Section 4 - Laboratory Equipment and Facilities

Contents

A. EMERGENCY EYEWASHES AND SHOWERS

Emergency washing equipment is required when using corrosives (acids and caustics), strong irritants (which cause inflammatory effects upon contact), and toxic materials that can be absorbed through the skin. Emergency washing facilities must be accessible (unobstructed) and personnel should be able to reach the equipment within 10 seconds (not more than 50 feet and perhaps closer if access is through a normally closed door). Equipment must be accessible at all times without requiring a key or overcoming other security safeguards.

1. Eyewash Stations

If chemicals can cause eye damage and are used in such a way that they may splash into eyes, an eyewash station is required. Laboratory personnel must be able to reach eyewash stations within ten seconds. The eyewash should be within 50 feet of where chemicals are being used, although this distance should be less if doors interfere with access. Always maintain clear paths to eyewash stations.

Chemicals can cause blindness or instant pain which can make it very difficult for someone to find the eyewash on their own in an emergency. Laboratory personnel should know the location and operation of the eyewash stations in their area. It is recommended that personnel practice locating the eyewash station while keeping their eyes closed. If at all possible, don't work alone when working with these chemicals.

Eyewashes must be flushed weekly by laboratory staff to ensure they are operating correctly, in accordance with **Washington Administrative Code (WAC) 296-800-15035**. Weekly flushing checks that they work and provide a strong enough stream of water to reach the eyes of someone bending over it, and to help keep the water clean. During the weekly check, the eyewash should be operated long enough (30-60 seconds), so that there is no visible rust or contaminant in the water. If the eyewash is located in a shared area, an individual should be appointed to perform the weekly test.

2. Safety Showers

Laboratory personnel should know the location and use of the emergency showers in their area. Laboratory personnel must be able to reach showers within ten seconds. Always keep the area underneath the shower and the path to the emergency shower clear.

Safety showers are tested annually by Facilities Services. A tag indicating the most recent test date should be found on the equipment. Contact Facilities Services (Appendix F) if a test or maintenance is needed.

3. Deluge Hoses

Deluge hoses have been replaced with dual eyewash stations. Deluge hoses are not acceptable alternatives to an eyewash or safety shower. They can be used for washing glassware and other materials. If your lab has a drench hose without an eyewash but an eyewash is needed, submit a work request to have an eyewash installed. Contact EH&S at 206.543.7388 if you have questions.

B. FIRE SAFETY EQUIPMENT

1. Fire Extinguishers

a. Proper Use

Portable fire extinguishers are provided in University buildings and are available for use by trained personnel. All laboratory personnel should be trained to use the type(s) of fire extinguishers that are present in the laboratory. Training classes are available through EH&S, with online registration http://www.ehs.washington.edu/psotrain/index.shtm. Individuals who have been trained in the principles of fire extinguisher use and the hazards involved may attempt to extinguish small (trash can or smaller) and incipient (early stage) fires if there is an escape route. Individuals not trained in the proper use of extinguishers should not attempt to use one during a fire. Doing so could put them and others in danger.

Fire extinguishers should be conspicuously located, wall mounted, and easily accessible.

b. Types of Extinguishers

The fire extinguishers available to the laboratory staff should be selected based on the materials inside or outside the lab. (See Table 9-4 for the list of fire classes).

Table 9-4 Classes of Fires and Proper Fire Extinguishers

Class of Fire	Description	Proper Extinguisher
A	Ordinary combustibles such as wood, cloth, and paper	Dry Chemical (ABC) or water
B	Flammable liquids such as gasoline, oil, and oil-based paint	Carbon Dioxide (BC) or Dry Chemical (ABC)
C	Energized electrical equipment including wiring, fuse boxes, circuit breakers, machinery, and appliances	Carbon Dioxide (BC) or Dry Chemical (ABC)
D	Combustible metals (e.g., Na, Mg)	Special Extinguisher (D)

University laboratories using hazardous chemicals should have an ABC rated dry chemical fire extinguisher located within 50 feet of the hazard, either along the exit path from the laboratory or in the hallway adjacent to the laboratory. Many fire extinguishers on campus are ABC, which perform well on most fires with one major exception: combustible metal fires. Combustible metal (Class D) extinguishers are not typically provided for laboratories unless needed.

Laboratories also may request a CO_2 extinguisher (Class BC). It is not as effective as a dry chemical extinguisher, but will require less clean up after use. Some pressurized water fire extinguishers (Class A) are still found in hallways but they are only suitable for use on ordinary combustible materials (e.g., paper, wood, plastic).

c. Maintenance

On the Seattle campus, extinguishers are certified annually by Facilities Services as part of the routine building maintenance. If an extinguisher needs to be refilled, contact Facilities Services at 206.685.1484. To request additional or alternative extinguishers,

contact EH&S at 206.543.0465. For repair or replacement of fire extinguishers at Bothell or Tacoma campuses, please refer to Appendix F.

