Laboratory Fume Hoods: Best Practices for Designing and Maintaining a Safe Environment

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Fume hoods are one of the most important tools in a research laboratory. The ventilation device ensures the safety of all researchers working in the laboratory by limiting exposure to hazardous or toxic fumes, vapors and dusts. There are two main types of fume hoods—ducted and ductless. Ductless fume hoods draw air in from the front of the cabinet, render it safe through filtration and feed air back into the room. In the case of ducted fume hoods, air is drawn in from the open side of the cabinet and expelled outside of the building. In addition to being energy-inefficient, installing these types of fume hoods requires a lot of design work to ensure the device is ducted into the building's ventilation system properly. Follow these best practices when it comes to your fume hood budget, facility design and safety requirements to ensure a happy, healthy and productive laboratory environment.

Fume Hood Budget

Determining a fume hood laboratory budget is just as important as designing the space. Here are five steps for designing fume hood laboratories that meet your needs and budget.

Step #1: Establish your fume hood laboratory budget with three areas in mind:

Personnel. Determine how many people you will have to pay to run and maintain your lab, and what that will cost.

Major equipment. Compile a list of major equipment needed and prioritize the list by necessity. Be sure to take the cost of service contracts into consideration when planning your budget.

Supplies. These are consumable and non-consumable goods that are needed on a day-to-day basis, such as tubes, glassware, chemicals, etc.

Step #2: Get written quotes for major equipment. Be sure to ask several companies for estimates, so you can compare prices. Ask vendors if they offer lab start-up programs that give equipment discounts to new labs.

Step #3: Compare your estimates to your budget. Are you in the ballpark? If not, take a look at your list and decide where you can compromise, and where you can't. You won't be able to do without your essential equipment, but may have to put your "nice to have" items on a list for future purchases.

Step #4: Get help. Develop a good relationship with your vendors and sales representatives, and ask them to suggest alternatives that will help you get what you need while also staying within your budget. These professionals work with many different laboratories, and will be able to share ways of cutting costs. Staying within budget could be as simple as changing the materials of your casework, for example.

Step #5: Get creative. Ask colleagues and other labs if they would be willing to donate used or old equipment in good working condition to your laboratory. This is a great way to get everything you need while staying within budget.

Fume Hood Facility Design

Once you have decided on a budget, the next step is deciding which fume hood design would be suitable to both your facility and research needs.

When it comes to fume hood facility design, there are two main goals to meet:

- Ensuring that the design of the fume hood facility meets laboratory work goals
- Ensuring that the design of the fume hood facility meets all safety requirements

In order to meet these goals, follow three steps:

Step #1: Determine the facility's needs. Collect and analyze information related to the facility's primary needs. Determine how often the laboratory will be used, the functions that will be performed in the laboratory, the chemicals and materials that will be used in the fume hood laboratory, and the levels of hazard and risk. In addition, you'll also need to determine the mechanical and electrical needs of the laboratory.

Step #2: Meet safety goals. Ensure the correct air exhaust volume by evaluating things like hood location and room air patterns. Fume hood facility design should ensure that hood noise, traffic patterns, and face velocity are at safe levels. Poor consideration can result not only in an unsafe fume hood laboratory, it can also contribute to inefficient laboratories that are expensive to run.

> ***"Nothing is more important than the health and safety of the people who work and learn in your fume hood laboratory."***

Step #3: Communicate requirements to laboratory architects and engineers. Once laboratory requirements have been determined, pass them to architects and engineers who will incorporate them into the fume hood facility design process.

When it comes to deciding how many fume hoods your laboratory will hold, and where you should place them, avoid relying solely on the square footage and layout of the room. To ensure your laboratory is safe and efficient, you'll want to take an additional three things into consideration during the fume hood laboratory design process.

Consideration #1: Ventilation: During the fume hood laboratory design process, it's important to position fume hoods near ventilation. This is usually not an issue in one-story buildings or in multi-story buildings with space between the floors, but can become problematic in multi-story buildings that don't have enough space for ducting. A fume hood laboratory design or planning specialist can help position fume hoods to avoid horizontal ducting.

