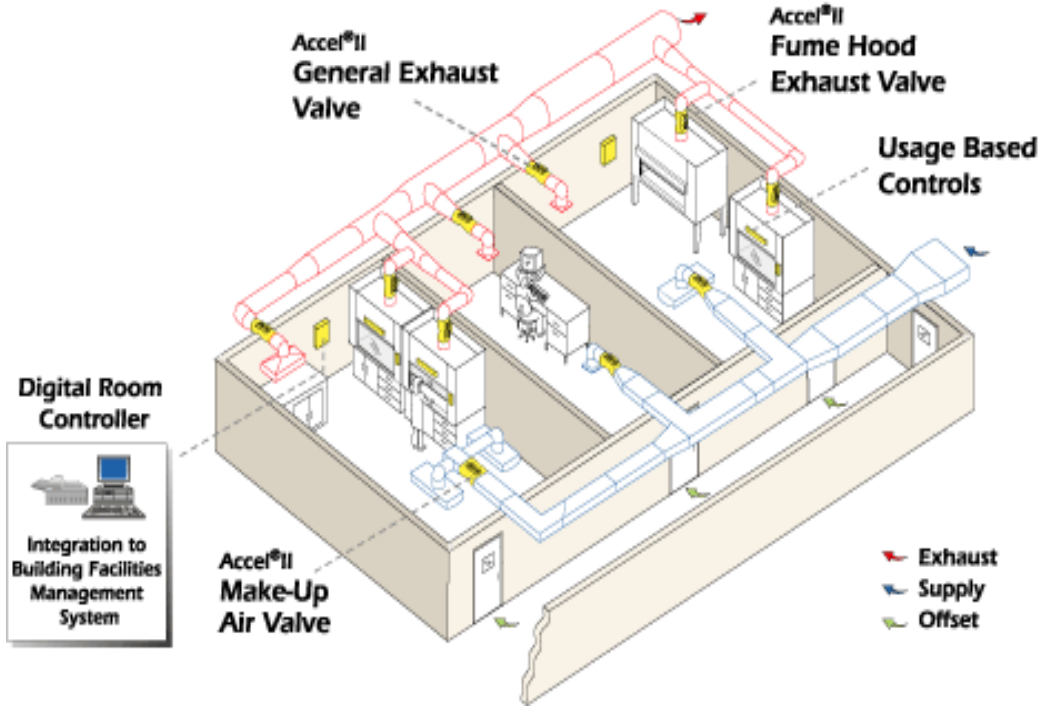
With Sash Closed

Variable Air Volume

Fume hood with VAV control system installed



Variable Air Volume Building Layout



Valves (or dampers) located around room sense demand for increased supply air based on exhaust levels at fume hood.

LBNL Berkeley Hood (Late 1990s)

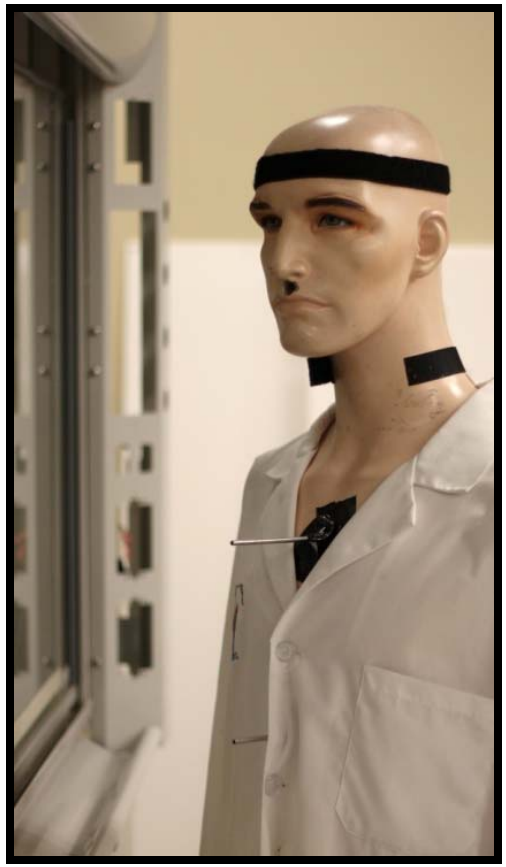
- San Diego Gas and Electric, US Department of Energy
- Push-Pull Design
- 70% Reduction in CFM
- Dramatic Containment Increased safety