Automatic fire suppression systems are found in a decreasing number of fume hoods and are being removed as equipment is replaced. Fire hoses may only be used by fire department personnel. Fire blankets are not recommended for laboratory use because they may trap heat in when a victim has burning clothes and cause more injury than would otherwise occur.

2. Flammable Liquid Storage Cabinets

Flammable liquid storage cabinets are required if you are storing over ten gallons of flammable liquids. Flammable liquid storage cabinets are not fireproof. Cabinets are designed to protect the contents from extreme temperatures for a limited time only. Contact EH&S at 206.543.0465 for further information on flammable liquid storage cabinets.

a. UL or FM Approval
Flammable liquids should be stored in an Underwriter's Laboratory (UL) listed or Factory Mutual (FM) approved flammable liquid storage cabinet outfitted with approved automatic or self-closing doors. All new cabinets must have UL or FM approval. (Note: Some existing wooden cabinets that are not labeled with UL or FM approval are still in service and approved for use.)

b. Label
Cabinets must be labeled "Flammable - Keep Fire Away".

c. Capacity
Do not over-fill cabinets; check manufacturer's recommendations for storage limits.

d. Bottles
All bottles should be placed on the shelves, never stacked. Keep all containers tightly closed.

e. Containers
Only containers designed for flammables storage may be used. Never use "makeshift" containers, such as a plastic cup, even for short-term or temporary storage.

f. Incompatible Chemicals
Do not store incompatible chemicals in these cabinets.

g. Cabinet Doors
Cabinet doors should never be propped open unless the mechanism is a designed part of an approved cabinet.

h. Unapproved Storage
Tops of cabinets are not storage shelves. Do not store combustible materials on or beside flammable liquid storage cabinets.

3. Flammable Storage Refrigerators

Flammable chemicals, or chemical mixtures that need to be stored below room temperature, must be stored in U.L. listed flammable material storage refrigerators or freezers. These refrigerators and freezers are specifically designed by the manufacturer to have non-sparking

interiors. All laboratory refrigerators and freezers must be prominently labeled with a warning sign indicating whether it can be used for flammable or non-flammable storage. For these warning signs or information regarding a flammable storage refrigerator purchase, contact EH&S at 206-543-0465. For more information on flammable storage refrigerators, see http://www.ehs.washington.edu/fsofire/flamfrig.shtm.

C. LABORATORY SIGNS

A list of required signs is provided in the following table and explanatory material is described in the following paragraphs.

Table 4-1 Safety-Related Signs

Safety-Related Required Signs	See Paragraph
Lab Caution Sign	4.C.1
Emergency/Safety Equipment Location Signs	4.C.4
Hazards Warning Signs	4.C.5
"Natural Gas Emergency Shut Off Valve" (*Must be posted if valve is present.)	5.C.6
"Laboratory Water – Do Not Drink" (*Must be posted on non-potable water outlets.)	4.C.7

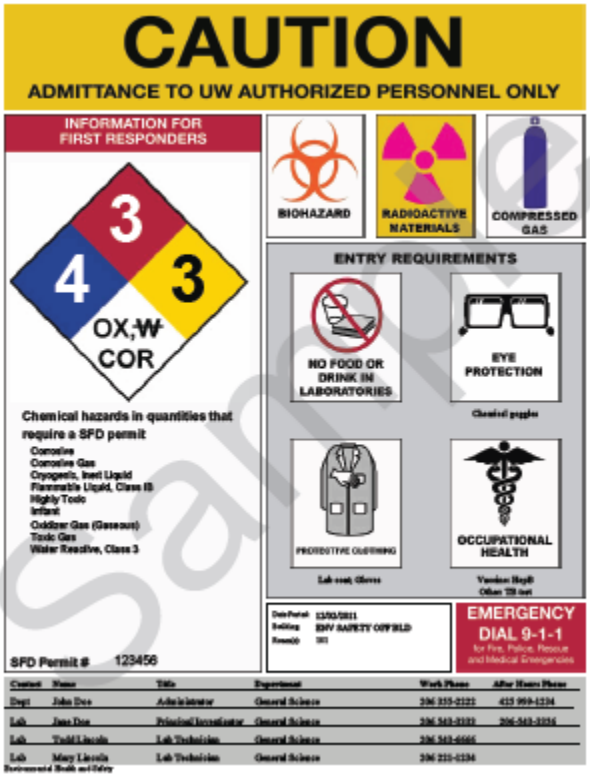
1. Lab Caution Sign

A standard UW Lab Caution sign is 'required' to be posted at each lab entrance in a Plexiglas holder above or near the room number placard. The purpose of the sign is to warn emergency responders and visitors of potential hazards in the lab and to meet multiple regulatory requirements.

Lab caution signs are installed by EH&S and updated by lab personnel using a tool in MyChem. Once the signs are posted by EH&S it is the responsibility of the lab personnel (PI, Lab Manager, CHO, etc.) to update the signs if significant changes occur in chemical inventories, entry requirements, hazardous materials authorizations or lab contacts.