Consideration #2: Fume hood users: When designing your fume hood lab, be sure to take your users into consideration. A research laboratory, for example, may require a completely different setup than a classroom. If your lab includes a demonstration hood, be sure to set up other fume hood stations so that they can easily view the teacher. Consider whether group work and communication between fume hood users is necessary, or if it's preferable to arrange fume hood stations with individual work in mind.

Consideration #3: Traffic patterns: Any movement that disturbs air, whether that movement is a result of foot traffic or of a door opening or closing, will affect fume hood airflow and operation. To ensure safe, consistent fume hood functioning, fume hoods should be placed in areas where minimal push and pull of the air occurs. During the fume hood design process, plan to place fume hoods well out of busy traffic patterns, and away from opening and closing doors.

Guide to Types of Fume Hoods

Fume hoods, standard in any chemical laboratory, enable researchers, workers, and students to safely work with hazardous and volatile materials. The concept of the fume hood is simple — to ventilate dust, debris, fumes, and other contaminants away from users and out of the laboratory. But while the concept is simple, the number of different types of fume hoods available can complicate choices. Here is a guide to fume hood types.

Air foil fume hoods: These hoods are designed to have an aerodynamic entrance shape. Instead of having square faces, air foil fume hoods have a gentle slope on the bottom front air foil that reduces turbulent air patterns and increases laboratory safety.

Walk-in fume hoods: If your laboratory requires fume hoods that house large equipment, walk-in fume hoods are an excellent option. While the name might indicate otherwise, walk-in fume hoods do not allow users to walk in and out of the fume hood while it is being used. Walk-in fume hoods, which are basically bench hoods that reach the floor, do allow users to walk in and out to set up equipment before and after work begins.

Flat-front fume hoods: Ventilated enclosures that keep laboratory users and the environment safe from fumes, dust and other contaminants, flat-front fume hoods are enclosed on three sides, and have a vertical, horizontal or combination sash that can be raised or lowered in front.

Demonstration fume hoods: These ventilated enclosures are designed to protect users from chemicals, dust, vapors, and other contaminants. However, there is one major distinction between typical fume hoods and demonstration fume hoods. Instead of being enclosed on three sides with opaque material, they are enclosed by transparent safety glass.

Thin-wall fume hoods: Designed to protect laboratory users and their environment from chemicals, fumes, dusts and other contaminants, thin-wall fume hoods are enclosed on three sides, with an adjustable sash made of safety glass in the front. Thin-wall fume hoods are usually attached to the laboratory's exhaust system, but can also be ductless in less dangerous applications.

Specialty fume hoods: While the general fume hood can be used in many different laboratory environments, there are situations in which specialty fume hoods are necessary. The reasons for requiring specialty fume hoods include the types of chemicals and properties used in the hood, the size of the equipment placed in the fume hood and even the needs of the operator.

Perchloric acid fume hoods: These hoods are designed to allow safe use of perchloric acid by meeting five criteria. They must not react to percholoric acid, are watertight, explosion-proof, have a dedicated duct and blower system and are designed for single use.

Radioisotope fume hoods: These hoods are designed with two very specific considerations in mind. First, they must be constructed so that even minute portions of radioactive material can be easily cleaned from the surface. Second, they must be strong enough to hold the heavy lead bricks that are used to shield radioactive material during work.

A fume hood's main job is to pull dust, debris, toxins, fumes, and gases out of the room and through the ductwork, so that users can work safely. In order to operate properly, the fume hood relies on a consistent face velocity and exhaust volume. Even the slightest shift in air patterns can affect the performance and safety of your fume hoods. Not only does air movement affect the air entering the hood, it also interferes with the air introduced via the supply outlet, which affects the movement of air at the face of the hood.

There's no way you can eliminate traffic in your laboratory. But the way you design your labs, and the thoughtful consideration you put into fume hood placement, can minimize the effects of traffic.