High Performance (2000s)

- Operation at low velocities
- Enhanced containment
- Used in constant volume or variable air volume systems

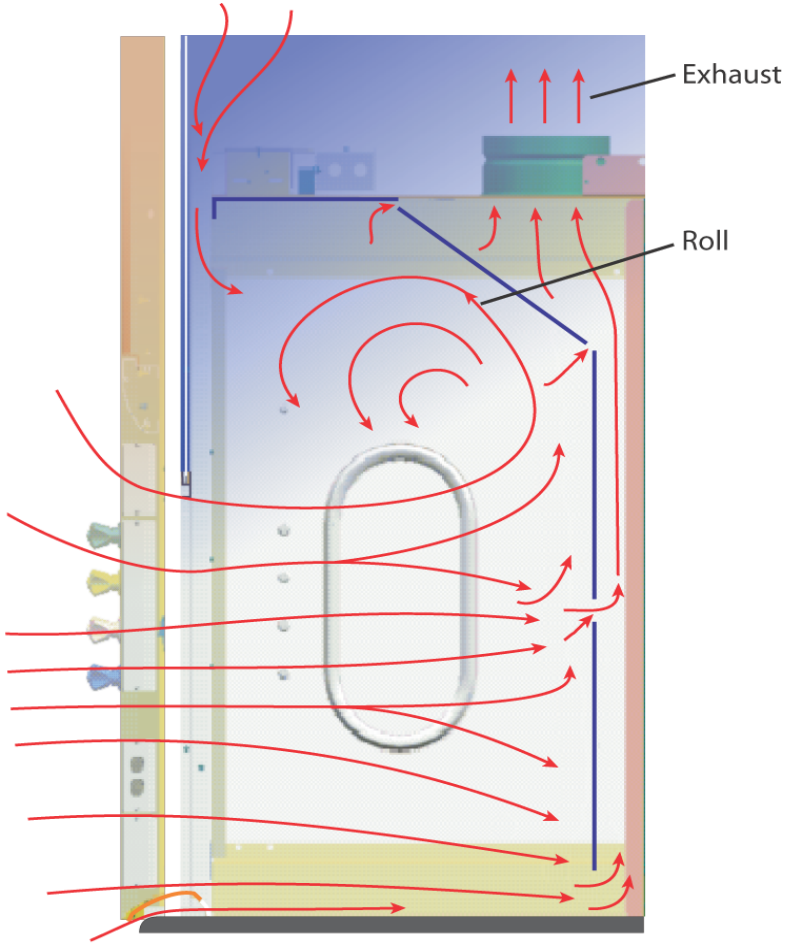
High Performance Defined

- SEFA® definition of High Performance:
  - 60 fpm or less face velocity
  - At maximum sash opening (25” min)
  - Must pass ANSI®/ASHRAE-110
    - Mannequin 3” from sash plane
    - Detector in the breathing zone
    - AM: 0.05 ppm
    - AI/AU: 0.1 ppm
- Aliases:
  - Low Velocity Fume Hoods
  - High Efficiency Fume Hoods

