Design Guidelines-Laboratories-Ventilation

Ventilation

Research laboratories have traditionally been designed to operate near 12 air changes per hour (ACH) throughout the entire facility when most areas do not require this high of an air exchange rate. EH&S recommends laboratories using chemicals be set to initially operate at 8 - 10 ACH, with sufficient capacity reserved to supply up to 12 ACH. 12 ACH should only be required as an initial rate for animal use areas, organic chemistry or other high activity laboratories that frequently use high volumes of volatile solvents. The proper selection and placement of direct ventilation devices can help to achieve better hazardous and noxious emission control without requiring as much general ventilation.

All laboratories should be adequately designed with supply and exhaust diffusers situated to ensure that air is well mixed in the entire ventilated space, turbulence is not created near fume hoods or other direct ventilation equipment and proper differential pressures are maintained between spaces and within the building envelope. Ventilation systems shall have sufficient capacity to provide maximum rates to all spaces, with reasonable room for future equipment installation and system expansion, while still being able to operate under loads that will not cause excessive noise or wear and tear on system components. Ventilation ducts should be run in a manner that will minimize turbulence and deposition, shall never be internally insulated, and internal obstructions shall be avoided to the greatest extent practical. Welded stainless steel ductwork is preferred for hazardous exhausts and is essential for laboratory fume hoods where strong corrosives may be used.

Nighttime setbacks can often be utilized. 4 ACH should be the lowest setback rate programmed for any space containing volatile or flammable chemicals. Other spaces can be set lower with EH&S and Utilities approval. These setback systems must be fail-safe such that the system reliably returns to normal occupied rates when conditions warrant, such as when controls or sensors fail, when they indicate that the space is occupied, or when indoor air quality parameters in the general exhaust are detected outside of prescribed bands.

NFPA-45 states “Air exhausted from laboratory work areas shall not pass unducted through other areas” and “Air from-laboratory units and laboratory work areas in which chemicals are present shall be continuously discharged through duct systems maintained at a negative pressure relative to the pressure of normally occupied areas of the building”. FSU considers a laboratory work area to be an area that is no larger than that which is obviously delineated by walls, doors and similar partitions or by a substantial difference in the types of activities expected to be supported by the design. The use of unducted return air grills or other passive means of exhaust ventilation shall not be used to transfer air between laboratory work areas.

- Fume Hoods
    - Fume hoods should be installed so that they will operate at an average face velocity between 90 and 100 fpm at an 18” vertical sash height, single point readings between 80-120 fpm are acceptable. Variable Air Volume (VAV) hoods are preferred, Constant Air Volume (CAV) hoods may also be considered.
    - Auxiliary Air hoods should not be used unless warranted by extraordinary conditions such as insufficient room volume. They should be considered only for very low hazard or nuisance material use and shall not be specified without prior EH&S approval.
    - Ductless fume hoods shall not be specified in lieu of a ducted fume hood and shall never be used for anything other than nuisance dust or odors.