The lab caution sign consolidates signage requirements for **National Fire Protection Association (NFPA) 704 Hazardous Materials**, biohazardous and radioactive materials authorization, entry requirements, food and drink prohibitions and lab contact information. An example of the sign shown in (Figure 4-1 below). More information on the contents of the signs is available on the web page: : http://www.ehs.washington.edu/fsohazmat/labsign.shtm.

Figure 4-1 Example Laboratory Caution Sign



2. Emergency Procedures for Laboratories (Flip Chart)

Laboratories must have the *UW Emergency Procedures for Laboratories* flip chart, which contains detailed emergency procedures and phone numbers for eight different emergency situations, posted in the lab in a prominent location. . Use the space on the front cover to write in emergency contact numbers for the lab. Provide numbers for PI and lab personnel to be called in case of fire, accident, hazardous chemical spill or other emergency.

3. Laboratory Floor Plan

A floor plan showing evacuation route(s), as well as spill kit, fire extinguisher, and other safety equipment locations should be included in the *Chemical Hygiene Plan* (CHP) and posted prominently in the laboratory. (See Appendix C for example laboratory floor plan).

If particularly hazardous substances are used in a designated area, the floor plan showing the designated area is mandatory.

4. Emergency/Safety Equipment Location Signs

Signs must be posted identifying the location of exits, safety showers, eyewash stations, fire extinguishers, first aid equipment, flammable storage cabinets, and other safety equipment. Contact Facilities Services to post these signs.

5. Hazards Warning Signs

Warning signs and labels should be posted in areas or on equipment where special or unusual hazards exist, such as biohazards, lasers, magnetic fields, radioactive materials, high voltage, restricted access, or particularly hazardous substance control areas when the hazard is present. These signs may be mandatory depending on the degree of hazard (or as listed on local codes). Contact EH&S for information on hazard signs.

6. Natural Gas Emergency Shut Off Valve

If the laboratory has an emergency shut-off valve for gas supply systems, post a sign indicating its presence.

7. Laboratory Water – Do Not Drink

If a non-potable water system (lab water) has outlets in the laboratory, such outlets must have signs posted identifying that the “water is not fit for drinking”.

D. LABORATORY VENTILATION

Washington State Department of Labor and Industries has set full shift (eight hour) and short-term (15 minutes) permissible exposure limits (PELs) for many chemicals to prevent adverse health effects in workers (see Section 5.A.1). Local exhaust ventilation systems (such as fume hoods) may be needed in order to control airborne contaminants and reduce exposure levels to acceptable limits. For assistance in measuring chemical exposures, contact EH&S at 206.543.7388.

1. Laboratory Design

a. Room Air Pressure

Room air pressure should be negative to the hallway so that accidental releases are kept in the lab and not released into the hallway and the building.

b. Vents

Do not block or cover supply and exhaust vents. Occupant changes to lab ventilation may compromise the safety features of the laboratory and local exhaust systems such as fume hoods, biosafety cabinets, etc.

2. Fume Hoods

A fume hood is ventilation equipment that vents separately from the building’s heating, ventilation, and air conditioning (HVAC) system. The primary means of controlling airborne chemical exposure is a fume hood. Fume hoods should be used when working with toxic compounds or compounds with a boiling point below 120°C. (However, some aqueous solutions may be an exception to this rule.) It may be necessary to use a closed system, such as a glove box or bag, for highly hazardous chemical materials.

EH&S maintains a roster of fume hood designs which have been approved for purchase on the EH&S web site: http://www.ehs.washington.edu/fsofumehoods/approvedfumehoods.shtm

a. Fume Hood Use

1) **Training** – Personnel using fume hoods should take the on-line training class: http://www.ehs.washington.edu/fsofumehoods/index.shtm.

2) **Verify Operation** – Make sure the fume hood is operating before starting work. Some new fume hoods have monitoring devices that indicate acceptable working conditions. Otherwise, a strip of Kimwipe™ taped to the underside of the sash can be used as an indicator of air flow. Since this strip may flutter, even when the air flow is inadequate, the strip should be placed and its movement observed when you know that the air flow is proper – such as at the same time that EH&S measures the air velocity.

3) **Exhaust Fan Speed** – Some older buildings have fume hoods equipped with two-speed exhaust fans with local control at the hood. The low exhaust setting is only appropriate for storage. The high setting provides protection for working with chemicals.

4) **Minimize Cross Drafts and Eddy Currents** – Air flow into the fume hood is adversely affected by cross drafts and eddy currents. Cross drafts occur when people walk in front of a fume hood or when nearby windows or doors are open. Eddy currents occur around the person using the fume hood and around objects inside it. To limit these effects, fume hoods should not contain unnecessary objects and the slots within the fume hood, which direct air flow, must not be blocked. The slot at the rear of the work surface is essential for proper air movement. If large pieces of equipment or large numbers of bottles are placed in front of the slot, they should be raised up on blocks or placed on a shelf to allow air to flow into the slot. Equipment should be placed as far to the back of the fume hood as practical, leaving six inches at the rear. Work should be performed at least six inches inside the fume hood opening to prevent cross drafts and eddy currents from pulling contaminated air out of the fume hood and into the room.

