Advanced Fume Hoods

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Users and their Safety – Our First Concern

Challenges of Advanced Hoods

- **Improve Safety**
- **Decrease Energy Use**
- **Maintain User Accessibility and Usability**
- **Reliable and Maintainable**

Low Flow Constant Volume Dynamic Barrier™ Hood

- **First Section based on April 2000 article in Laboratory Design Newsletter by Dr. Robert Haugen and Rudolf Poblete of Kewaunee Scientific, Statesville, NC**
- **Owners want to lower hood operating costs.**
- **Option 1: Low Flow Constant Volume**
- **Option 2: Variable Air Volume Controls**

Low Constant Volume (LCV)

OPTIONS:

- **Low Face Velocity (Below 80 feet per minute)**

- **Restricted Face Openings**
  - **Horizontal Sashes**
  - **Sash Stops at 18” Vertical Open**

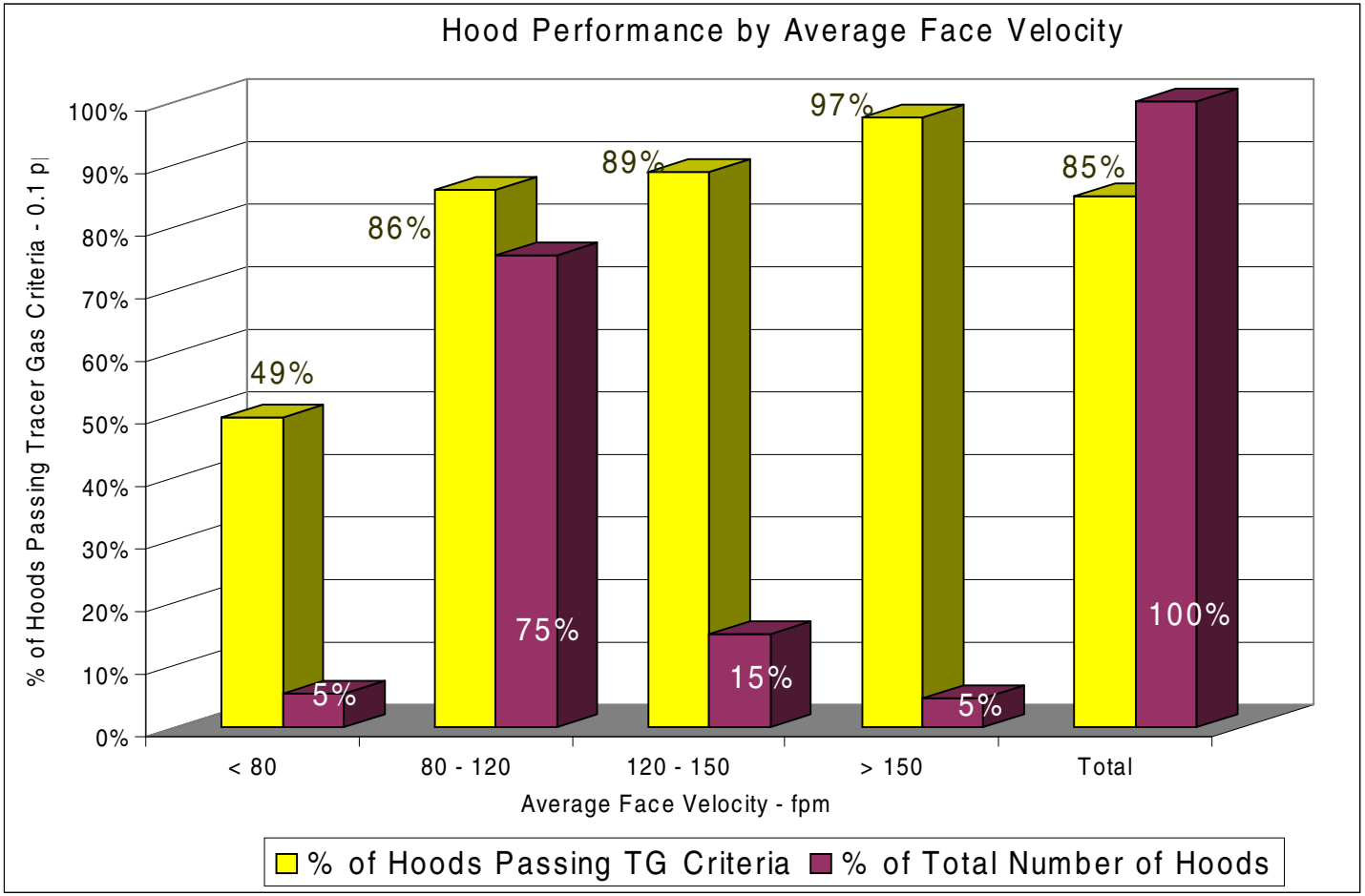
- **Night Setback**
- **Room Occupancy Sensors (Two-Position Constant Volume)**
- **Exhaust Air Heat Recovery**