Air foil fume hood

To minimize the effects of traffic on performance and safety, follow these fume hood laboratory design tips:

- Place fume hoods at the end of the room. Fume hoods placed at the end of the room are exposed to less that traffic that fume hoods placed at the front of or in the middle of a room.
- Keep fume hoods away from windows and doors. Every time a window or door is opened or closed, air patterns in the room are affected.
- Note traffic patterns, and locate fume hoods out of the way of these patterns. Do not locate fume hoods in areas that people must pass through, or in areas where people are required to move from one location to another to do their work.

When it comes to planning your laboratory, make sure the fume hood mechanical system is factored into the design.

During the design phase, it is important to ensure that the fume hood mechanical system comprising HVAC, plumbing, and valving complement the fume hood system, as well as the laboratory and building. To match your fume hood mechanical system to your fume hood laboratory, take these three steps:

- Determine the type of work done in your lab
- Identify safety needs
- Figure out cost of energy based on frequency of hood use and climate

For those trying to reduce energy costs, variable air volume systems may be just what you're looking for. These systems exhaust air depending upon fume hood use. When the sash is open, energy use increases. When it's closed, energy use automatically decreases. This advanced technology means that variable air volume systems are more expensive to purchase up front, but many laboratories easily save money in reduced energy costs in the long term.

Variable air volume systems do require consistent monitoring and maintenance to ensure they are working properly.

For those looking for less inexpensive mechanical systems that are easy to maintain and monitor, constant exhaust and supply airflow systems may be the best option. These systems work best with fume hoods that exhaust consistent air, regardless of whether the sash is opened or closed. While this type of mechanical system is less expensive up front, the long-term costs can be high due to the amount of energy it uses.

OSHA Regulations and Fume Hood Lab Safety

Nothing is more important than the health and safety of the people who work and learn in your fume hood laboratory. One of the best ways to ensure the health and safety of your employees is adhere to OSHA requirements. Not only is adhering to OSHA requirements good practice, it's also the law.

Laboratory safety guidelines are provided in 29 CFR 1910, 1450, Occupational Exposures to Hazardous Chemicals and Laboratories.

According to OSHA regulations, fume hood laboratory personnel must participate in formal training before using fume hoods. In addition, regulations stipulate that the proper use of fume hoods must be addressed in formal meetings held several times per year.

Your organization must also write a Chemical Hygiene Plan to meet OSHA requirements. This plan must include:

- Standard operating procedures
- Work practices
- Prevention of hazardous chemical overexposure

Specialty fume hood

The Chemical Hygiene Plan must include fume hood education and training, medical consultation, record keeping, respirators, and hazardous identification.

OSHA regulations 29 CFR 1910 subpart B stipulate acceptable exposure levels of hazardous chemicals and contaminants.

Each hazardous chemical must be identified, and a Materials Safety Data Sheet must be written for each chemical. The Materials Safety Data Sheets must be made available to each person working or learning in the fume hood laboratory.

The Materials Safety Data Sheet lists:

- The name of the chemical
- Health hazards associated with the chemical

- Safe handling and use instructions
- Protective equipment requirements
- Spill clean-up procedures
- Emergency procedures

To further ensure fume hood safety, OSHA requires that all chemical fume hoods are fitted with an indicating manometer. A manometer is a detection device that measures the amount of pressure when the correct amount of air is drawn out of the fume hood. A drop in the pressure indicates that the fume hood is not operating properly, and must result in the fume hood being shut down and tagged until it has been fixed and inspected. A quick drop in air pressure indicates a potentially serious safety hazard, and emergency protocols should be followed.

If you want to take safety to the next level, you could employ an alarmed manometer. Traditional manometers rely on humans to read them. To increase safety and not have to rely on people paying attention, new technology allows an alarm to be attached to the manometer. Instead of the person using the fume hood having to periodically check the pressure gauge, the alarm sounds if pressure drops into the danger zone. This ensures that the user is made aware of potential problems as soon as possible, and is exposed to the minimal amount of risk in the event of a malfunction.

Custom walk-in fume hood

Types of Fume Hood Laboratory Furniture

While fume hoods and other types of specialized equipment used for learning, research or manufacturing often takes center stage in the laboratory, laboratories are also home to many different types of furniture. Here is an overview of furniture designed specifically for the lab environment.

