# VIRGINIA COMMONWEALTH UNIVERSITY
# STANDARD OPERATING PROCEDURES

# CHEMICAL FUME HOODS

OFFICE OF ENVIRONMENTAL HEALTH AND SAFETY
CHEMICAL AND BIOLOGICAL SAFETY SECTION
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## Standard Operating Procedures

## Chemical Fume Hoods at VCU

**1. Definition.** A chemical fume hood is a partially enclosed workspace that is exhausted to the outside. When used effectively, hazardous fumes, gases, and vapors generated inside the hood are captured before they enter the breathing zone. This serves to minimize employee/student exposure to airborne contaminants. The Chemical and Biological Safety Section (CBSS) of OEHS recommends the use of a fume hood during the following situations:

a. When handling chemicals with significant inhalation hazards such as toxic gases, toxic fumes, toxic chemical vapors; volatile, radioactive material; respirable toxic powders; and nanomaterials.

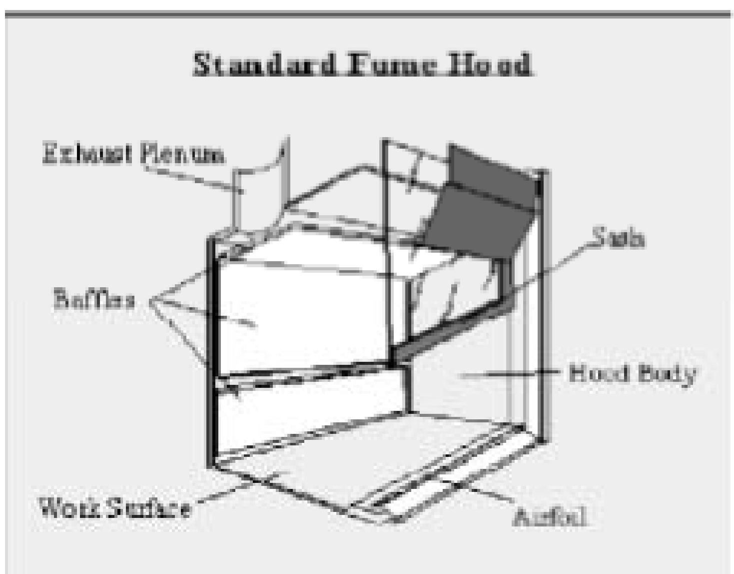
b. When carrying out experimental procedures with strong exothermic reactions.

c. When handling chemicals with significant vapor pressure.

d. When chemical vapors generated could create a fire hazard.

e. When working with compounds that have an offensive odor.

**2. Hood Design.** The common parts of a fume hood and their major functions are:




a. **Airfoil.** Found along the bottom and side edges, airfoils streamline airflow into the hood preventing the creation of turbulent eddies that can carry vapors out of the hood. The space below the bottom airfoil provides a source of room air for the hood to exhaust when the sash is fully closed.

b. **Baffles.** Moveable partitions used to create slotted openings along the back of the hood body. Baffles keep the airflow consistent across the hood opening, thus eliminating dead spots and optimizing capture efficiency.

c. **Exhaust plenum.** Helps to distribute airflow evenly across the hood face. Materials such as paper towels or filter paper drawn into the plenum can create turbulence in this part of the hood, resulting in areas of poor airflow and uneven performance.

d. **Face.** The imaginary plane running from the bottom of the sash to the work surface. Hood face velocity is measured across this plane.

e. **Hood body.** The visible part of the fume hood that serves to contain the hazardous vapors and gases.

f. **Sash.** By using the sash to adjust the front opening, airflow across the hood can be optimized for maximum capture. Each hood is marked with the best sash configuration. The sash should be held at this position when work involving the fume hood is performed and closed completely when the hood is not in use.

g. **Work surface.** Generally considered laboratory bench top, this is the area under the hood where chemicals and apparatus are placed for use.