Face Velocity Recommendations

Organization	Citation	Face Velocity
ACGIH	*Industrial Ventilation* 19th ed. p.5.24	60-100 fpm
ASHRAE	*1999 ASHRAE Handbook* 13.5	60-175
ANSI/AIHA	ANSI/AIHA Z9.5 Sect 5.7	80-120 fpm
CALOSHA	CCR Title VIII Subchapter 7.5454.1	100 fpm
Nat.Rsrch.Cnc.	*Prudent Practices* p.187	80-100 fpm
NFPA	NFPA 45 6-4.5 & A6-4.5	80-120 fpm
NIOSH	*Recommended Industrial Ventilation Guidelines* p.166	100-150 fpm
NRC	NRC Guide 6.3	100 fpm
OSHA	29 CFR 1910 Appendix A Sec. A.C.4.g	60-100 fpm
SEFA	SEFA 1.2:5.2	75-100 fpm

Author's Note: No published standard currently lists Face velocities below 60 feet per minute.

1400 Hood Field Tests

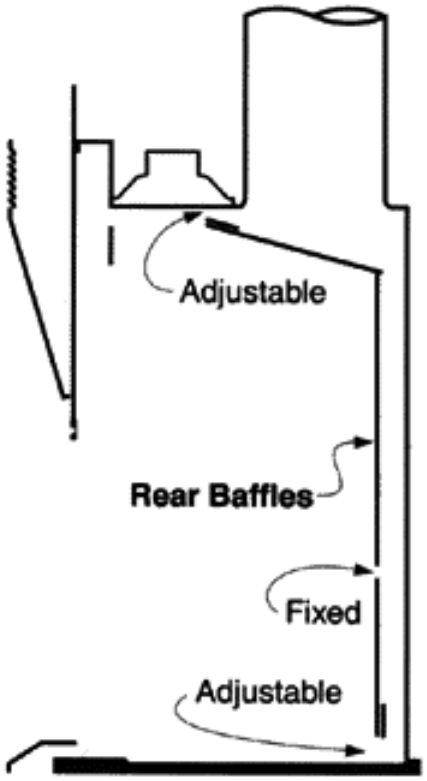


Courtesy of Thomas C. Smith, Exposure Control Technology, Cary, NC

Specific LCV Hood Design

- **Sash Stops Not Well Understood or Bypassed and Opening A Combination Sash Vertically with a partial Horizontal Opening Not Allowed.**
- **This dynamic barrier design passes bypass air over the sash, improving containment from walk-bys.**
- **Spoiler Wing sash handle minimizes air profile and Top Front Aileron panel directs roof-vicinity contaminants away from sash opening.**
- **37” inch high opening for setup, 22” high horizontal with Flush sill airfoil provides air stream to wash benchtop.**

