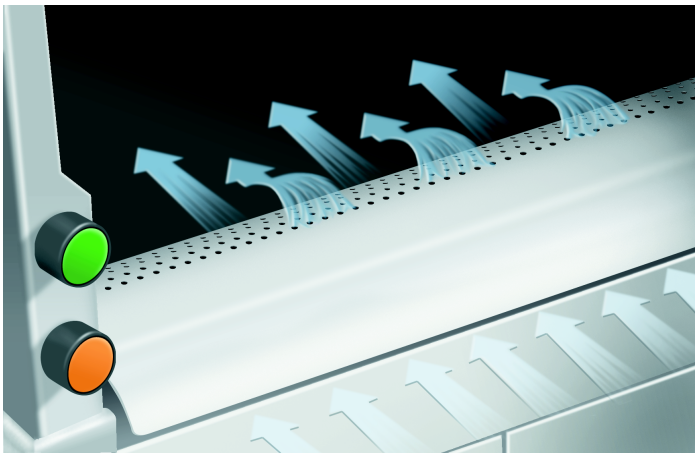
# Sustainable Lab Planning Requires High Efficiency Fume Hoods

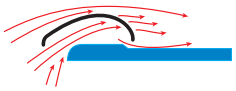
It's estimated that there are over 1 million fume hoods in more than 10,000 North American labs consuming in excess of $5 billion in energy each year. Worldwide there are at least twice that many labs, and since the average fume hood uses the same amount of energy as three U.S. homes, it is vitally important that fume hood energy usage is optimized.

To create optimized sustainable laboratories, lab planners, architects, and engineers will need to fully comprehend airflow volume and face velocity. Airflow volume is typically measured in cubic feet per minute (CFM), and the best way to optimize is to reduce the CFM used by laboratory fume hoods.

**Enhanced Fume Hood Design Features for New Construction**

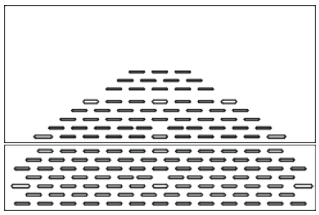
Efficient new design construction requires using high performance fume hoods that minimize the required CFM. Be aware, however, that not all hoods are created equal so pay particular attention to the hood manufacturer's specified CFM. Depending on the hood, it may be necessary to set the exhaust volume (CFM) to a specified face velocity and restrict the sash operating height to ensure the energy savings.





The aerodynamics of the high performance fume hood, such as the choice of lower air foil and type of rear baffle removal system, play a significant role in reducing wasted CFM. Aerodynamically designed, curved lower air foils reduce CFM by as much as 10%, compared to typical flush foils on the market. Furthermore, an aerodynamic and efficient rear baffle removal system (as pictured) can reduce CFM by promoting more uniform face velocity.

ANSI Z9.5 specifies a minimum exhaust volume based on 150-375 ACH (air changes per hour) going through the fume hood. In variable airflow volume (VAV) systems, minimum exhaust volume becomes critical to decreasing annual operating costs. For example, the attached chart illustrates the effect of using high performance hoods at lower face velocities, with lower sash heights (with or without sash intelligence), resulting in significant annual operating cost savings. These features can be combined with VAV to use 1/2 to 1/7 the energy of a standard constant air volume (CAV) exhaust system. In addition, sash intelligence systems that automatically close the sash save enough energy to pay for themselves 3 to 7 times over a hood's expected 15-year lifetime.



**Annual Operating Costs and Initial Capital Costs**

Annual operating costs for fume hoods relate directly to the number of CFM exhausted from the lab. Operating costs range from $4 to $12 per CFM and average around $7 per CFM every year. But initial capital costs for equipment such as the cooling system, heating system, reheating, exhaust fan, supply air handler with variable frequency drive, and exhaust ductwork can total $25 to $30 per CFM to exhaust air from the lab and to supply make-up air for the amount of air exhausted.

| **Initial Capital Costs** | **per CFM** |
|---|---|
| Cooling System | $14 |
| Heating System | $2 |
| Reheating | $0.6 |
| Exhaust Fan | $6 |
| Supply Air Handler | $5 |
| Exhaust Ductwork | $0.4 |
| **TOTAL** | **$25 - $30 per CFM** |
| **Annual Operating Costs** | **$4 - $12 per CFM ($7 average)** |

Photo Credit: Randy Braley

As an example, a recent laboratory upgrade at the University of Kansas included 34 high efficiency fume hoods. Since the hoods demand 10% less airflow volume, they each save 60 CFM from the lab's overall demand. Supply air and exhaust air for the laboratory design will require 2040 CFM less airflow volume at around $25 to $30 per CFM. So the high efficiency hoods save $51,000 to $61,200 in initial capital costs in addition to 10% lower operating cost. Thus, the choice of high performance hoods and their specification becomes vitally important to both initial capital costs and annual operating costs, without compromising safety.

**Conclusion**

The initial investment in a building is only a fraction of the cost over its lifetime. Inefficient fume hoods can become an enormous recurring expense hidden in the energy bills. Always pay attention to the performance specifications of fume hoods and other equipment specified in the lab, and especially the airflow volume (CFM), to optimize annual energy usage. Also pay attention to the operating sash height and explore ways to lower the effective sash height, which affects airflow volume. Exploring ways to reduce the CFM required will help save on initial capital costs as well, since heating and cooling systems can be scaled back with the lowered demand for airflow volume.

Lastly, explore ways to use newer technology, such as enhanced high performance hood features, direct replacement LED lighting, new multi-speed blowers, and new filtered hoods and ventilated enclosures to ensure lab sustainability in both new construction and existing labs. Being a good steward of energy also generates a return on investment for the building owner.

| Hood Size/Type | Face Velocity | Operating Sash Height | Constant Volume or Variable Volume | Airflow | Annual Costs | Lifetime Costs |
|---|---|---|---|---|---|---|
| 6' Typical | 100 fpm | 28" sash | CAV | 1250 CFM | $8750/yr. | $131,250 |
| 6' HP | 100 fpm | 28" sash | CAV | 1150 CFM | $8050/yr. | $120,250 |
| 6' HP | 60 fpm | 28" sash | CAV | 690 CFM | $4830/yr. | $72,450 |
| 6' HP | 60 fpm | 18" sash | CAV | 430 CFM | $3010/yr. | $45,150 |
| 6' HP | 60 fpm | 14" sash | CAV | 325 CFM | $2275/yr. | $34,125 |
| 6' HP | 60 fpm | 18" sash | VAV | 250 CFM, 8 hr. day | $1750/yr. | $26,250 |
| 6' HP | 60 fpm | 18" Sash Intelligence | VAV | 170 CFM, 3 hr. day | $1190/yr. | $17,850 |