



# The Basics of Laboratory HVAC



This is one in a series of short, topical guides to help people who work in laboratories where chemicals are used to better understand the general aspects of laboratory ventilation and to improve laboratory safety. Guides on other laboratory ventilation topics can be found at the **American Chemical Society Committee on Chemical Safety (CCS) website**.

## What is Laboratory Ventilation?

Laboratory ventilation is part of the building's heating, ventilation, and air-conditioning (HVAC) system. Modern laboratory HVAC systems are complicated enough to require computer controls, and their design assumptions often place limits on the chemistry you can do safely in your laboratory. Laboratory HVAC systems assume that chemicals are used in small quantities and may also assume that work is done during certain hours. To protect yourself effectively against airborne contaminants such as volatile organic compounds (VOCs), it is essential for you to understand the basics of laboratory ventilation.

## What Does My Laboratory Ventilation System Do?

Your laboratory ventilation system does many things. Two of the most important are:

- Supplying a measured amount of outside air and circulating it in a specific direction to dilute fugitive contaminants in laboratory air, thereby minimizing your inhalation exposure; and
- Providing a comfortable range of humidity and temperature for you, your equipment, and the science you are conducting.

## How Does My Laboratory Ventilation System Work?

For a basic understanding, think of laboratory ventilation as following the simple equation:

$$\text{air in} = \text{air out}.$$

Air usually enters the room through inlet vents, often in the ceiling. These can be identified by the supply air diffusers (Figure 1), which are designed to spread the inlet air throughout the room.

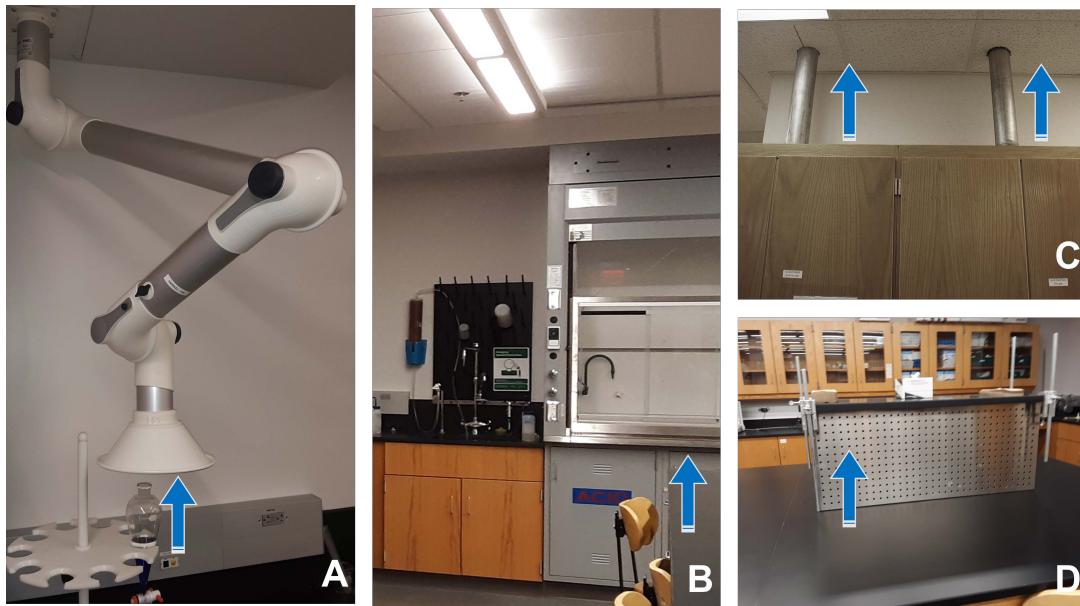
Outside (supply) air enters the building and is conditioned for temperature and sometimes humidity after basic filtration to remove outdoor dust particulates. In a well-designed system, 100% fresh outside air is used for supply air. In a typical laboratory, the room air pressure is set lower than the air pressure outside the room, by having more air exhausted from the room than is supplied. This negative pressure helps to contain any odors or spills within the laboratory.



Figure 1.

Typical outside supply air diffuser found in a laboratory HVAC system. (Image courtesy of CCS.)

Air exits the laboratory through a system of exhaust vents, which can include simple louvered covers, local exhaust points, and chemical fume hoods (Figure 2). Because ventilation systems in laboratories are connected to the building's HVAC system, facilities managers often need to balance airflow in several parts of the building to deal with a single reported temperature or odor problem.