5) **Sliding Sashes** – The sash should be kept as low as possible to improve overall performance of the hood. The more closed the sash is, the better protection from an unexpected chemical reaction. Procedures should be done with the sash at the level of the maximum approved sash height marking or lower. Use a separate safety shield, such as a face shield, when working with an open sash.

6) **Chemical Evaporation** – It is illegal to evaporate chemicals in the hood to "dispose" of them. Any open apparatus used in hoods which emit large volumes of volatile chemicals should be fitted with condensers, traps, or scrubbers to contain and collect hazardous vapors or dusts.

7) **Storage** – Do not store chemicals or supplies in the fume hood. Chemicals and supplies should be stored in approved cabinets.

8) **Flammable Liquid Vapor** – Laboratory fume hoods are designed to reduce flammable vapors below lower explosive limits when properly operated and maintained. As an added precaution, use only non-sparking and explosion proof electrical equipment (hot plates, stirring plates, and centrifuges) in fume hoods where a large volume of flammable liquid vapor may be generated. Take care with flammable liquids and heat sources.

9) **Containers** – All containers of chemicals must be securely capped when not in use. A rule is that containers should be open for minutes (at the most) – which is the maximum time it normally takes to pour a small amount of chemical into another container and replace the cap. All containers must be labeled with the chemical identity and appropriate hazard warnings (or the material must be used up during the work period and be under continuous control of the researcher using it).

b. Fume Hood Prep for Maintenance

1) Prior to any maintenance of fume hoods the entire interior surfaces must be decontaminated and/or cleaned by the researchers using the hood (as described below in Section G.2 Decontamination of Equipment for Service).

2) Maintenance may require access to storage cabinets below or to side of the hood. If access is required, the entire cabinet and adjacent area also needs to be emptied, decontaminated, cleaned, and rinsed. Lab staff need to identify a contact for coordinating with Facilities Services regarding the work to be done. See Section G.2 (below) for details and the required maintenance request form.

c. Fume Hood Performance and Testing

EH&S performs a functional performance test annually to assure hoods are performing as designed. If a hood fails, it may need to be taken out of service until repaired. EH&S will notify the researchers and post a "Do Not Use" sign if repair is required.

Fume hoods can be tested using up to five functional performance criterion, depending upon the fume hood design. This includes face velocity, variable air volume (VAV) tracking, sound, and containment to monitor functionality. Specific performance measures for each test are outlined below. For more information, contact EH&S at 206.543.0465.

1) **Face Velocity** –
   - Standard Flow Hoods: 80 – 120 Feet Per Minute (FPM)
   - Sash height should not be less than 18 inches
   - High-Performance Hoods: 60 – 84 FPM

2) **VAV Tracking** – The sash is lowered about 50% from the target sash height to assure the HVAC system responds appropriately to maintain optimal capture velocity.

3) **Sound** – Measure sound using a sound meter on Scale A with the sash optimized and the sound meter located about one foot from the front of the hood at 18 inches above the work surface (roughly ear level of the testing technician). The ambient sound level must be less than 80 dBA.

4) **Containment Test** – Use visual powder or dry ice; check for effective containment.

5) **Monitor Alarm Properly Functioning** –
   - Confirm monitor has power and is properly calibrated
   - Raise sash to reduce face velocity below 80 LFM (60 LFM for low-flow fume hoods) and to confirm that both visible and audible alarm signals function
   - Test monitor's mute function by pressing the mute button
   - Test the reset button
   - Test Failure: Monitor fails to alarm, is more than 10 FPM out of calibration, fails any functional test, or is damaged

d. Fume Hood Problems

If you are having problems with your fume hood, contact EH&S at 206.543.0465. EH&S will troubleshoot the problem and may refer it to Facilities Services for repair.

3. Perchloric Fume Hoods

Procedures using concentrated perchloric acid (>70%) or which heat any amount or concentration of perchloric acid must be performed in a closed system or within a specially designed perchloric acid fume hood with wash down systems to prevent the accumulation of explosive perchlorates in the hood and ducting. For assistance in locating a perchloric acid fume hood, call EH&S at 206.543.0465.

4. Glove Boxes

Glove boxes generally operate under either positive or negative pressure to the lab, depending on the process or material used. Positive pressure glove boxes are used when you are trying to protect your material from contamination. Negative pressure glove boxes are used to provide increased operator protection. Glove boxes should be thoroughly tested before each use and there should be a method of monitoring the integrity of the system (such as a pressure gauge).

5. Biological Safety Cabinets

Biological safety cabinets (BSCs) are laboratory hoods designed to protect the worker and the experiment by drawing air across the samples and away from the worker and into a HEPA filter.

There are two types of BSCs. Class II type A and Class II type B1 units recirculate filtered air into the laboratory and are not designed for chemical use for this reason. The Class II type B2 unit is designed for use of some chemicals but is not substitute for a fume hood. The use of chemicals in this type of hood needs to be evaluated carefully so that the protective barrier (HEPA filters) is not destroyed by the chemicals.