Cabinets: Cabinets serve as storage units. There are several different kinds of laboratory cabinets:

- Chemical cabinets are designed to withstand the specific chemicals that will be stored in them. They may be anti-corrosive, made out of fire-retardant materials, lined with glass, or have other safety properties.
- Mobile cabinets are wheeled structures with drawers and shelves, designed to be moved from station to station.
- General cabinets serve as general storage for the laboratory and can be custom built or standard.

Carts: Carts are wheeled pieces of furniture with flat tops. They are ideal for more easily moving equipment and volatile substances from one workstation to another.

Casework: Casework is a term used to describe built-in cabinets. These can be built according to lab specifications and dimensions, and come in a variety of materials depending on the type of work being done in the laboratory.

Workbenches: Experiments, research and tests are done on long workbenches. Workbenches come in a variety of different materials depending on the lab's specialty, but are typically heat and corrosion resistant.

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Modular Casework: Modular casework has the look and feel of built-in cabinets, but is able to be moved without massive deconstruction. Modular casework is a flexible, cost-effective option for those with growing labs, or for those who see renovations in the future.

When choosing casework for your fume hood lab, consider these five benefits of modular casework:

Benefit #1: Modular casework is flexible. In today's modern laboratory, needs change quickly. Because modular casework isn't fixed, it can be quickly and easily disassembled for relocation and reconfiguration as the laboratory evolves. This reduces the cost associated with typical fume hood laboratory renovations, as major construction is not needed.

Benefit #2: Modular casework is quick and easy to install. Typical millwork requires on-site production. Modular casework, on the other hand, is typically produced in a factory, then shipped ready to install. When the casework arrives, anyone with basic construction skills can install them with tools in a short period of time. With modular casework, installation time can be cut in half.

Benefit #3: Modular casework looks custom-designed. Because it's factory produced, many people erroneously believe that this type of casework is "cookie cutter." Nothing could be further from the truth. This type of casework can be designed to meet your lab's specific design needs, and can be customized according to size, color, material, and style.

Laboratory Furniture Glossary

This helpful glossary will help you better discuss laboratory furniture with laboratory planners and designers.

ADA – Americans with Disability Act. There is now a wide variety of laboratory furniture designed to conform to ADA guidelines.

BIFMA – BIFMA stands for the Business and Institutional Furniture Manufacturer's Association.

Base Cabinet – A case that is mounted to the floor and typically contains a surface. Base cabinets can have doors or drawers or can be open, and are typically used for storage.

Best Practices – The act of choosing high-quality manufacture and installation of laboratory furniture, including those that conform to SEFA-8 Recommended Practices.

Cabinet Depth – The measurement of a cabinet from back to front.

Cabinet Height – The measurement of a cabinet from top to bottom, excluding the surface.

Cabinet Width – The measurement of a cabinet from one side to the other.

Casework – A general term used to describe laboratory furniture including base cabinets, wall cabinets, display cabinets, and storage cabinets, as well as desks and counters.

Composition Core – A core material of furniture comprising particle board.

Counter-Mounted Cabinet – A cabinet that is mounted on a shelf or work surface.

Cupboard – The part of the cabinet that has no drawers. May or may not be enclosed by doors.

Combination Unit – A cabinet that features both drawers and doors.

Drawer – A box in a cabinet that is opened and closed by pulling or sliding.

Free-Standing – Furniture that stands alone, and is not mounted to other surfaces, walls, or cabinets.

Hardware – Materials used in cabinet making, such as hinges, pulls, and screws.

High-Pressure Laminate – Decorative sheets of thermosetting laminate used in the manufacture of casework.

Laminate – A material that is made from one or more layers of materials being bonded together.

Levelers – Hardware that enables cabinets and casework to be vertically adjusted to level.

Medium Density Fiberboard (MDF) – A type of building material made by bonding wood fibers together with heat and pressure.

Particleboard – A type of panel that is made when particles, often wood, are joined together with a binder.

