Fume Hood Standard

A fume hood is an enclosed working chamber fitted with an exhaust ventilation system. It is one component of an exposure control system which is designed to contain, dilute and disperse gases, vapours and aerosols to the external environment. It is also an integral part of the building air handling system.

The fume hood is the primary control device in most laboratories for protecting employees and students from exposure to hazardous chemicals. The efficiency of operation is essential in maintaining good air quality in laboratories. It is therefore imperative that it function properly and that it be used appropriately. This standard was developed with reference to the Canadian Standards Association (CSA) Standard Z316.5-04(R2009) (Fume Hoods and Associated Exhaust Systems).

Application:

This standard applies to constant air volume (CAV) and variable air volume (VAV) fume hoods found in any University of Toronto building. Specialty fume hoods such as Walk-in, Radioactive materials, Explosion-Proof and Perchloric Acid fume hoods require special design considerations that are dealt with on a case-by-case basis through Property Management, Design and Construction, Facilities and Services, and the Office of Environmental Health and Safety (EHS). This standard is also intended to provide a standard for selection, installation, usage, and maintenance of the laboratory exposure control systems.

Recirculating Fume Hoods

Recirculating fume hoods are not recommended for protection from chemical hazards at the University of Toronto. Existing hoods of this type may continue to be used for low risk activities; however serious consideration should be given to replacement. Under no circumstances should recirculating hoods be used where materials of high or unknown toxicity have the potential to become airborne: for instance for volatile liquids with a known IDLH (Immediately Dangerous to Life and Health) concentration. Approval of new uses of recirculating fume hoods will be considered by EHS on a case-by-case basis.

Responsibilities:

The appropriate maintenance/engineering division on each campus or other business unit operating on UofT property shall:

- routinely inspect and adequately maintain all exhaust systems (ducting, exhaust fans and exhaust stacks);
- respond when notified of a system malfunction;

- provide appropriate service for malfunctioning fume hood cabinets (working chambers) --- eg. repair malfunctioning sashes, etc.;
- ensure that new installations conform to system design specifications (see Appendix A – Technical Specifications).

Principal Investigators/Laboratory Supervisors and all others in authority shall:

- ensure that all fume hood users perform the necessary "Maintenance checks" on a routine basis (see User Guidelines);
- ensure that no work or experiments are conducted in a malfunctioning fume hood;
- ensure that all fume hood users follow prudent work practices when operating fume hoods (see User Guidelines).

Fume hood users shall:

- regularly inspect the physical condition of the hood interior and the mechanical services inside the hood and report malfunctions to the appropriate authority (see User Guidelines);
- routinely test (switch on monitor) the air flow monitoring device (if present) to assure functional status;
- rigorously follow prudent work practices (see User Guidelines).

The Office of Environmental Health and Safety shall:

- maintain this standard;
- provide advice and guidance on the selection and use of fume hoods;
- annually re-certify fume hoods and those alarm systems that can be certified by in-house personnel.

User Guidelines

User Maintenance Checks

- The efficiency of a fume hood is very dependent on its functional status and on how it is used.
- Users must ensure proper operation of fume hoods by performing the following **"Maintenance Checks":**
    - Inspect the physical condition of the hood interior, sash and visible duct work.
    - If available, use the vane anemometer or real time face velocity read-out on the alarm to ensure face velocity is between 80 and 130 fpm at the desired sash height.
    - Check sash for ease of operation.

- Test air-flow monitoring device if present.
- Check mechanical services inside the hood. (eg. water, steam, compressed air, gas, vacuum, etc.).
- In case of fume hood malfunction, do the following:
  - Discontinue use of fume hood, and boldly label it so that no others will use it until repaired.
  - Inform your supervisor.
  - Call the number that corresponds to the fume hood location.
    - St. George Campus at 978-3000
    - U of T at Mississauga at 828-5301
    - U of T Scarborough at 287-7579.
  - Report your name, phone number, exact location and reason for call.