BSCs are certified annually by EH&S. If a BSC fails the certification, it may not be used until repaired, unless specifically authorized by the Institutional Biosafety Officer. BSCs may not be repaired or moved until decontaminated by EH&S.

Refer to the EH&S Focus Sheet “Chemical Use in Biological Safety Cabinets” http://www.ehs.washington.edu/fsobiocab/focusbsctips.pdf for information about using chemicals in a BSC.

For additional information on the proper use of BSCs, Class II type B2 design, cabinet certification, troubleshooting problems, or decontamination, contact EH&S at 206.543.0465.

6. Laminar Flow Hoods

Laminar flow hoods are designed to protect the work surface from contaminants and may blow out into the face of the person using the hood. Therefore, any chemical use will cause the person to be exposed to the chemical. Toxic or volatile chemicals may not be used in a laminar flow hood.

7. Ductless Laboratory Hoods

In some cases, installation of a ducted fume hood may be impossible and a request for a “ductless hood” must be approved by EH&S. This type device uses special filters or absorbents to clean the contaminated air in the hood prior to recirculating the air back into the room. Recirculation of potentially contaminated air into the room presents special dangers and special requirements must be met.

The requesting department must demonstrate that the following concerns are addressed as long as the hood is in use:

a. Chemical Characterization

Each of the chemicals to be used in the ductless hood must be completely characterized as to the quantity which may be released within the hood at one time and the frequency of use. The hood manufacturer will need this information for the design of the hood. Once designed, use of other chemicals in the hood must be forbidden unless the hood manufacturer approves the alternate chemical. Records as to the design of the hood and the designated chemical usage must be maintained in the laboratory.

b. Ductless Hood Approval

The Principal Investigator (PI) must verify that the size, shape, and layout of the proposed hood, as offered by the hood manufacturer, is appropriate for the intended use. The PI must also develop a management plan for the hood which addresses staff training, procedures for using the hood including: emergency procedures, ongoing maintenance, certifications for the hood, and recordkeeping. This plan needs to assure continuity if management of the hood is taken over by another individual. A description of the items required in the management plan is available from EH&S at 206.543.7388. Hood approval by EH&S is contingent on submittal of the hood design information from the proposed manufacturer and submittal of the management plan.

c. Laboratory Staff Information and Training

All personnel in the laboratory must be trained as to the fact that the ductless hood recirculates air back into the room, that only certain designated chemicals may be used within the hood, and that failure to operate properly and maintain the hood may result in personnel exposures.

Also, a sign must be placed on the hood identifying which chemicals may be used and warning that the air is recirculated back into the room from the hood.

8. Cold Rooms, Warm Rooms and Environmental Chambers

a. Room Design

Controlled environmental rooms generally are completely enclosed with no fresh air and with heating/cooling and other environmental systems independent of the building. Rooms large enough to enter should be designed or retrofitted with doors that allow anyone trapped inside to get out easily. The electrical system within environmental rooms should be independent of the main power supply so that people are never left in these areas without light.

b. Chemical Use

Controlled environment rooms usually recirculate the air using a closed air-circulation system. Hazardous chemicals must not be stored in these rooms because ambient concentrations of volatile chemicals can accumulate to dangerous levels.

Flammable solvents should not be used in controlled environment rooms. Ignition sources in these rooms could ignite vapors.

Avoid using volatile acids in cold rooms because vapors can corrode the cooling coils, leading to possible refrigerant leaks.

If solid carbon dioxide (dry ice) is placed into a cold room, its sublimation will raise the carbon dioxide levels within the room, possibly to dangerous levels. Use extra precautions if you must use or store dry ice in these spaces.

9. Other Ventilation Systems

A ventilation engineer must design all other local exhaust systems used in the laboratory. Do not attach canopy hoods or snorkel systems to existing fume hood exhaust ducts without consulting a ventilation engineer at Seattle Facilities Services, Campus Engineering, 206.543.7372 or your local campus engineering design services (if available). All local exhaust systems should have a visual indicator that the system is functioning properly at all times, even if the indicator is just a Kimwipe™.

a. Discharge of Hazardous Vapors

Laboratory apparatus that may discharge hazardous vapors (vacuum pumps, gas chromatographs, liquid chromatographs, and distillation columns) must be vented to an auxiliary local exhaust system such as a canopy or a snorkel, if not already vented to a fume hood.

b. Hazardous Chemicals

Hazardous chemicals should be stored in approved cabinets.

c. Isolation/Clean Rooms

Isolation rooms typically operate under negative pressure and clean rooms typically operate under positive pressure to the anterooms or hallways. These rooms require considerable engineering. Procedures for entering and exiting these areas should be written out and employees should be trained accordingly.