- "High efficiency" type hoods that reportedly provide adequate containment at lower air flows or face velocities have not proven to provide adequate containment within our typical campus environment at the lower ventilation rates prescribed by manufacturers. They have increased complexity and are more expensive, therefore EH&S recommends that these not be specified. If these are desired to be utilized, guarantees must be obtained to ensure future performance will remain adequate and future cost savings will be realized as an overall net benefit to FSU.
- After any new installation or major ventilation system repair work, the affected system fume hoods shall be tested in accordance with ASHRAE-110 (1995 or more current version). This testing shall be scheduled after facility testing and balancing has been completed and shall be performed by a qualified third-party testing agent or company. Copies of all performed testing results (whether passed or failed) must be forwarded to EH&S along with the manufacturer's "As Manufactured" (AM) testing results. If changes are made to the ventilation system after this testing is done, which could be expected to affect fume hood performance, the ASHRAE-110 tests must be repeated. These hoods must pass the As-Installed (AI) testing criteria with tracer gas flow rates increased from 4.0 to 8.0 lpm and they shall not exceed an average release concentration of 0.05 ppm or exceed a peak concentration of 0.5 ppm. If a hood cannot pass ASHRAE testing with these enhanced specifications EH&S personnel must be contacted to determine if the original ASHRAE specifications can be utilized for that particular space.
- Fume hoods shall be designed and manufactured in accordance with industry standards with chemically resistant materials. They should be able to contain small spills with assurance that these will not cause degradation of the fume hood and shall be easy to decontaminate. Standard resins and composites that are currently utilized for construction of these units should be adequate. Stainless steel interiors are not necessary for the typical radioisotope work that is performed at FSU and shall not automatically be specified for this purpose. Likewise, HEPA filtration, wash-down systems, scrubbers or other special exhaust components should not be necessary for anything other than dedicated radiochemistry or perchloric acid hoods. Please consult with EH&S staff, if researchers report or design professionals feel that these types of additional criteria will be needed.
- Visual and audible low flow alarms shall be provided for each fume hood. These shall be calibrated when installed, visible to users at the hood, and have a means for the users to temporarily silence the alarm. They shall also be capable of set point adjustments by trained FSU Utilities personnel that have been provided any necessary equipment.
- Vertical sashes are preferred for standard countertop fume hoods. Horizontal, or combination, sashes are preferred for ADA compliant hoods. Ensure that horizontal sliding sashes do not exceed 18" in width, so that users can comfortably reach around them.
- Only laminated safety glass should be used for fume hood sashes.

- Other Local Exhaust Devices
  - Gloveboxes, downdraft tables and other such equipment can be used effectively as adjuncts or replacements for chemical fume hoods. These shall be ducted to appropriate exhaust systems whenever ventilation is required to control hazardous emissions. With the exception of biological safety cabinets or laminar flow hoods,

recirculation or filtration type devices shall not be specified unless they will only be utilized to control non-hazardous emissions. Any installed gloveboxes used to protect personnel from exposures or products from undergoing potentially dangerous reactions shall meet the specifications outlined in "Guidelines for Gloveboxes" Third edition, AGS-G001-2007. Initial training and testing of these devices should be arranged with the manufacturer when these products are purchased.

- Snorkels, canopy hoods and other such ducted devices that cannot be sufficiently tested for containment performance shall not be installed with the intention of controlling hazardous exposures. These devices may only be utilized for heat removal or the control of non-hazardous emissions.

- Exhaust Fans and Stacks
  - Exhaust fans and stacks used for fume hood, laboratory or other potentially hazardous ventilation exhaust shall comply with all applicable code requirements, including NFPA-45. Fan sets must be AMCA certified for the pressures and flows that they will be required to provide.
  - All fans, ducts and discharge stacks should comply with the ACGIH *Industrial Ventilation, A Manual for Recommended Practice for Design, 26th edition*. Material and type selections must be based on the types of chemicals that are reasonably expected to be used during any future operations.
  - The absolute minimum discharge velocity is 2000 fpm and the minimum effective stack height above the roofline is 10 feet for all hazardous exhausts.
  - Designs that incorporate continually operating exhaust systems with strobic fans or cylindrical vertical discharge stacks that have sufficient height and discharge velocity to ensure exhausted air reaches beyond roof wake boundary zones must be used. Insufficiently diluted exhausts shall be prevented from becoming entrained back into building supplies, reaching personnel outside buildings or impacting maintenance personnel working near rooftop equipment.
  - Short upblast style fans, even if they are rated for hazardous exhausts, should only be considered when:
    - the hazards that may be present are known to be of very low toxicity
    - assurances can be made that all laboratory operations can be halted in the exhausted facility before any workers access these roof areas, and
    - re-entrainment and adequate dilution can be addressed sufficiently
  - If exhaust system fans are not expected to operate continually, offset discharge stacks, or similar methods, must be utilized to prevent rain from entering the system(s). Reverse flows back into occupied spaces must be prevented from occurring when those areas are under negative pressure relative to the outdoor environment and the exhaust fan is not operating.