University of Hawaii at Manoa – Environmental Health and Safety Laboratory Design Guide

Note: This Design Guide is not "all inclusive." It covers neither all regulatory issues nor all design situations. For additional questions or clarification, contact EHSO at 956-8660. The primary referenced used in this guide's development is from "Prudent Practices in the Laboratory (updated version), Chapter 9 – Laboratory Facilities.

I. General Laboratory Design Considerations

A. Provide separate office spaces for laboratory employees. Basically, clear separation between office and lab. areas, preferably a wall or a door. Office occupants should not have to walk through the laboratory to exit.

B. Open vs. closed laboratory design: Though open/shared laboratory is a new and upcoming trend in lab. design, it is our experience that shared laboratories have create problems for researcher and our office, especially when specific hazards such as the use of radioisotope, carcinogens or other highly toxic/hazardous chemicals are used in the research. Therefore, we discourage this open/shared laboratory concept and prefer closed or separate laboratory spaces.

However, if the open laboratory design is used, provide a separate area/space for equipment or activities involving the use of radioisotopes, autoclaves, darkrooms, glass washing facilities, electron microscopes, high-powered lasers, tissue culture work and high-pressure equipment.

C. The laboratory shall have a means of securing specifically regulated materials such as controlled substances regulated by the Drug Enforcement Administration (DEA), select agents, regulated by Center for Disease Control (CDC), and radioactive materials (lockable doors, lockable cabinets, etc.)

D. Locate fixed elements such as chemical hoods and sinks at the perimeter to ensure maximum mobility of interior equipment and furniture.

E. Work surfaces should be chemical resistant, smooth and clean. Benchwork areas should have knee space to allow chairs near fixed instruments or for procedures requiring prolonged operation. **(Note: Bench tops should not be made of any asbestos-containing material.)**

F. Sheet flooring is preferred over tiles. Covered flooring that allows 4-8 inches of flooring material secured to the wall base is also desired.

G. Doors should have view panels to prevent accidents caused by opening the door into a person on the other side and to allow individuals to see into the laboratory in case of an accident or injury. Doors should open in the direction of egress and automatically self-closing.

The self-closing laboratory doors are able to be opened with a minimum of effort as to allow access and egress for physically challenged individuals.

H. All exit and emergency doors shall swing in the direction of exit travel, regardless of occupant load and shall be equipped with panic hardware.

I. No operable windows in laboratories especially where chemical fume hoods and other local ventilation systems exist.

J. Some laboratory equipment may be vibration sensitive, noisy or require special exhaust to remove heat, design separate area for these.

K. All shelves shall have a passive restraining system such as seismic shelf lips (3/4 inch or greater). The shelved themselves shall be firmly fixed so they cannot vibrate out of place and allow shelf contents to fall.

L. Flexible connections are preferred for connecting equipment and devices to utilities to allow for relative movement in a severe earthquake.

II. Safety Equipment and Utilities

A. Each laboratory should have an adequate number and placement of safety showers, eyewash units and fire extinguishers for its operations. Refer to the American National Standards Institute (ANSI)Z358.1 for safety shower and eye wash installation. Locate eyewash/safety showers near door. Do not include a floor drain for the shower. (Note: Drench hoses are unacceptable eyewash facility.)

B. Emergency eyewash/safety showers shall be in unobstructed and accessible areas that require no more than 10 seconds for an injured person to reach along an unobstructed pathway. There should be no doors in the path of travel; however, if there are doors, there should be no more than one , and it should swing in the direction of travel.

C. No electrical apparatus, telephones, thermostats or power outlets should be located within 18 inches of either side of the emergency shower or emergency eyewash facility (i.e. , 36-inch clearance zone) or within an area that may reasonably considered as a splash or flood zone. If 120-volt outlets or receptacles are present within 6 feet of an eyewash/shower, it shall be equipped with a Ground Fault Circuit Interrupter (GFCI).

D. Laboratories should have an abundant electrical supply outlets to eliminate the need for extension cords and multi-plug adapters.

E. Place electrical panels in an accessible area not likely to be obstructed.

F. Circuit breakers shall be located outside the lab, but not in rated corridors.

G. Install GFCI (ground-fault circuit interrupters) near sinks and wet areas.

H. Use chemical resistant sinks and piping.

I. Main valves for gas and vacuum lines should be located outside the laboratory (e.g., elsewhere on the floor or in a mechanical room).