10. Maintenance of Ventilation Systems

All ventilation systems need routine maintenance for blocked or plugged air intakes and exhausts, loose belts, bearings in need of lubrication, motors in need of attention, corroded duct work, and minor component failure. Contact Facilities Services (see Appendix F) if a ventilation system has a problem. When maintenance is scheduled for fume hood exhaust systems, warning signs will be posted on the affected fume hoods and researchers must cease fume hood use during the maintenance procedures in accordance with the requirements listed on the sign.

a. Filters

Filters should be replaced periodically in certain types of ventilation systems such as electrostatic precipitators, cyclones for dust collection, and BSCs. For laboratory maintained equipment, keep a record of these filter changes in a notebook or file that can be easily located in case a regulatory agency requests a copy of this documentation.

b. Monitoring Devices

Monitoring devices should be included in new ventilation systems to make the user aware of malfunctions. All personnel within the laboratory need to understand the meaning of associated alarms and readout devices and the actions to take if an alarm or unacceptable reading occurs.

E. OTHER FACILITY CONDITIONS

1. General Laboratory Environment

a. Building Repairs and Alterations

Building occupants are not authorized to repair or alter facilities. Facility problems such as broken flooring and broken electrical cover plates should be corrected by initiating a work request with Facilities Services (see Appendix F).

b. Floors and Walkways

1) **Flooring** – Floors should be level, with no protuberances which could cause a tripping hazard. Openings in the floor should be covered, if possible, or else protected or guarded to prevent falls. If impervious mats are present, they should have a non-slip backing or be fastened to prevent moving when someone steps on them. Material spills should be cleaned up as soon as possible.

2) **Obstructions** – Equipment and supplies should not be placed in corridors and pathways where it would impede exiting or make exiting hazardous. For more information, see the “Use of Corridors and Unassigned Space” policy.

c. Seismic Bracing and Earthquake Preparedness

Details concerning seismic bracing are noted in Section 9.A.5. Facility Services must perform all facility modification, such as installing mounting brackets on the walls.

d. Plumbing Systems

Place a strainer or mesh pad over all sink drains to prevent objects from falling into the plumbing.

Piping systems and plumbing connections in a room should be labeled. Such plumbing systems may include sewage lines, potable water lines, non-potable water systems, cryogenic and pressurized gases, or other systems. All personnel should know what to do in case of a leak in any system.

If experimental procedures will require connecting laboratory apparatus to any plumbing, personnel must also know how to avoid improper connections (i.e., avoiding mistakes such as connecting to the wrong system or making an inappropriate cross connection). Public Health regulations require additional safeguards to the plumbing system when connecting chemical equipment or experiments to potable water systems. Check with EH&S and Facilities Services prior to any connections to potable water systems.

e. Lighting

1) **Light Fixtures** – Light fixtures should be operational and diffusers should be installed. If emergency lighting and exit signs are not functional, immediately initiate a work request with Facilities Services (see Appendix F).

2) **Lighting Intensities** – Light intensities should be adequate for the tasks being performed. If lighting seems inadequate when all fixtures are working, consider obtaining additional fixtures, especially if the laboratory arrangement is temporary. If this will not resolve the problem, call EH&S at 206.543.0465. In a few cases, increased lighting may be required to reduce potential hazards from activities such as laser use or ultraviolet light applications. In these unusual situations, contact EH&S Radiation Safety at 206.543.0463.

f. Noise and Vibration

When possible, equipment that produces irritating noise and vibration should be replaced with equipment designed to produce less noise and vibration. If equipment in the area is producing noise levels that require people to raise their voices to be heard while standing next to each other, potentially hazardous noise levels are being produced. These levels can be evaluated by contacting EH&S at 206.543.7388.

Equipment should not be purchased which produces noise levels greater than 80 dBA without specific written approval from EH&S at 206.543.0465. A formal hearing protection program may need to be implemented for the installation and use of such equipment.

g. Indoor Air Quality

1) **Occupant Activities** – Many complaints about odors are due to occupant generated problems. Such sources include dried out drain traps in sinks and floor drains, chemical spills inside a laboratory or adjacent area, rotting food within a room, and expected or unexpected chemical reactions creating a stench. The room occupants should check these potential problems. If a dry trap is suspected, the trap should be filled with a few hundred milliliters of water at least once a month, or infrequently pour ten or twenty milliliters of a slower evaporating chemical such as glycerin, propylene glycol (not ethylene glycol) or mineral oil into the drain. Additional information about unknown odors is available at http://www.ehs.washington.edu/ohs/iaq.shtm..

2) **Facility Related** – Recurring poor indoor air quality may be due to inadequate or malfunctioning general HVAC systems. In some cases, odors may come from a leak in a plumbing system (such as natural gas or sewage), an open drain that was never capped by Facilities Services when a piece of equipment was decommissioned, or a construction project in an adjacent area. If these conditions are suspected, contact Facilities Services (see Appendix F).

3) **Unknown Odor** – If an unknown odor persists, contact EH&S at 206.543.0465.

h. Asbestos, Lead and Other Hazardous Laboratory Components

1) **Asbestos** – Asbestos may be found in various equipment components (such as fume hood and safety cabinet wallboard and in autoclave and oven gaskets) and various supplies such as heat-resistant gloves and heat-resistant cloth. Non-asbestos materials should be used whenever possible in place of the asbestos materials and all personnel should avoid damaging suspected asbestos-containing materials. Do **NOT** use an ordinary vacuum cleaner or dry sweep to clean up suspect dust from these materials. Such materials are handled by a contractor via a work order through Facilities Services. Contact EH&S at 206.543.0465 concerning asbestos questions.

