

# University of Colorado - Environmental Health and Safety Guideline

## CRITERIA FOR INSTALLATIONS OF CHEMICAL FUME HOODS AND STORAGE CABINETS

**Laboratory ventilation** must conform with provisions of ANSI/AIHA Z9.5-1992 and current editions (at the time design begins) of other applicable codes and standards, including UCB Standards 15850 and 15880. Complete laboratory chemical and gas inventories must be submitted to the CU Environmental Health and Safety Department (EH&S) for review prior to system design. The following criteria have precedence over conflicting or vague information contained in other references.

**1. Ducts** for ventilating chemical fume hoods and flammable storage cabinets must be of galvanized steel construction or PVC-coated or stainless steel when used for corrosive or reactive chemicals. Duct work should be installed with a minimum of elbows, using round ducts and sweep ells wherever possible. To further minimize friction loss and turbulence, the interior of ducts should be smooth and free from obstructions, especially at joints. Installation of duct work must be in compliance with NFPA 91 and ANSI Z9.5, including provisions for properly sealing penetrations, grounding and sealing duct joints, and providing required clearances from combustible construction materials. Penetration of fire barriers should be avoided. In addition, requirements of NFPA 45 must be followed for installations of laboratory exhaust systems. Chemical fume hood ducts are generally not equipped with fire sprinklers or fire dampers, but wherever code requires, ducts shall be in fire-rated or fire-protected shafts. If multiple hoods are on the same fan system, each should be equipped with a balancing damper. Hazardous exhaust systems are not typically equipped with filters to capture contaminants. In some cases, however, prefilters may be installed to protect heat exchange coils or other HVAC equipment from accumulating debris. Consult with EH&S regarding filter specifications for hazardous exhaust systems.

**2. Fan systems** must be designed and installed to ensure that hoods, cabinets and ducts are under negative pressure all the way out of the building through unobstructed stacks with uncapped vertical discharges. Fan selection, stack height and discharge velocity determinations should give consideration to preventing the re-entry of contaminants into buildings. Fans must be roof mounted units with exhaust stacks terminating at least 10 feet above the roof-line, away from eddy currents, air intakes and openings. Discharge velocities should not be less than 3,000 fpm. HVAC and exhaust air systems will have to be balanced to ensure that the lab is under negative pressure with respect to the corridor while keeping the hood under negative pressure relative to the lab. Make-up air shall be provided to compensate for the air being exhausted. The location and volume of make-up air is critical to assuring proper fume hood operation and worker protection. Fan blades, housings and other components must be corrosion resistant and meet the AMCA standard for spark-resistant construction. The motor must be vapor tight (Class I, Division I) if it is located in the air stream. All fans, ducts, and power supplies should be clearly labeled to indicate exactly which areas they serve.

If a hood is to be tied into an existing central exhaust system serving multiple fume hoods, then the air system will have to be evaluated to see if it has sufficient capacity for the addition of other exhausted equipment. On/off switches are generally not provided on fume hoods. Hazardous exhaust systems should be provided with emergency backup power and not shut down upon activation of any alarm, however, dedicated switches may be provided in the building fire alarm panel to allow capability for manual fan shut-down by the fire department.

**3. Chemical fume hoods** must be capable of maintaining 120 fpm face velocity (see correction factor, section 6) through the sash opening with the sash door at 13 inches, measured from the top of the air foil. Sash stops should be installed to keep the sash from being raised above the point where the face velocity drops below 100 fpm, but stops shall not be placed higher than 18 inches above the hood working surface. Constant face-velocity fume hoods should be capable of maintaining 120 fpm at all sash heights below 18 inches. Hoods must be equipped with audible and visual airflow indicators, with the low-flow alarm set at 75 fpm face velocity.

Class I - Division I interior lighting and other electrical utilities are required where internal utilities are desired. Built-in ventilated chemical storage cabinets with spill-containment should be included in hood installations.

Storage cabinets must meet criteria outlined in the storage cabinet section below. In certain cases, depending upon the types and quantities of hazardous materials used, a fume hood fire suppression system may also be required. Sinks inside fume hoods must have a raised rim or other design feature which prevents accidental chemical releases to the sanitary sewer. Do not install sinks inside hoods unless they are specifically requested and needed.