Rack Resistance – The ability of a desk or table to remain stable under stress.

Removable Back – A panel on the back of a cabinet that can be removed to gain access to plumbing.

Shelving – A flat, open surface designed to store items.

Table – Any type of furniture with a flat horizontal surface.

Tall Cabinet – A floor-mounted cabinet that stands 84 inches high.

Wall Cabinet – A cabinet that is mounted on a vertical surface, such as a wall or panel.

Work Surface – A horizontal surface placed on a table or base cabinet.

Benefit #4: Modular casework is easy to repair. Fixed casework usually requires on-site repairs that can be costly and time-consuming. Because modular casework is designed to have features that can be disassembled then reattached, repairs to hinges, doors and drawers are simple.

Benefit #5: Modular casework has tax benefits. Traditional fixed casework is considered a permanent structure, and requires 39 years to depreciate. Modular casework is considered furniture, so depreciates over the course of seven years.

An installed group of fume hoods and assorted lab furniture

Is it Time to Repair or Replace Your Fume Hood Lab Furniture?

One of your goals is to ensure that your chemical laboratory operates efficiently. But in order to operate efficiently, equipment and design must meet modern standards. If your furniture is old, in disrepair, or no longer complements your laboratory design, it could be having a negative impact on its efficient operation.

1. The fume hood lab furniture is damaged. Some laboratory furniture can be repaired with basic woodworking and refinishing. In other situations, laboratory furniture is beyond repair. If your laboratory furniture is in disrepair, make plans to fix or replace it. Laboratory furniture in poor condition makes for an inefficient laboratory.

2. The laboratory furniture is uncomfortable. If seats are too high, or furniture is so large that it minimizes space, it may be time to replace your fume hood lab furniture. Today's ergonomic laboratory furniture makes for excellent learning environments.

3. The furniture no longer meets the requirements of your processes. Chances are, your laboratory's needs have changed over the years. If your laboratory is operating with furniture designed for different processes, it's time to update it. Choose furniture that works with modern equipment and processes, and you'll notice efficiency increase.

4. The furniture is out of style. If the laboratory furniture is so outdated that it doesn't comply with your more modern laboratory's aesthetic, it's time to replace it. Fortunately, today's laboratory furniture manufacturers make lab furniture in a wide variety of styles and colors. Today, it's easy to find fume hood lab furniture within your budget that suits your design needs.

Taking Control of Your Fume Hood Laboratory Remodeling Budget

No matter how good your planning and intentions are, it's easy for a fume hood laboratory remodeling project to go quickly over budget. Here are some tips that will help you remodel your fume hood laboratory without breaking the bank.

1. Develop a plan, and stick to it. Work with experienced planners and designers to determine exactly what you will need for your fume hood laboratory now and in the future. Then, determine a budget that will help you realize your plans. Once you set your budget, share it with your designer and contractor and ask them to work within these figures.

2. Consider long-term expenses. In addition to your immediate expenses, think about long-term expenses and how that will impact your fume hood laboratory remodeling choices. For example, if you're interested in reducing costs associated with energy usage, it may make sense to spend on fume hoods that use less energy to realize more sustained cost savings.

3. Consider the long-term needs of your fume hood laboratory. Plan your laboratory so that it will be able to evolve with minimum expense. For example, one great way to allow for quick, cost-effective remodels in the future is to choose modular casework. Modular casework may look fixed, but it's designed to be easily moved and reconfigured without major reconstruction.

4. Repurpose current equipment. While you'll likely need new equipment and furniture for your remodel, take a careful look at current equipment and salvage what you can. You may find that some of your current furniture can be repurposed to fit into your new design, which will save you money.

About Labscape

Labscape has established itself as a leading sole source supplier of the industry's finest wood, plastic laminate, and metal casework. We strive to provide only the highest quality products to academic environments, research and development companies, and medical settings. Our goal is not only to achieve unequivocal excellence in our casework, but in all aspects of our company. Working with Labscape ensures customers of the durability, functionality, and reliability that they deserve and demand every time.

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