2) **Lead** – Lead may be used in a lab as a barrier when density is needed (such as an x-ray radiation shield) or as a weight when a heavy material is needed (such as an equipment counterbalance). The primary health hazard would come from inhaling or ingesting dusts from these materials, but skin contact with these materials should also be minimized. If a laboratory operation routinely creates lead dusts or melts lead, the process should be evaluated by EH&S at 206.543.7388.

3) **Other Materials** – Other laboratory materials that could present a health hazard include polychlorinated biphenyls (PCBs) in light fixtures, window caulking/putty and transformers, liquid mercury switches in piped gas systems, mercury in fluorescent and high-pressure light bulbs, flammable or toxic gases in piped gas systems, and potentially hazardous materials in sewage plumbing and ventilation ducts. If any leak of such material is suspected, contact Facilities Services (see Appendix F).

2. Electrical Hazards

Even small electrical currents passing through the body may cause injury or death. Observe the following precautions to reduce electrical risks. Additional information is on the EH&S Web page http://www.ehs.washington.edu/fsophyssafe/electric.shtm..

a. Circuit Breaker Access

1) **Access** – Maintain at least three feet clearance in front of any circuit breaker panels within the laboratory.

2) **Utility Access in Other Rooms** – If you must enter other rooms to access the circuit breakers, you must be observant of any conditions in that room which may indicate a hazard. Such conditions could include puddles in front of the circuit breaker box or temporary barriers preventing entry to the circuit breaker box. (If a barrier is deliberately placed, such as a sign indicating that entry is restricted due to a hazard, obtain permission from the agency placing the barrier before entry.)

b. Permanent Wiring and Outlets

Request permanent wiring be installed for situations when you would be using extension cords for periods longer than eight hours. All building electrical repairs and wiring must be done by Facilities Services. If conduits appear damaged or cover plates over electrical outlet boxes are damaged or missing, please report that information to the Building Coordinator for forwarding to Facilities Services or directly contact your supporting Facilities Services organization (see Appendix F).

c. Equipment Cords and Extension Cords

1) Extension cords should be a minimum of 14 gauge size (heavy duty) and be in good condition with no splices, knots, deterioration, taping, damage, or sharp, permanent bends. Plugs (110 volt) must have three prongs with a grounding prong longer than the current prongs.

2) Extension cords may never be used in place of permanent wiring. Consider instead power strip outlets or surge protectors with build-in circuit breakers.

3) Carpeting, heavy objects, and equipment that may abrade or melt an electrical cord should never be placed on top of electrical cords. Cords should serve only one fixture or piece of equipment. Cords should never be strung through holes in walls or ceilings, or over metal fixtures such as pipes or equipment racks because cord movement may abrade the cord.

d. Chemical Splashes into Electrical Equipment

Place equipment so as to reduce the chances of a spill of water or chemical on the equipment. If a spill occurs while the equipment is unplugged, the spill should be promptly cleaned, and the equipment must be inspected before power is applied.

e. Grounding

A facility using water or other liquid conductor that has a likelihood of creating a wet floor or work area should be equipped with ground fault circuit interrupter (GFCI) or equivalent protection to help prevent a serious electrical hazard in the event of an uncontained leak or other unexpected condition. Portable GFCIs are acceptable.

f. Equipment Modifications

Any problems with electrically powered equipment should be brought to the attention of the PI or laboratory supervisor. If equipment setup is modified, someone knowledgeable with the apparatus should check the new setup, before power is applied. Equipment operators must understand the hazards of equipment and apparatus in use and be familiar with the correct operation of that equipment. Power line cords should be unplugged before any modifications or repairs are made to equipment. Even though power may need to be applied to equipment while calibrations are performed, the operator must remain wary of the energized state of the equipment and not adjust the equipment beyond safe operational parameters.

If there is a potential for a worker to contact live electrical circuits of 50 volts or greater while performing equipment installation, modification or maintenance, that person must take electrical safety classes including lockout/tagout procedures and wear appropriate arc/flash protective clothing. If at all possible, equipment setup and maintenance must be performed with the equipment in a de-energized condition.

3. Lockout / Tagout Concerns

a. Hazardous Situations

In addition to common electrical hazards, other energy hazards may exist in the laboratory that require special procedures, called Lockout/Tagout procedures. These situations may include equipment with internal pressurized systems (hydraulic or gas), multiple electrical energy source systems (where electricity is supplied through more than one cord), systems containing batteries or capacitors, and gravity systems (where a weight is held at a height). Such systems must be labeled with a warning sign. Anyone using such systems must know of the hazards and that only trained and authorized individuals may repair and modify the equipment.

b. Precautions

Trained and authorized personnel must perform all repairs and modifications. When repairs and modifications are performed, the energy source must be prevented from being activated using appropriate techniques such as de-energizing the system, inserting blanks into pressure systems, and locking out controls with individualized locks.

