UMassAmherst | Environmental Health & Safety

Fume Hood Fact Sheet

In a lab, the fume hood is used to protect the researcher from toxic substances that may be inside. A constant air volume (CAV) fume hood does exactly what its name implies; it pulls a constant volume of air through the duct work at all times. The variable air volume (VAV) fume hood relies on a moveable valve (i.e., damper) system to change the air flow depending on the sash height. There are also many other types of specialty fume hoods, which can be found in a few labs. This guide specifically goes through the VAV, CAV, and perchloric acid fume hoods to help your lab decide which type of fume hood it may be equipped with and how it functions.

CAV

The CAV is only used in certain labs on campus. These hood will have a blue service sticker (seen on the right) on them, indicating they are a CAV. Since the HVAC system pulls a constant amount of air, the factor that controls the face velocity is the sash opening. The face velocity is inversely proportional to the sash height (i.e. the higher the sash is, the lower the face velocity). Many older labs are equipped with these types of hoods, but some newer labs that have higher hazards or a specific need for one will be designed with a CAV.

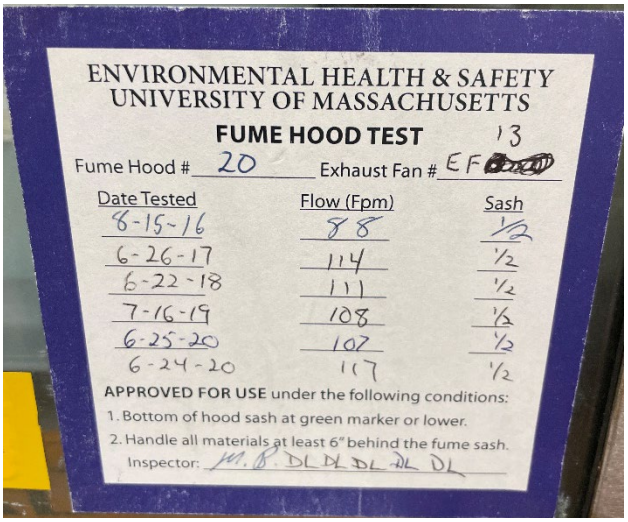

Figure 1. Blue sticker on a CAV fume hood on campus.

Pros of a CAV

- Have a constant air flow, so they can be used for special projects that may need higher constant airflow.
- Are easier to install and operate as they do not require installation of valves, actuators, and flow controllers.
- Less susceptible to break downs as there are less moving parts.

Cons of a CAV

- A CAV utilizes a large amount of energy as it is always pulling a constant volume of air. This leads to larger costs over time.
- A CAV can cause temperature fluctuations in the lab.

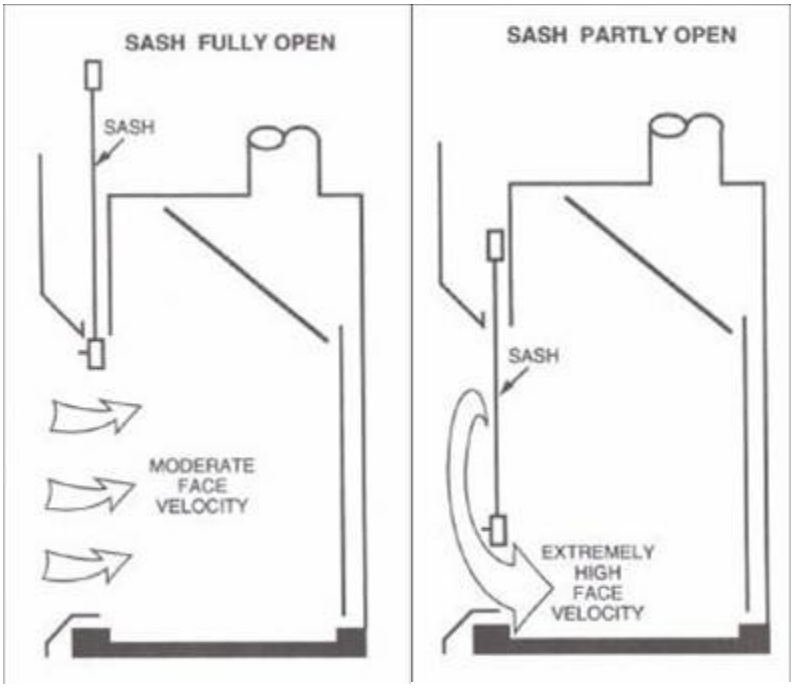

Figure 2. Visual representation of how a CAV works, with the sash opening determining the face velocity of the hood.

VAV

The VAV is used in most labs around campus, and is the primary type of hood installed in new lab construction/renovations. These will be found with red service stickers (seen on the right), indicating they are a VAV. These fume hoods utilize a moveable damper in the ductwork to maintain a constant face velocity by varying the air flow. These hoods rely on the position of the sash to change the air volume to maintain a safe and constant face velocity. These hood are energy efficient when used properly, and the sashes should be closed when the hood is not in use to utilize this energy savings.