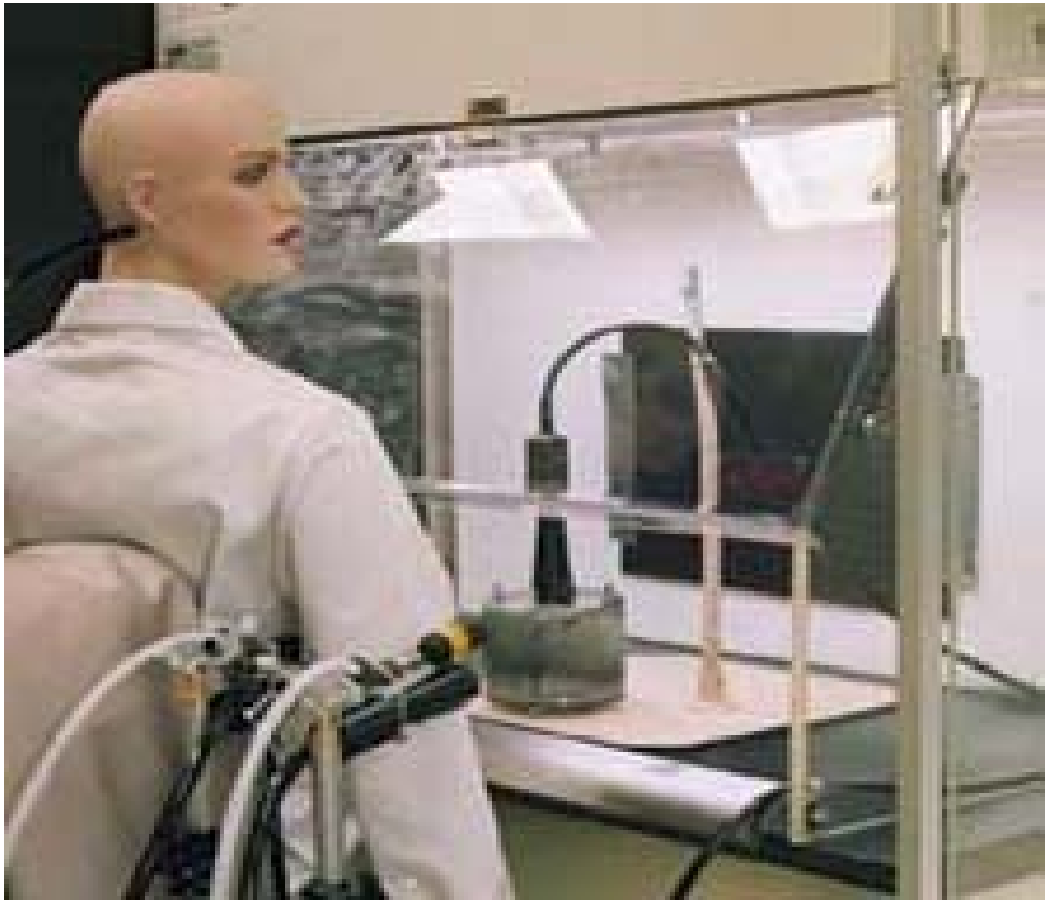
Fume Hood Baffles



Restricted Hood Opening Test

- **ASHRAE 110 Testing, At 100 and 40 fpm, results were less than 0.05 ppm.**
- **But Manufacturer Doesn't recommend below 80 fpm.**
- **A shorter manikin height did not affect containment.**
- **In actual use, a walk-by at 200 feet per minute can often overcome a 40 fpm face velocity vector.**

ASHRAE 110 Tracer Gas Test



Energy/ Cost Savings

- **Smaller openings offer more containment and more protection allowing energy efficiency with higher face velocities.**
- **6’ Hood, 22” wide x 10” opening, 80 fpm, 350 cfm saves $3,760 per year vs. standard 1290 cfm hood. (All calcs. Use $4/cfm)**
- **Internal hood airflow below 5 airchanges/min. can cause corrosion when using heated acids.**

FisherHamilton Designs

- **Information Provided by Jon Zboralski of FisherHamilton, Two Rivers, Wisconsin**

