Bad Air

Maintaining Your Laboratory Exhaust Systems

Introduction
The fume hood system is a safety device for personal protection. It requires proper maintenance and operations to protect the user and other laboratory personnel. Through the years, it has been found that a vast majority of fume hoods and remote blowers need to be fine-tuned to ensure safety, energy savings and regulatory compliance. This paper will give you guidelines that will be helpful in maintaining your laboratory exhaust systems and eliminate **Bad Air.**

Your most valuable asset needs – and deserves – PROTECTION!
As with all mechanical systems, inspections and regular preventive maintenance are critical to ensure that the laboratory exhaust systems operate without unscheduled interruptions in service. Records of all inspections and corrective actions for each laboratory building must be kept. Depending on the system component, inspections should be done quarterly, semiannually or annually and laboratory personnel must receive advanced notification of fan stoppage to ensure that an unsafe condition doesn't occur.

There is a growing need for laboratories to conduct teaching, research, quality control and related activities. This brings to light that these labs should be safe places to work, they should be in compliance with environmental, health, and safety regulations. It is imperative that they meet necessary criteria for the occupants and technology involved in terms of control of temperature, humidity and air quality.

Save energy and potentially thousands of dollars every year.
Fume hoods and exhaust fans are designed to work with the highest efficiency only when they are in good working order. Each fan applied to serve a laboratory exhaust system or to exhaust an individual piece of laboratory equipment has to be adequately sized to provide the necessary amount of exhaust airflow in conjunction with the size, amount, and configuration of the connecting duct. In addition, each fan's rotational speed and motor horsepower is designed to sufficiently maintain both the required exhaust airflow and stack exit velocity and the necessary negative static pressure in all parts of the exhaust system. Not only are poorly performing systems a danger to personnel, but also a drain on the facility's cost of operation.

Complying with government regulations.
OSHA regulates that each laboratory develop and implement specific measures to ensure the proper operations of fume hoods. The establishment of good work practices along with training in proper operation and use of a fume hood will make compliance of regulations much easier. Work practices should reduce emissions and personnel exposures. No modifications of the interior or exterior or components of the hood without approval should ever be done that would compromise the operation of the fume hood system.

The NFPA (National Fire Protection Agency) goes further than a recommendation, they mandate the following regulations:
NFPA-45 Standard on Fire Protection for Laboratories Using Chemicals
8.8.7 Measuring Devices for Hood Airflow
8.8.7.1 A measuring device for hood airflow shall be provided on each chemical fume hood.
8.8.7.2 The measuring device for hood airflow shall be a permanently installed device and shall provide constant indication to the hood user of adequate or inadequate hood airflow.

Monitoring Gases and Vapors
A reliable and adequately sensitive monitoring system should be utilized to indicate absorbent breakthrough of gases and vapors. The sensitivity of the monitoring system should be a predetermined fraction of the Threshold Limit Value (TLV) or appropriate health standard of the contaminant being absorbed but shall not be more than 25% of the TLV.

The standard remote blower fan rotates approximately 136,000,000 times a year.
Or, you might say, there are 136,000,000 reasons to keep your system fine tuned. Evaluation of insufficient room air, sash operation, duct corrosion, drive mechanisms, excessive temperature of the motors, belt tension or belt wear are just some of the areas that are critical and should be inspected.

Exhaust System Duct

Duct material for ventilating chemical fume hoods and storage cabinets should be chosen according to your specific application and the type of chemicals being exhausted. In most instances, the most widely recommended is PVC, but you can also use stainless steel, PVC coated, or galvanized steel. Stainless steel is recommended for corrosive or reactive chemicals. To ensure that you make the right selection, always consult with your fume hood manufacturer or your chemical hygienist.

Duct work should be installed with a minimum of elbows, using round ducts and sweep ells wherever possible. To further minimize friction loss and turbulence, the interior of ducts should be smooth and free from obstructions, especially at joints. Installation of duct must be in compliance with NFPA 91 and ANSI Z9.5, including provisions for properly sealing penetrations, grounding and sealing duct joints, and providing required clearances from combustible construction materials. Penetration of fire barriers should be avoided. In addition, requirements of NFPA 45 must be followed for installations of laboratory exhaust systems.

Chemical fume hood ducts are generally not equipped with fire sprinklers or fire dampers, but wherever code requires, ducts shall be in fire-rated or fire-protected shafts. If multiple hoods are on the same fan system, each should be equipped with a balancing damper. Hazardous exhaust systems are not typically equipped with filters to capture contaminants. In some cases, however, pre-filters may be installed to protect heat exchange coils or other HVAC equipment from accumulating debris. Consult with EH&S regarding filter specifications for hazardous exhaust systems.

Fan Systems

Fan systems must be designed and installed to ensure that fume hoods, acid cabinets and ducts are under negative pressure all the way out of the building through unobstructed stacks with uncapped vertical discharges. Fan selection, stack height and discharge velocity determinations should give consideration to preventing the reentry of contaminants into buildings. Fans must be roof mounted units with exhaust stacks terminating at least 7-10 feet above the roof-line, away from eddy currents, air intakes and openings. Discharge velocities should not be less than 3,000 fpm. HVAC and exhaust air systems will have to be balanced to ensure that the lab is under negative pressure with respect to the corridor while keeping the hood under negative pressure relative to the lab.