J. Prohibit the installation of an acid waste neutralization system/tank.

III. Laboratory Ventilation

A. All laboratory rooms shall exhaust 100% to the outside. There shall be no return of fume hood and laboratory exhaust back into the building.

B. A pressure differential should exist in such a way that negative pressure exists between the laboratory and adjacent non-laboratory spaces.

C. General ventilation is usually between 6-12 air changes per hour. (note: there is no specific requirement for ventilation rates). This is not an appropriate concept for designing contaminant control system, as it implies that general ventilation will be utilized to remove contaminants. Contaminants must be controlled at the source, therefore the use of chemical hoods, and flexible local exhaust such as “snorkels”, “elephant trunks” shall serve this purpose.

D. Cabinetry or other structures or equipment shall not block or reduce effectiveness of supply or exhaust air.

IV. Laboratory Chemical Fume Hood

A. Chemical fume hoods should maintain a face velocity of 80-120 feet per minute at 18 inches.

B. All hoods shall be equipped with a flow indicator, flow alarm or face velocity alarm indicator to alert users to high- and low-exhaust flow. The flow- measuring device shall be capable of indicating airflows at the design flow and +/-20% of the design flow. The means of alarm or warning chosen should be provided in a manner readily visible or audible to the hood user.

C. Chemical fume hoods must be certified by ASHRAE/ANSI 110-1995 “Method of Testing Performance of Laboratory Fume Hoods” at the time hood is installed. Results of this test shall be submitted to EHSO.

D. Place hoods away from doors and heavy traffic aisles to reduce the chance of turbulence.

E. Fume hood exhaust should have vertical stacks that terminate at least 10 feet above the roof deck or two feet above the top of any parapet wall, whichever is greater. This 10 ft. above the roof line is called for to primarily protect maintenance workers from direct exposure from the top of the stack. However, this minimum 10 ft. height may be insufficient to ensure that harmful contaminants would not enter the outside air intake of the building or nearby buildings. Wind tunnel or air flow studies to determine air flow patterns would determine the stack height that would be needed to avoid re-entrainment of effluent into any building intake or opening and to minimize the exposure of the public.

F. Fume hood controls shall be such that shutting down one fume hood for maintenance will not reduce the exhaust capacity or create an imbalance between exhaust and supply for any other hood manifolded to the same system.

G. For systems with multiple hoods and exhaust fans, adequate redundancy shall be built into the design. This shall be done by either providing 75% capacity with the largest exhaust fan out of service; or providing a redundant fan equal to the capacity of the largest unit.

H. A regular chemical fume hood may be used for radioisotope work but needs to be labelled as such. If using perchloric acid, need to use a Perchloric acid hood (has specific construction and material requirements different from a regular chemical fume hood).

V. Gas Cabinets/Compressed Gas Cylinder Storage

A. Use and storage of highly toxic or hazardous gases such as arsine, phosgene and diborane that are large and cannot be used within the chemical hood must be placed in ventilated gas cabinets. Gas cabinets should be connected to the laboratory exhaust ventilation using metal ductwork instead of flexible tubing as tubing is more apt to leak.

B. When separate gas storage rooms are provided, they shall operate at a negative pressure in relation to the surrounding area, and direct the exhaust ventilation to the fume exhaust system, assuring that incompatible gases are not mixed in the ductwork.

C. Approved storage racks shall be provided that adequately secure gas cylinders by chains, metal straps or other approved restraining materials, to prevent cylinders from falling or being knocked over.

D. Gas cylinder securing systems should be anchored to a permanent building fixture.

VI. Hazardous Materials Storage Cabinets

A. Laboratories that store, use or handle more than 10 gallons of flammable or combustible liquids shall have one or more flammable storage cabinets.

B. If a ventilated flammable-liquid storage cabinet is used under a chemical hood, do not vent it into the chemical hood above it. It should have its own separate exhaust duct connected to the exhaust system.

C. Flammable liquid cabinets shall not be located near exit doorways, stairways or in a location that would impede leaving the area.

D. Flammable liquid storage cabinets shall not be wall mounted.

C. Non-metal cabinets or metal cabinets specially treated to be corrosion-resistant material should be used to store corrosive materials.

VII. Other

A. Prohibit the use of asbestos-containing building materials; this should be confirmed from submittals provided in construction.

B. Provide emergency generator to ensure essential equipment (incubators, refrigerators, etc.) are still operational in the event of a power failure.