**3. Hood Types.**

**a. Conventional fume hood.** This term is used to describe a constant air volume (CAV) hood; an older, traditionally less elaborate hood design used for general protection of the worker. Because the amount of exhausted air is constant, the face velocity of a CAV hood is inversely proportional to the sash height. That is, the lower the sash, the higher the face velocity.

b. **Variable air volume hood.** Variable air volume (VAV) hoods differ from constant air volume (CAV) hoods because of their ability to vary air volume exhausted through the hood depending on the hood sash position. Variable air volume hoods are becoming the preferred hood due to the elimination of excess face velocity that can generate turbulence leading to contaminated air spillage and potential endangerment of the worker. A VAV hood maintains a constant face velocity regardless of sash position. To ensure accurate control of the average face velocity, VAV hoods incorporate a closed loop control system. The system continuously measures and adjusts the amount of air being exhausted to maintain the required average face velocity. The addition of the VAV fume hood control system significantly increases the hood's ability to protect against exposure to chemical vapors or other contaminants. Many VAV hoods are also equipped with visual and audible alarms and gauges to notify the worker of hood malfunction or insufficient face velocity.

**4. Hood Uses.** Chemical fume hoods are approved for three types of uses: general purpose, radioisotope, and perchloric acid. Hoods approved for each of these uses will appear similar but require different functional and operating parameters.

a. **General purpose hoods,** the most common type, are used to prevent exposure to toxic, irritating, or noxious chemical vapors and gases.

b. **Radioisotope hoods** are ideally made from welded stainless steel to ensure against absorption of radioactive materials.

c. **Perchloric acid hoods** have limited functional ability and are designed to prevent the buildup of explosive perchloric salts within the exhaust system. Researchers heating perchloric acid must use a perchloric acid hood. There are currently dedicated hoods located on both campuses. For information on these hoods, contact CBSS at 828-1392.

**5. Fume Hood Operating Guidelines.**

a. All university fume hoods should be posted with the hood's face velocity at a specified sash opening. This is the average velocity of air that is carried across the face of the fume hood measured in linear feet per minute (fpm). The CBSS requires a face velocity of 80 to 120 fpm ± 3%, and certifies and posts these velocities on the hood annually (unless by request). Due to exhaust ventilation system constraints, hoods located within the Hermes A. Kontos Medical Sciences Building (KSB) will be evaluated against a face velocity range of 80 to 150 fpm ± 3% at a sash opening of 18 inches. As with hoods in other buildings, if a KSB hood fails to achieve an acceptable face velocity at a sash opening of 18", the sash may be lowered to not less than six inches to achieve an acceptable face velocity. If the hood cannot achieve an acceptable face velocity with the sash lowered to six inches, the hood will not be certified and a work order placed.

b. If a "CAUTION" sign is posted, laboratory personnel should not work in the hood until the face velocity has been adjusted by the VCU Facilities Management (8-9444) and the hood retested and certified by CBSS. However, a PI may conduct a risk assessment of materials and operations performed within the hood and authorize use of the hood where those materials or operations present minimal risk to laboratory personnel.

c. Perform work with the sash no higher than the height indicated by the label. The sash should be kept closed with the hood in operational mode when not in use.

d. Place chemical sources and equipment as least six inches behind the face of the hood. Applying tape across the work surface at the six-inch line will help as a reminder. The possibility of exposure to contaminants is greatly increased if work is performed at the face of the hood rather than behind the six-inch mark. Laboratory researchers should never extend their head inside the hood while experiments are being performed.

e. Large pieces of equipment in the hood may cause dead space and should not be used in the hood. Large equipment such as gas chromatographs that emit gases or fumes should have dedicated hoods or other ventilation devices designed for their specific use. Keep fume hoods and adjacent work areas clean since solid debris can enter the hood's exhaust ductwork.

f. Do not store chemicals in a fume hood unless storage is the sole use of the hood. Only those chemicals necessary to perform the experiment should be left in the hood.

g. Foot traffic, local ventilation systems, windows, and doors may cause air currents to form across the face of the hood which may reduce the hood's performance by pulling air out of the face of the hood and into the breathing zone. Foot traffic and rapid body movements should be avoided at the face of the hood. These air currents create vectors which can disrupt the directional airflow through the face of the hood potentially exposing workers.

h. Do not make any modification to the local exhaust ventilation system without getting an approval from CBSS and VCU Facilities Management first. Any changes made to the system may result in unsafe conditions and may directly affect other ventilation systems in the building.

i. Prevent pollution. The fumes, gases, and chemical vapors generated in most hoods are exhausted into the atmosphere. To minimize pollution, cap and/or seal all chemical containers when not in use. Never use the hood to vent or evaporate excess chemical waste. By law, all chemical containers must be capped when the hood is not operating and evaporation is not a permissible means of waste disposal.