When using a fume hood, one must remember that the hood does not provide absolute containment or absolute protection from the materials in the hood, however, a properly designed hood in a properly designed room can provide adequate protection if the following practices are observed:

Prudent Work Practices

- All work involving hazardous or odorous chemicals should be performed in a fume hood.
- All equipment and materials should be placed at least 6 inches back from the face of the hood; these items should not obstruct the movement of air into the hood.
- The sash should be used to minimize the size of the working aperture and to act as a safety screen. Adjust the sash height so that it is as low as is practicable while keeping the face velocity in the 80 to 130 feet per minute (fpm) range. Where sliding vanes are present the vanes should be slid open such that the same velocity range is obtained.
- Note that the annual recertification of hoods provides a label that will indicate the safe range of operation for the sash and for sliding panes (if present).
- One should use an appropriate barricade if there is a chance of an explosion or splashing of materials.
- One should not place one's head into the hood when contaminants are being generated.
- The hood should not be used as a storage area or overloaded with unnecessary equipment and materials. The presence of these materials can seriously affect the air flow in the hood. Suitable storage facilities can often be provided underneath the fume hood or in approved safety storage cabinets.
- The hood should not be used for long term (>1 week) storage of hazardous chemical wastes. To dispose of these wastes consult the pertinent procedures in your facility/campus. For additional information call the Office of Environmental Health and Safety at 978-7000 (St. George Campus).

- Electrical receptacles or other spark sources should not be placed inside the hood when flammable liquids or gases are present. Electrical connections should be made outside the hood and no permanent electrical receptacles should be permitted in the hood.
- Foot traffic past the face of the hood should be minimized. Air flow caused by such traffic can seriously disrupt the operation of the hood and cause gases and vapours to be drawn out of the hood into the room. Cross-draughts from windows and doors close to improperly located fume hoods will also affect the stability of the air flow within the fume hood.
- Keep the interior of the hood clean and tidy.
- Do not conduct work in a malfunctioning fume hood.

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Appendix A – Design and Technical Specifications

System Specification and Maintenance

The fume hood is one component of the exposure control system; its performance therefore cannot be judged in isolation from the rest of the system. The total system consists of: 1) the working chamber, 2) the exhaust system, 3) fume hood location, 4) make-up air to the fume hood, 5) system indicators, 6) operational parameters, and 7) system maintenance. The following specifications provide the standard for acceptable performance and efficiency of fume hood systems; all new installations shall conform to these specifications and existing installations should be brought to this standard as funding permits.

1. The Working Chamber

- ***By-pass type hood*** should be used when constant volume systems are required.
- ***A non-flammable, acid resistant interior***. The working chamber should be constructed of a non-flammable, acid resistant material.
- ***A back baffle system*** to more evenly distribute the air across the face of the chamber such that uniform air flow through the face of the hood will result.
- ***An airfoil*** along the lower edge and the tapered configuration on the other edges to provide the streamlined front entrance profile. It should be fabricated from type 316 stainless steel.
- ***A vertical sliding sash*** (with counter weights) to minimize the size of the working aperture and to act as a safety screen. The sash should be constructed of transparent glazing that is resistant to discoloration and crazing by age or exposure to chemicals. The sash may have additional sliding panes.
- ***A recessed work surface*** to retain spilled liquids. The work surface must be able to bear the weight of any equipment or radiological shielding material that is required.

2. The Exhaust System

The ducting shall:

- provide optimum air flows in the working chamber;
- be sized to minimize noise levels;
- avoid horizontal runs to minimize collection of corrosive condensates;
    - where horizontal runs exist, the ducts must slope at least 2.5cm per 3 metres downward in the direction of the airflow to a suitable drain;
- provide circular cross-sections to reduce the number of corners and crevices where corrosion might occur;

- The ductwork must be labelled with a unique identifier at the fan, at the exhaust stack, and at the hood itself. Where multiple hoods are on the same fan, the fan must be labelled with the identifier of all of the hoods that are connected to it.
- Construct all ductwork using type 316 stainless steel, welded construction, except where the chemicals used require compatible materials (ensure that these materials comply with the requirements of the Ontario Building Code and the Fire Code). Subject to EHS approval other types of construction may be used if they provide the same level of protection.
    - ***The exhaust fan*** shall be located so as to ensure that the exhaust ducting below the fan within the building remains at negative pressure, with the exception of the short ductwork on the positive side of the exhaust fan in the mechanical room. The fan/mechanical room shall be well ventilated:
    - ***Flexible coupling*** (linking the ductwork to the fan unit) must be constructed of a fabric which is highly resistant to a wide range of chemicals and environmental conditions (rated as "completely air-tight and moisture proof").
    - ***The exhaust stack*** shall be so positioned as to ensure that emissions are unable to re- enter the building or adjacent buildings.
    - ***Discharge stacks*** shall be connected to a properly installed trap and drainage system, not drain into the exhaust fan.
    - ***Environmental Certificate of Approval.*** Notwithstanding any of the above, the fume hood must meet all environmental Certificate of Approval (C of A) requirements. EHS will ensure that all needed modelling of exhaust is conducted and that any needed changes to the C of A are submitted.