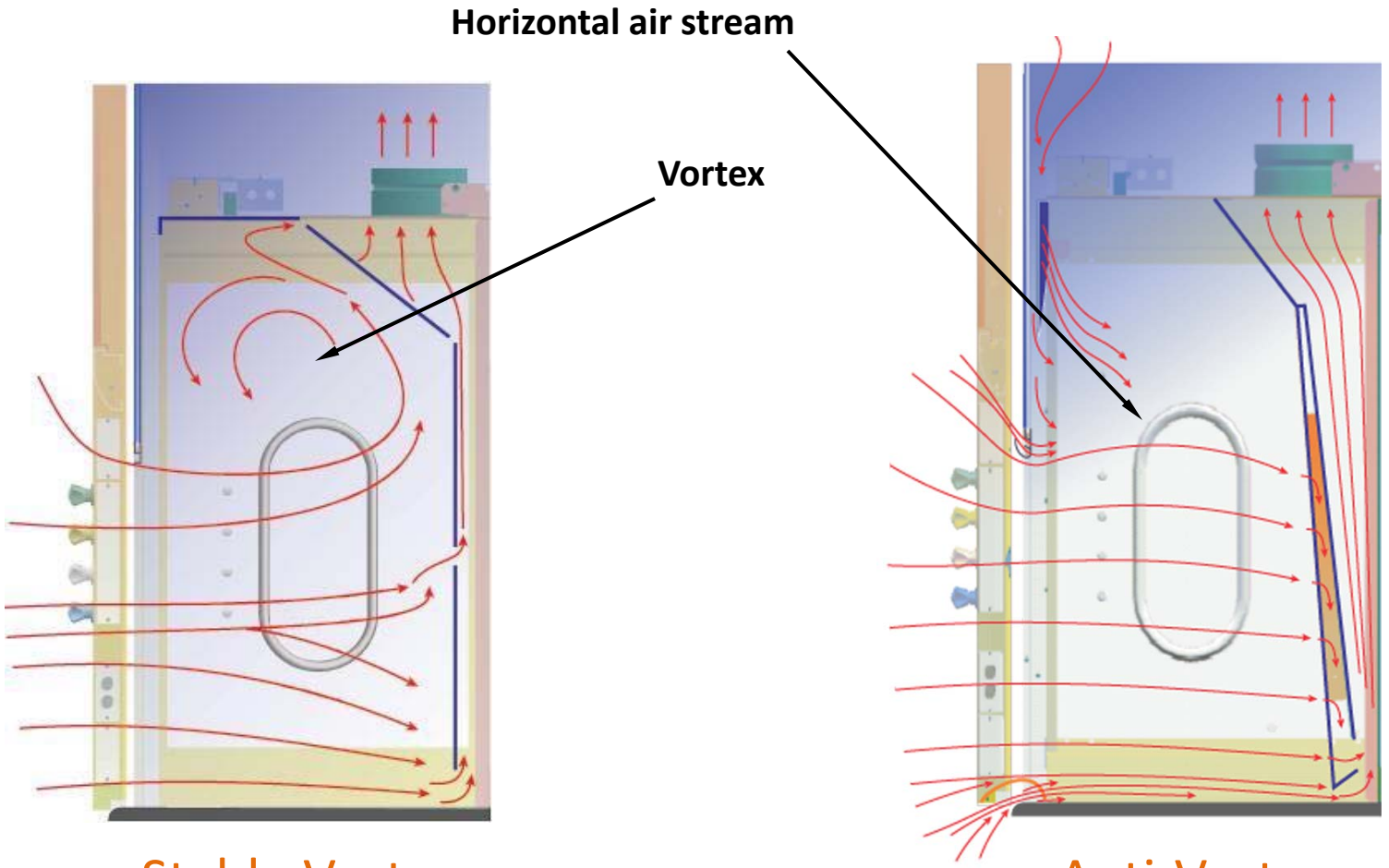


Traditional Hood Design

Traditional fume hoods show a tendency for contaminants generated in the interior to roll forward producing high concentrations behind the sash.