- **Cost/ Complexity/ Containment (3-C's)**
- **Tradeoffs between additional cost, additional complexity, limits on user accessibility, and sought after increases in containment.**

- **Restricted openings limit user accessibility.**
- **"Barrier" airfoils limit user accessibility.**
- **Reduced volumes affect dilution rates.**
- **Reduced Face Velocities more affected by worker movement, traffic, and air-conditioning diffusers.**

FisherHamilton Concept Hood

- **Sash automatically drops to 18” high vertical opening if not physically held.**
- **Offered 4,5,6,7,8ft with 31.25”, 37.25” and 43.25” depths.**
- **Low Flow at 80 fpm, can be run at 60 fpm in setup mode**

Concept Fume Hood vs. Local Ventilation

FisherHamilton Concept Hood

- **Downflow Bypass Air**
- **Celing Enclosure for sash has bypass air drawn from room and not from above clg.**
- **Flush Airfoil Sill washes worktop without limiting user accessibility, has containment trough, and cord passthru.**

HOPEC IV – XD

- **Operates Down to 60 feet per minute**
- **26” and 18” Manikin Challenge Heights**
- **Barrier Airfoil gives ASHRAE 110 Containment < 0.05 ppm, 39” Deep.**
- **Barrier Airfoils typically 1 ½” high and extending 6” into hood improve containment but limit use of hood.**

In Development

- **Pioneer Hood to be Introduced Soon**
- **ASHRAE 110 Committee studying relation of heat loading in hood and susceptibility to walk-by leakage.**

LabCrafters Air Sentry Hood

- **Material based on LabCrafters Information Package and interview with Robert DeLuca and Robert H. Morris**
- **Introduced 5 years ago**
- **Over 500 installed**
- **Developed for low velocities,**
  - **40-60 feet per minute**

LabCrafters Air Sentry Hood

- **Utilizes Moving Rear Baffle and Barrier type Air Foil**
- **Deeper Chamber Dimension**
- **Based on Bi-Stable Vortex Technology**
- **Uses VFV™ Vortex Sensor for Alarm**

LabCrafters Air Sentry Hood

LabCrafters Air Sentry Hood

- **Has Upper Chamber Turning Vane**
- **Multi-Slot Airfoil**
- **Aerodynamic Side Posts**
- **See Engineered Systems Magazine, January 2000 issue for general background to fume hood issues**

AccuAire Sash Closer

- **One of the few commercially available sash closers on the market.**
- **Uses proximity sensor to open sash when user walks up.**
- **Has infrared sensor to stop sash in case of obstruction.**

Labconco XStream

- **Designed to operate at 60 fpm.**
- **Eliminates Vortex with:**
  - **Upper Dilution Air Supply washing sash**
  - **Rear Downflow Dual Baffle System**
  - **Perforated Back Baffle**
  - **Clean Sweep™ Aerodynamic Air Foil**

Labconco XStream

- **Perforated Sash Handle directs contaminants back into hood**
- **6’ Hood at 60 fpm, 945 cfm**
- **Savings of $1880 per year vs. 100 fpm hood and an opening of 28”, 0.11”w.g.sp**

Berkeley High Performance Hood

- **Patented, with 5 years of research and development and $500,000 budget, by the Lawrence Berkeley National Laboratory.**

- **Funds provided by the U.S. Department of Energy, University of California, CIEE, and SCE**

Berkeley High Performance Hood

- **Designed to operate at 30 fpm**
- **Field tests for over a year at University of California, San Francisco and Montana State University**
- **Additional field tests currently being installed.**