Fume hoods should be located in close proximity to where chemicals are stored, and away from exits or where interfering air currents and cross drafts from doorways, windows, high traffic areas, HVAC systems, or other apparatus could adversely affect the proper function of the hood enclosure. Consideration of make-up air volume and location is critical for effective, safe operation of the hood. Ductless (filtered) fume hoods may be used in place of ducted fume hoods only for operations that could be performed safely on the open bench without presenting health exposure hazards.

Perchloric acid is an extremely dangerous, powerful oxidizer. Use of an alternative material is encouraged wherever possible. If perchloric acid is to be used, a specialized, dedicated stainless steel hood, labeled for perchloric acid use only must be installed. A regular chemical fume hood may not be used for perchloric acid. The perchloric hood must have its own non-reactive duct and exhaust fan, built-in water wash-down system, and other features as described in the ACGIH Industrial Ventilation Manual.

Radioisotope hood installations and the use of radioactive materials on campus requires prior review, approval and licensing by EH&S Health Physics. Conventional chemical fume hoods are suitable for many low level radioisotope applications, however the use of some materials such as radioactive iodine requires a specialized radioisotope hood equipped with integral filter components. In these cases, service contracts must be set up for maintenance, calibration and filter replacement or disposal.

**4. Storage cabinets** for flammable or hazardous chemicals should be located in close proximity to where the chemicals will be used, preferably under or adjacent to fume hoods. Chemical storage cabinets, including those located under fume hoods, should be ventilated as per the cabinet manufacturer's instructions to provide a minimum of 10 air changes per hour, using galvanized metal ducts (threaded conduit or pipes are acceptable). Chemical storage cabinets must be UL listed for the materials that they contain and must comply with the applicable requirements of NFPA 30, 45, and 99. Multiple cabinets must be used to segregate acids and oxidizers from flammables and organics. Cabinets must also be self-closing and have spill-containment features or devices. Consult EH&S and Facilities Management Fire Protection for additional requirements and restrictions in areas where flammable liquid dispensing occurs.

**5. Other safety cabinets** and enclosures for highly-reactive or toxic gases, and other specialized operations will have different and/or additional requirements than those listed above. EH&S must be consulted before planning such installations. In order for EH&S to evaluate these and other ventilation issues, the users must submit complete chemical and gas inventories which show chemical names and quantities of hazardous materials used and stored in the laboratory.

Biosafety cabinet installations and proposals for biological or biomedical research must be reviewed and approved by EH&S and the Institutional Biosafety Committee (IBC) to evaluate conformance with requirements of the Center for Disease Control (CDC) and the National Institute of Health (NIH). Such requirements can be found in CDC/NIH publication: "Biosafety in Microbiological and Biomedical Laboratories." The CU-Boulder campus is not approved for biohazardous work above Biosafety Containment Level 2. Biosafety cabinet selection and room designs must comply with National Science Foundation Publication 49: "International Standard for Class II (Laminar Flow) Biohazard Cabinetry" in addition to CDC and NIH requirements. Biohazard cabinetry equipped with integral filter components will require a special service contract for maintenance, calibration and filter replacement or disposal.

**6. Testing, certification, and inspection** of hazardous exhaust systems, fume hoods and chemical storage cabinets will be performed by Facilities Management Department and Environmental Health and Safety. All

appropriate UCB Standards shall be followed for hazardous exhaust systems, fume hoods and chemical storage cabinets to meet certification requirements for safe operating conditions.

Testing procedures should conform to sections 4.7, 4.8, 5 and 6 of the ANSI/ASHRAE 110-1995 Standard: "Method of testing performance of laboratory fume hoods" using calibrated air velocity measuring devices as specified in Chapter 9 of the ACGIH Industrial Ventilation Manual. EH&S will use a calibrated, direct reading air velocity meter, such as a swinging vane anemometer for certification and inspection purposes. If a meter has not been calibrated at 5,000 feet above sea level, a density correction factor must be used when measuring air velocities. EH&S will affix a signed and dated "Safe Operating Level" sticker at 13 inches above the sash ledge or at the point where the average face velocity measures 120 fpm, certifying that the hood is approved for use. Chemical fume hoods, storage and safety cabinets must meet all criteria set forth in this policy before EH&S can authorize the equipment to be placed into service.