**Figure 2.**

Common ways in which air is exhausted in a laboratory or chemical storage area HVAC system: (A) a snorkel, (B) a chemical fume hood, (C) vented storage cabinets, and (D) a tabletop downdraft. Blue arrows indicate direction of air flow. (Images courtesy of CCS.)

## Why Are the Air Inlets and Exhausts of My HVAC System So Far Apart?

The air inlets and exhausts of your HVAC system are positioned so that the air will move linearly to sweep through the entire room, thus avoiding dead zones or areas of recirculation. When mixing is inadequate (often because of the placement of equipment or chemical processors), contaminants and heat can build up in the air. This can potentially influence your experimental results or expose you to higher chemical concentrations than are appropriate.

## Why Am I Encouraged to Lower the Hood Sash?

1. Having your fume hood sash closed at all times (other than during setup)—or kept as low as possible—reduces the possibility of chemical vapor escape and personal exposure.
2. The sash provides a physical barrier between you and your chemistry. It protects those working in the laboratory should an experiment go wrong.
3. A closed fume hood sash conserves energy. In most laboratory buildings, the HVAC system is the single largest user of energy. Some traditional fume hood systems consume as much energy as 3.5 households.<sup>1</sup> Modern systems are more energy-efficient but are still significant users of energy. Much of this energy use is a result of unnecessarily exhausting air that is uncontaminated and conditioned. Modern ventilation systems have sophisticated controls that save up to 50% less energy when the sash is lowered to the fully closed position.

Keeping fume hood sashes in the lowest practical position protects the laboratory occupants, saves energy and money, and reduces the laboratory's carbon footprint.

## Who Is Responsible for Maintaining the Ventilation System?

Laboratory workers should create a well-informed ventilation “village”. This village includes students, researchers, educators, environmental health and safety professionals, and facilities staff. Ongoing communication between these individuals is key to ensuring that equipment is operating properly and providing fresh air in the laboratory. Environmental health and safety professionals should work closely with facilities staff to ensure that worker safety is always first and foremost when considering changes to the ventilation system.

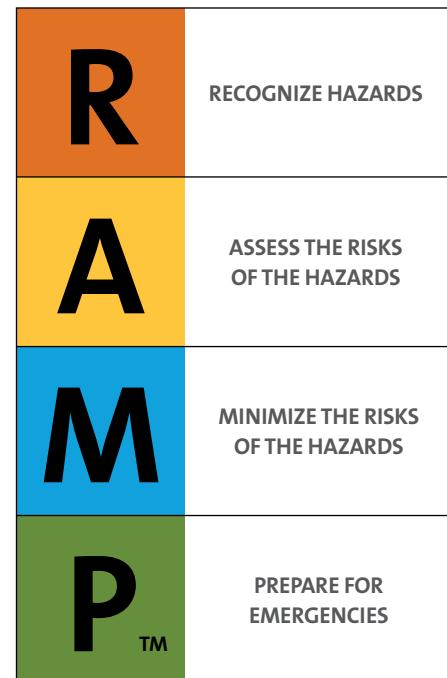
## How Does Laboratory Ventilation Fit into RAMP?

RAMP is an acronym for the process to Recognize hazards, Assess risk, Minimize risk, and Prepare for emergencies. It is the organizing principle for managing risks in laboratories. As part of the M in RAMP, laboratory ventilation is an engineering control that provides one important way to minimize chemical risks in the laboratory. Many volatile laboratory chemicals have some degree of toxicity.

Ideally, when a volatile and potentially toxic chemical is recognized, the risk can be assessed by measuring exposure (usually done by an industrial hygienist) and comparing it with the exposure standard for that chemical. Because of the paucity of information on toxicity and safe exposure, hazard recognition and risk assessment are often difficult. Therefore, ventilation is the key to minimizing risks from many volatile laboratory chemicals.

### More Information:

- See other Tip Sheets in the Ventilation Series at [acs.org/ccstipsheets](https://acs.org/ccstipsheets).
- A short video, [“Lab Worker’s Guide to Better Ventilation”](#), is available on YouTube.
- A recommended and more detailed overview of laboratory ventilation can be found in Chapter 9 of [Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards, Updated Version](#).



<sup>1</sup> Mills, E.; Sartor, D. Energy Use and Savings Potential for Laboratory Fume Hoods. *Energy*. 2005, 30 (10) 1859-1864. <https://doi.org/10.1016/j.energy.2004.11.008>.