Make-up air shall be provided to compensate for the air being exhausted. The location and volume of make-up air is critical to assuring proper fume hood operation and worker protection. Fan blades, housings and other components must be corrosion resistant and meet the AMCA standard for spark-resistant construction. The motor must be vapor tight (Class I, Division I) if it is located in the air stream. All fans, duct, and power supplies should be clearly labeled to indicate exactly which areas they serve.

If a hood is to be tied into an existing central exhaust system serving multiple fume hoods, then the air system will have to be evaluated to see if it has sufficient capacity for the addition of other exhausted equipment. On/off switches are generally not provided on fume hoods. Hazardous exhaust systems should be provided with emergency backup power and not shut down upon activation of any alarm, however, dedicated switches may be
provided in the building fire alarm panel to allow capability for manual fan shut-down by the fire department.

Safe Work Practices

The health and safety of laboratory personnel and building occupants must be the primary goal of laboratory management. Properly functioning fume hoods help achieve this goal with respect to the hazards of chemical vapors and other harmful airborne substances. It is important to remember that a fume hood is not a storage area. Keeping equipment and chemicals unnecessarily in the hood may cause airflow blockage. Here are a few health and safety tips concerning fume hoods :

- Substitute toxic chemicals with less hazardous materials whenever possible.
- Keep fume hood exhaust fans on at all times.
- Perform all work six inches inside the hood.
- Never place your head inside the hood.
- Keep the hood sash closed as much as possible at all times to ensure the optimum face velocity and to minimize energy usage.
- Keep lab doors closed to ensure negative room pressure to the corridor and proper air flow into the hood.
- Do not store chemicals in the fume hood.
- Keep the slots of the baffle free of obstruction.
- Do not use the hood as a waste disposal mechanism (e.g., for evaporation of chemicals).
- Avoid rapid movements in front of the hood including opening and closing the fume hood sash rapidly and swift arm and body movements in front of or inside the hood. These actions may increase turbulence and reduce the effectiveness of fume hood containment.
- Do not override or disable mechanical stops on the sash.
- Train and educate employees regarding specific hazards and include work methods that help reduce contaminant exposure.
- Have a general awareness of the operation of your hood and be aware of any differences in visual or audible cues that may imply a change in function.

Troubleshooting an Exhaust System – Helpful Hints

Most of the following checks can be made by visual observation and do not require extensive measurements.

If air flow is low in the fume hoods, check:

- Fan rotation
    - •reversed polarity will cause fan to run backward
    - •a backward-running centrifugal fan delivers only 30-50% of rated flow
- Fan RPM
- Slipping belt
- Clogged or corroded fan wheel and casing
- Clogged ductwork
    - •high hood static pressure and low air flow may indicate restricted duct
    - •open clean-out doors and inspect inside duct
- Closed dampers in duct
- Clogged collector or air cleaning devices
- Improper weather cap installed on discharge stack
    - •Style B Zero Pressure is recommended
    - •Style A is not recommended
- Poorly designed duct system
    - •short radius elbows
    - •branch entries enter main duct at sharp angles
    - •duck diameter too small for the air-flow needed
- Lack of make-up air
    - •high negative pressures affect propeller fan system output
    - •lack of supplied make-up air causes high airflow velocities at doors and windows

If air flow is satisfactory in a hood but contaminant control is poor, check:

- Cross Drafts
    - •from process air movements
    - •worker-cooling fans and air-supply systems
    - •open doors and windows
- Capture velocity
    - •work operation too far from hood opening
- Hood enclosure
    - •Door
    - •Baffles
    - •Sides may be open or removed

Chemical Hygiene Plan

The development of a detailed written chemical hygiene plan is necessary to establish continuity, to train personnel, and to help ensure that all employees recognize and comply with work place safety. It is extremely difficult to effectively communicate and enforce requirements without a detailed written chemical hygiene plan.

An effective chemical hygiene plan necessitates that mechanisms be in place and functioning to ensure that safety policies and procedures are being adhered to, personnel are meeting their safety responsibilities, and an effective form of monitoring and documentation is in place for confirmation purposes. The Code of Federal Regulations, Title 29, Section 1910.1450 provides guidelines for chemical hygiene plans.

SUMMARY

Bad Air does exist in laboratories more often than necessary. Accidents can and do happen due to poor safety practices. The need for safety in our laboratories is critical and can be attained through diligent monitoring of fume hood systems that will prevent most of these events. By instituting routine maintenance programs and complying with existing regulations, your lab will be a safe environment.

References

OSHA Technical Manual Section III, Chapter 3
Office for Research Safety, Northwestern University, Chicago, IL
NFPA – National Fire Protection Agency Standard on Fire Protection for Laboratories Using Chemicals
ANSI/AIHA – Approved American National Standard/American Industrial Hygiene Association
Code of Federal Regulations, Title 29, Section 1910.1450, Occupational exposure to hazardous chemicals in laboratories.

LOC Scientific, Inc.
1036 Parkway Court
Buford, GA 30518
770.932.0202 or 877.527.5775
www.locscientific.com