High Performance Designs



Stable Vortex Hood

Anti-Vortex Hood

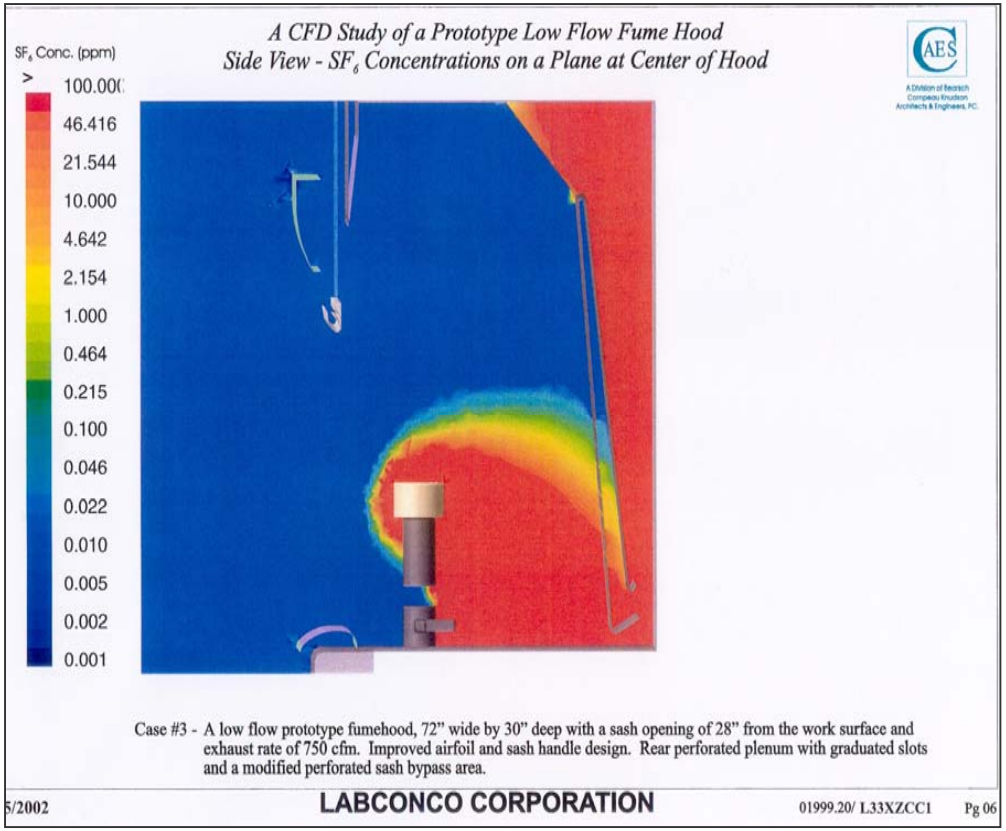
Traditional By-pass Design

Front View

Side View

High Performance and Computational Fluid Dynamics

Anti-Vortex Type



Special Purpose Hoods

- Perchloric Acid/Acid Digestion
- Radioisotope
- Floor-Mounted
- Canopy
- Educational

Consult with EHS & the manufacturer

Lab Safety

General Work Practices

- Understand the hazards of the material you are working with
- Operate the fume hood at or above the recommended threshold limit value (TLV)
- Lower the sash as much as possible
- Keep apparatus and work 6" behind the air foil

Lab Safety

General Work Practices

- Never use fume hood for chemical storage
- Keep baffle area free of obstructions
- Do not lean into the fume hood
- Keep doors to the laboratory closed unless the HVAC design calls for doors to be open

Lab Safety

General Work Practices

- Do not remove any parts from the fume hood
- Minimize foot traffic past the fume hood
- Provide routine maintenance on the complete system
- Establish a scheduled testing program within your Lab

Fume Hood Airflow video

Lab Safety

Fume Hood Accessories

- Remote controlled service fixtures
- Electrical switches and receptacles
- Lighting
- Vapor proof – fluorescent
- Explosion proof – incandescent
- Exhaust blowers
- Coated Steel, Fiberglass, PVC

Lab Safety

Accessories

- Base cabinet and work surfaces
- Acid storage or Solvent storage, General Storage
- Filters
- Activated carbon or HEPA
- Air flow monitors
- Audio-visual