**6. Instruments.** OEHS uses a CompuFlow Thermo-anemometer 8570 to measure the airflow velocity during the assessment of a fume hood. This is a hand-held microprocessor digital instrument that measures velocity up to 9999 fpm ± 3% of reading. The instrument can store more than one thousand readings and display the average on demand. The thermo-anemometer electronically calibrates itself but will be calibrated by Alnor at least once annually to maximize the long-term accuracy.

**7. Fume Hood Assessment Procedures.**

a. Chemical fume hoods are assessed on a biannual basis to ensure:

1. Appropriate storage within the hood.

2. There is no damage to the hood.

3. Proper sash function and position.

4. Acceptable face velocity of 80-120 fpm ± 3% in accordance with ANSI/AIHA Z9.5 and ASHRAE 110 guidelines (except as noted for KSB).

b. An Alnor Thermo-anemometer 8570 is used to measure the hood's face velocity.

1. Position the sash so that the fume hood opening is twelve inches.

2. Divide the fume hood opening into twelve equal notional sections (4 x 3 grid) and take velocity measurements at the center of each notional section.

3. Turn the Alnor Thermo-anemometer on to check the battery and reset the instrument. Measure the velocity of the air at the center of each of the twelve notional squares. This is accomplished by placing the probe of the Alnor at the center of each square in line with the sash. Allow the Alnor time to stabilize between readings. When a fairly constant reading is displayed by the Alnor, push the "enter" button, then release to add values. This will display and enter the reading into the Alnor's memory and display the number of measurements taken. This reading is then entered into the AIM hood evaluation form. Continue taking readings and storing them into the Alnor's memory until all twelve measurements are completed. After the twelfth reading, view the average by pressing the Alnor's "average" button and noting the result. Once the average face velocity is noted on the inspection sticker, press the "enter" button to clear the memory and reset the instrument. The average face velocity reported by the Alnor for each hood must be entered into the appropriate AIM form.

c. If the average velocity at a twelve inch sash height is above 120 fpm, raise the sash to a maximum of 18 inches and repeat the assessment procedure. If the velocity exceeds 120 fpm (allowing for accuracy of the instrument, the maximum acceptable average reading is 124 fpm) at 18 inches, the hood will not be certified until serviced (exceptions apply to the KSB discussed in paragraph 5).

d. If the average velocity at a twelve inch sash height is below 80 fpm (allowing for accuracy of the instrument, the minimum acceptable average reading is 78 fpm), lower the sash to a minimum of six inches, and repeat the assessment procedure. If the velocity is less than 80 fpm at six inches, the hood will not be certified until serviced and achieving appropriate face velocities.

e. If the hood does not pass inspection, a "Caution" sign will be placed on the hood's sash indicating the problem(s) and the date of inspection. OEHS will submit a work order to Quick FM for repair. The CBSS hood inspector will contact either the PI or laboratory manager to explain and discuss the reason for the failure, that OEHS will submit a work request for adjustment of the hood, and that work may continue within the hood based upon the PI's assessment of risk relating to chemicals, biological hazards, or operations carried out in the hood.

f. Hoods approved for use will display a label on the hood's right side, indicating the designated working height of the sash, face velocity at the time of the inspection, inspector's initials, and date of inspection. Inspections are valid for one year from date of the last inspection, unless issues arise such as no/low flow or excessive noises in which case the hood may be re-inspected upon request. Reports noting the results of the inspection will be sent to PIs within seven calendar days of completion of the inspection.

g. iPad hand held devices along with the appropriate AIM inspection form(s) will be used to assess laboratory hoods.

For questions regarding this or other health and safety issues, contact OEHS at 828-1392.

# CAUTION

**This hood has not passed inspection by OEHS for the following deficiency(ies)**

- ☐ Storage: excessive materials inside hood.
- ☐ Damage: physical damage to the hood.
- ☐ Function: ability of the sash to open, close, and/or stay in a stationary position; or improper airflow of _______ fpm.
- ☐ The required airflow should not be less than 80 fpm or exceed 120 fpm.
- ☐ Other: ______________________________________________________.

OEHS will place a work order for damage, function, and/or improper airflow deficiencies.

OEHS: _______________________________________

DATE: _______________________________________

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DATE: _______________________________________