3. Fume Hood Location

- A fume hood shall be located in such a way as to minimize risks to persons in the event of fire or explosion, and away from major traffic patterns (doorway, etc.) and major air patterns (air inlets and other sources of air disturbance) that produce cross-draughts.
- Supply-air diffusers in the laboratory shall be of the low-velocity style.

4. Commissioning

A newly installed fume hood must be tested before the area is released for use. Commissioning should be covered as part of the project cost, with assistance from EHS if needed. The tests to be conducted should include at a minimum a face velocity test at the three working opening 12”, 18” and fully open and at sliding pane openings of 1 pane and 2 panes (if present). Face velocities need to meet the standard of 80-120 fpm at one of the specified openings. In addition an ASHRAE 110 test should be conducted on the hood to determine if the fume hood is performing up to standard as installed with the HVAC running normally.

5. Make-Up Air to the Fume Hood

- Provide make-up air to replace air exhausted by the fume hood.
- The make-up air shall be at a suitable temperature to avoid wind chill effects.
- Supply-air diffusers shall be sited so as to maximize the general dilution ventilation of the laboratory without disturbing the air flow pattern in the fume hood. Diffusers should be placed at least 1.5m away horizontally from the face of the fume hood as per NIH guidelines. High velocity and linear slot diffusers should be avoided and it is preferred that the diffuser be placed to the side of the fume hood.

6. System Indicators

If the airflow in the system is not monitored, the hood operator may not be aware when a partial or complete failure of the exhaust system occurs.

- All new fume hoods shall be fitted with an alarming (audible & visual) air flow monitoring device.
- These monitors are required and part of the installed cost when new fume hoods are purchased.
- For complex variable air volume systems which include integrated controls and alarms, an audible and visual alarm system must be present at the face of each hood that warns of any system performance deficit.
- EHS reserves the right to determine if any such system is adequate.
- Preapproval of the alarm system before installation is the preferred process.
- Any installed alarm system must be capable of being calibrated by EHS on an annual basis.
- For inadequate systems the Department or Project may be required to install further equipment.
- Existing installations shall be retrofitted with an alarming air flow monitoring device.

Additional information about air flow monitoring devices may be obtained through the Property Manager for the building or by contacting the Office of Environmental Health & Safety at 978-4467.

7. Operational Parameters

- ***For a By-Pass Fume Hood (constant volume):***

  Air flow through the hood shall provide an average face velocity of 0.4 m/sec (80 ft/min) - 0.65m/sec (130ft/min) at a working sash height of 18 inches. The low end of the face velocity range provides for adequate capture of contaminants

generated within the hood while the high end of the range produces an air flow into and within the hood that is not excessively turbulent and therefore not likely to degrade hood performance.

- ***For a Variable Air Volume (VAV) Fume Hood (constant velocity):***
  Air flow through the hood shall provide an average face velocity of 0.4 m/sec (80 ft/min) - 0.65m/sec (130ft/min) regardless of sash height.

8. System Maintenance

If the system is not properly maintained, it will eventually fail.

- When installed or modified, and annually thereafter, fume hoods shall be inspected and tested. This inspection should include:
  - Visual inspection of the physical condition of the hood interior, sash, and visible ductwork;
  - Face velocity;
  - Air flow indicator system.
- The ducting, exhaust fans and exhaust stacks shall be adequately maintained.

9. Special Requirements – Hoods for Radioactive Materials

a. Fume hoods used for nuclear substances will be identified with the radiation warning sign.
b. Fume hood exhaust ducts must be marked with the radiation warning symbol at 3 metre intervals. The fan and exhaust stack must also be identified with the symbol.
c. If the fume hood is used for storage of nuclear substances, it will remain on at all times.
d. If the fume hood is to be used for continuous exhausting of radioactive substances:
   i. the exhaust fans will be connected to an emergency power system and;
   ii. the fume hood exhaust will not connect to other exhaust systems.
e. Fume hoods will not contain filters. If filtration is needed, then filter radiation monitoring and change out schedules must be confirmed with the Radiation Safety Officer.
f. The exhaust stack shall discharge vertically upwards at a velocity of at least 1.4 times the average wind velocity, and be so positioned as to ensure that emissions are unable to re-enter the building or adjacent buildings; the minimum recommended distance to any air intake is 15.24m. For new buildings, the stack height will be at least 3.05m above the highest point on any adjacent building, and the stacks will be downwind of any air intakes where possible to determine a prevailing wind direction.