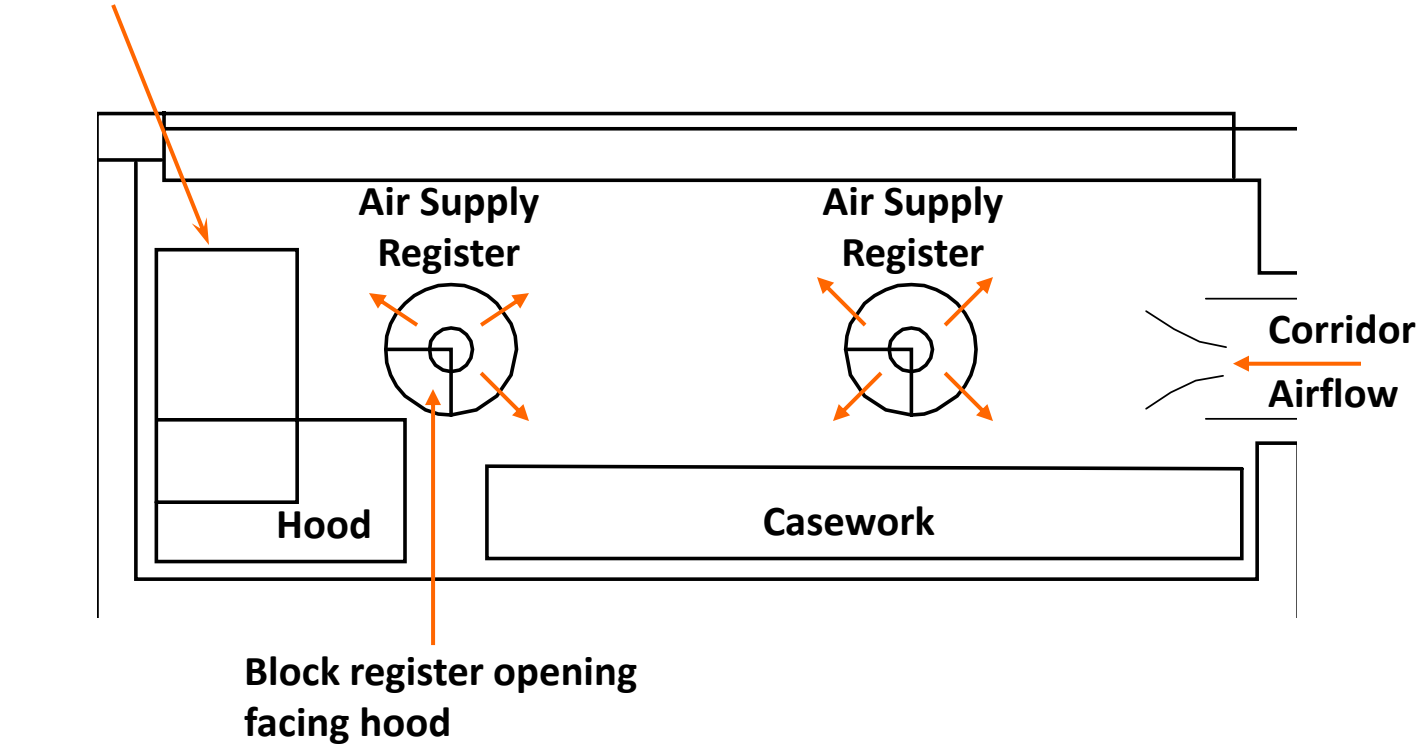
Planning Laboratory Space

- Identify airflow configurations
- Adequate supply of air
- Supply air diffuser location
- Energy conservation varies geographically

- ~ 130 CFM = 1 ton of air conditioning
- Cost to temper room air is $4 to $7/CFM

Planning Laboratory Space

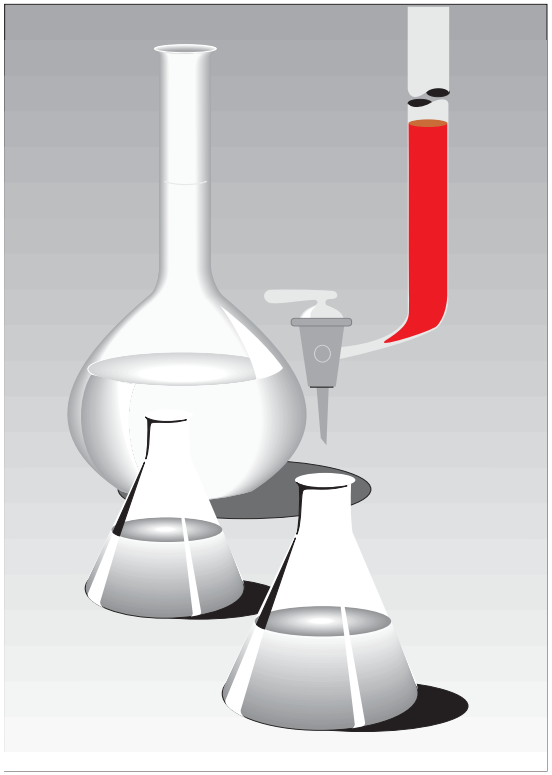
Each hood affects a room's ventilation and traffic flow, so everything must be considered when planning lab space.