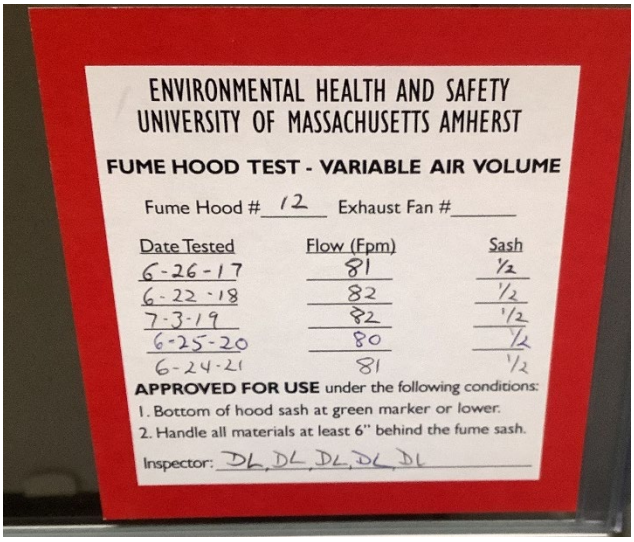

Figure 3. Red sticker on a VAV fume hood on campus

Pros of a VAV

- High energy savings over time as the air volume is changed based on sash height.
- Using a VAV is better for the environment overall, leading to less carbon emission by using less energy.
- A VAV system does not affect the temperature of the lab, leading to more comfort.

Cons of a VAV

- A VAV is more expensive to initially install as it requires more parts and components in the duct work.
- VAVs are also more prone to mechanical failures because of these added parts, including actuators and flow controllers.

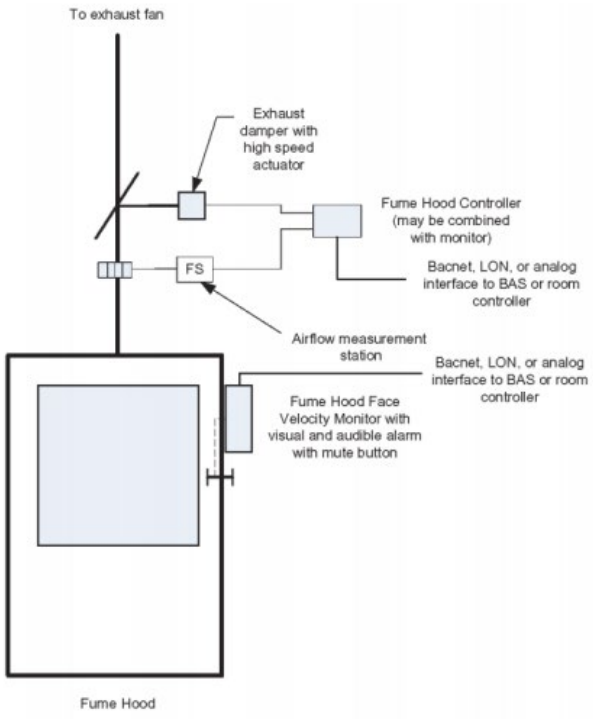

Figure 4. Visual representation of how a VAV works, with the damper controlling the volume of air flow.

Perchloric acid fume hood

One final common fume hood found on campus is a perchloric acid fume hood. As its name implies, it should be used when handling perchloric acid. Special considerations must be used when using high concentrations of perchloric acid frequently as well as heating, because constant digestions with this material can lead to degradation of the fume hood and duct work and deposition of potentially explosive metal perchlorate salts. Thus, these hoods are required to be manufactured with materials that will not degrade, and the ductwork used to complete this construction is to be the same. A wash down procedure must be completed after use to minimize the risks of forming perchlorate salts, which are shock sensitive and unstable. It is also very important to use only compatible materials (i.e., never organic solvents) in these hoods as perchloric acid and metal perchlorates can react with many organic compounds to yield explosive and unstable compounds. Please consult the EH&S guide for using perchloric acid when needed.

Types of Ductwork Used In Fume Hoods

The international mechanical code and national fire protection association helps to govern what types of materials can be used in the duct work of a fume hood. There are several common types of materials used for duct work connected to a fume hood. Determining the work present in the lab will dictate what kind of duct work should be installed for the fume hood, and in turn, the duct work can place limitations on the type of work that is appropriate to conduct in a particular hood.

Galvanized Steel

Older fume hoods on campus tend to have galvanized steel ductwork. This duct work is not welded at the seams because this would destroy the oxidatively protective zinc coating, and therefore, positive pressure in the system could lead to leakage through the seams. As such, it is particularly important for these systems that the fan providing exhaust for the fume hood is placed on the roof of the building to prevent having runs of ductwork in occupied spaces that is positively pressurized. Galvanized steel also can become compromised over time, especially if continuously exposed to corrosive materials, like acid

fumes, which can quickly react away the zinc coating. For these reasons, galvanized steel is seldom used in new lab renovations or construction on campus.

Stainless Steel

The most common material used in renovated or newly constructed hazardous exhaust on campus is stainless steel (and typically 316 stainless). This material is much more expensive than galvanized steel, and it stands up well against solvents used in a typical fume hood environment as well as the heat of vapors that may be travelling through the duct work. Stainless will also tolerate regular use of corrosive materials, however, if heavy work with corrosives (e.g., acid digestions) is performed regularly, the duct may become compromised over time. In those situations, in-line scrubbing of process exhaust to remove corrosive vapors prior to discharging to the hood or different duct work should be considered. Stainless steel duct work is also typically welded so that it is seamless. This provides added assurance against leakage even if the duct work were to become positively pressurized.

Plastic or Coated

If working with many corrosives (i.e. acid digestions), plastic or polymer/glass lined duct work is typically the best choice. PVC is generally used when there is little to no use of solvents as it is cost-effective, rigid, and durable. While tolerant of corrosives, PVC and other plastic ductwork can degrade with exposure to solvent vapor, and it is also inherently less fire resistant than metal duct work. Combined use of solvents and heavy corrosive use can necessitate the use of polymer/glass-lined metal duct work, which can be rather expensive and difficult to install. As such, it is usually preferable to separate the use of material or scrub the process exhaust prior to discharging to the fume hood to avoid the need for this.

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2015 International Mechanical Code (IMC)