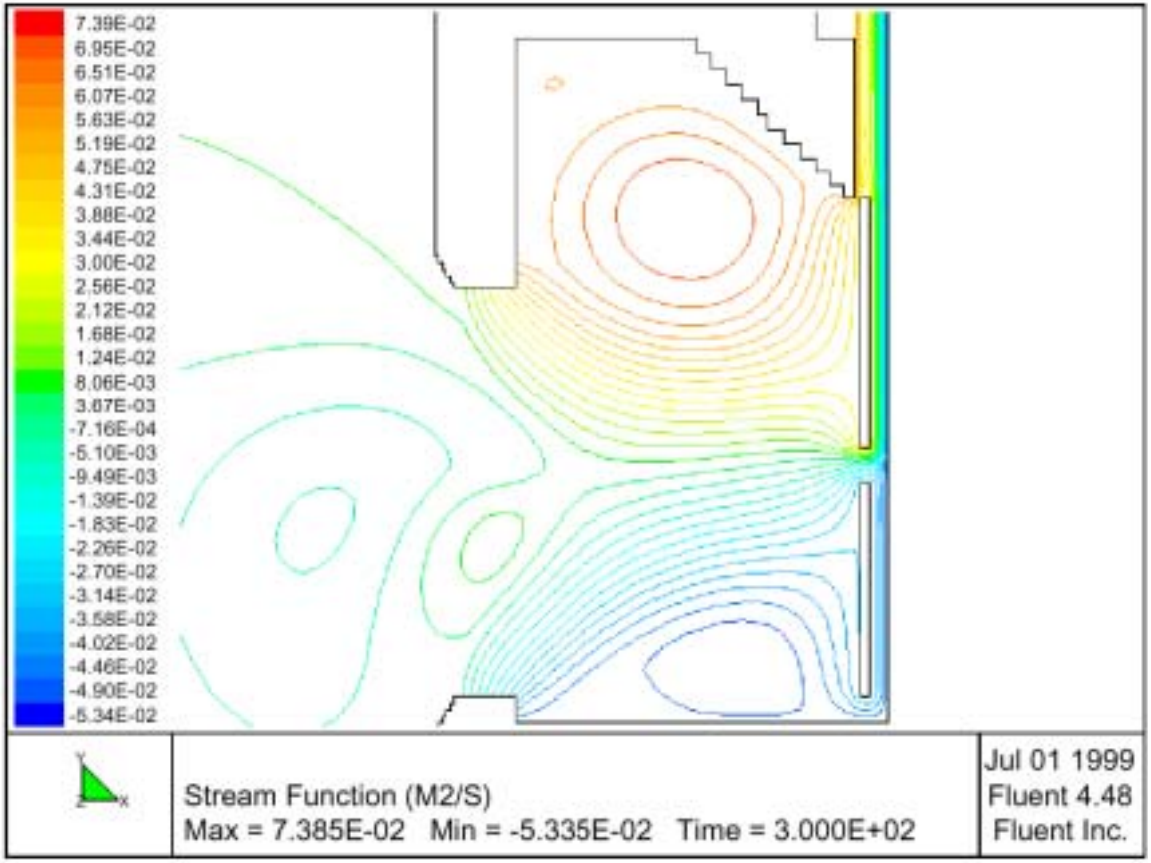
Push-Pull Concept

- **One of more small fans push room air into the hood eliminating the vortex or roll effect, an air divider**
- **Gentle Air curtain down the sash**
- **Perforated Rear Panel**

Design Concepts

- **Perforated Airfoil**
- **Chamber Design tested in multiple mock-ups and extensive computer fluid dynamic simulations**

Computer Airflow Simulation



Berkeley Hood

- **Lawrence Berkeley National Laboratory is negotiating with various manufacturers to license this technology.**
- **Successful manufacturer is expected to go into production in 2002.**

Fume Hood Systems

- **Need more emphasis on operator training. An unsafe fume hood user can not be saved by a safe hood.**
- **Over 5% of hoods have contaminant releases monthly due to bad exhaust fan design.**
- **Eliminate cross-drafts especially from air-conditioning vents.**

VAV Hoods

- **Need minimum turndown volumes to prevent extreme corrosion or flammability.**
- **VAV hoods, operated properly, will save more energy than even the most aggressive low flow constant volume fume hoods.**

Questions?

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