Fume Hood Selection

- Determine application/chemical usage
- Determine number of users & types of equipment to be used in the hood
- Identify utilities and accessories required
- Review local codes and/or corporate guidelines
- Americans with Disabilities Act guidelines

Fume Hood Selection

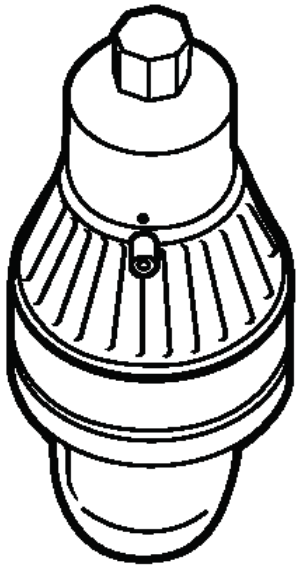


Lower Explosive Limit

The lower limit of flammability of a gas or vapor at ordinary ambient temperatures.

What is an EP Fume Hood?

- Explosion Proof (EP) hoods will **not** contain an explosion
- EP hood: void of potential spark
  - Modified to reduce spark potential outside the hood
  - Reduced chances of igniting a flammable atmosphere in the room
- Specially designed EP electrical components
  - Switches, receptacles and internal wiring
  - Not supplied by the fume hood manufacturer
  - Installed on site by a licensed electrician
  - Meet all state and local codes

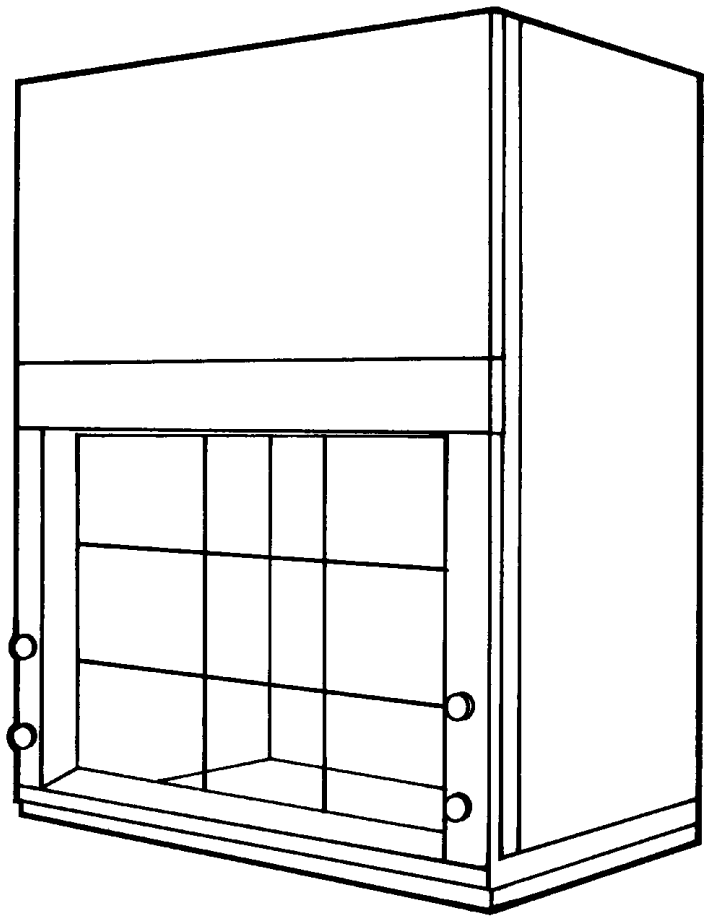


When Do You Need an EP Hood?

- If the room may have a potentially explosive/flammable atmosphere
- NFPA-70: Class 1, Div 1 and 2 Laboratory
- NFPA-45
  - Exempts hood interior from electrical classification
  - Exception: *Unusual Hazard*
- Unusual Hazard
  - 25% of the LEL with hood in operation
  - Calculate the “dilution factor”
  - Comparing it to the volumetric rate (CFM)

Face Velocity

Average face velocity is calculated by dividing the sash opening into one-foot squares. Velocity readings are taken in each grid area and averaged.



Questions?