4. Equipment Guards and Mounting

a. Guards

Belts, pulleys, and other exposed moving equipment parts must be guarded. Equipment covers should be in place.

b. Instruction Manuals

Operator manuals should be available. Workers using the equipment should know where such manuals can be found and should review the manuals prior to using the equipment.

c. Mounting

Equipment designed to be used in a particular location should be permanently fixed in place to prevent movement from vibration or earthquake. This is especially important for equipment which may topple (e.g., a drill press) or which needs to be balanced (e.g., a centrifuge).

5. Confined Spaces

Laboratories may contain equipment (such as large tanks or ovens) or facility arrangements (such as tunnels, sumps or pits) that laboratory staff may need to enter. Since potentially hazardous exposures may occur in a confined space, the space will need to be controlled as a permit-required confined space. Special training and other precautions are required for permit-required confined space entry. Contact EH&S at 206-543-0465 for space evaluations and to schedule training.

F. PRESSURE VESSELS AND SYSTEMS

1. Vessels

Pressure vessels, autoclaves, and steam sterilizers operating at pressures greater than 15 pounds per square inch gauge (psig) or larger than six inches in diameter fall within the **Washington State Boiler Codes** for public spaces. As such, there are strict requirements for design, testing, and approval. The units must be placed on the University's insurance carrier's inspection list maintained by Facilities Services.

2. Pressure Systems

Pressure vessels and systems with operating pressures greater than 15 pounds per square inch gauge (psig) are of potential concern. Design should produce a protection factor of 4:1 up to 10:1, depending upon design parameters and whether the system can be safely tested. A pressure relief device to release safely pressures greater than 10% above the operating pressure should be installed.

3. Precautions

a. Large-Scale Processes

Large-scale processes (exceeding 100 psig or involving more than 10 to 20 grams of reaction compounds) should be carried out in containment devices designed for high pressures.

b. Hazards

Hazards from explosions due to over-pressurizations include flying scraps, glass, and spills of potentially harmful reaction compounds.

c. Small Scale/Low Pressure Procedures

Avoid damage during small-scale/low-pressure procedures. Procedures to avoid damage include the use of barriers, use of undamaged components, use of tubing and glassware designed for the temperatures and pressures involved, and application of the minimal amount of cold (such as using dry ice) or heat (such as using low-temperature steam) instead of the application of extreme temperatures or spot applications.

G. DECONTAMINATION OF WORK AREAS

Laboratory personnel are responsible for providing a clean and unobstructed work area for all maintenance and service personnel. Floors should be cleaned regularly and kept free of obstructions.

1. Custodial Services

UW Custodial Services will clean floors in laboratories only if requested. Contact Custodial Services at 206-685-1500 on the Seattle campus; (refer to Appendix F) for contact numbers for Facilities Services at other locations. Custodial floor care equipment should not be used to clean up spills or chemical residue.

2. Servicing of Lab Area or Equipment

If facility workers need to service an area or equipment, ensure the area/equipment is unobstructed, emptied of chemicals, decontaminated, washed with warm, soapy water and rinsed. The area or equipment must have a posted *Notice of Laboratory Equipment Decontamination Form (UoW 1803)* before service will be provided. This form is available online at http://www.ehs.washington.edu/forms/fso/lab_equip.pdf.

Facilities Services and maintenance personnel will refuse the work if the area or equipment has not been decontaminated and/or cleaned. Staff look for visible debris, absorbent pads or papers taped to surfaces, and visible or sticky spilled materials when determining if the area or equipment is clean.

If laboratory staff may not be present when service personnel are scheduled to arrive, leave a note stating a contact name and phone number in case there are questions about the work.

H. DECONTAMINATION OF EQUIPMENT FOR DISPOSAL

Laboratory equipment is often contaminated with hazardous materials and/or may be inherently unsafe. UW Surplus Property cannot accept some types of laboratory equipment and cannot accept laboratory equipment containing hazardous materials.

To surplus contaminated or potentially contaminated laboratory equipment, you must first make sure that the equipment is safe for handling and resale by following the directions on the Notice of Laboratory Equipment Decontamination (U o W 1803 at http://www.ehs.washington.edu/forms/fso/lab_equip.pdf). The Chemical Hygiene Officer (Laboratory Supervisor or PI) must sign the notice to certify that all of the applicable instructions on the form have been followed. Affix the notice to the equipment. Surplus Property will not pick up equipment that does not have this notice attached or does not appear to be clean and empty.

Examples of equipment that must be decontaminated include: centrifuges, incubators, fume hoods, cryostats, ovens, BSCs, refrigerators, freezers, sinks, storage cabinets, lockers, bins, and tanks. (Tanks have the potential to be a “confined space hazard” and thus require special procedures. Call EH&S at 206.543.7388.)

Any equipment capable of generating dangerous radiation or containing radioactive sources must be checked by the EH&S Radiation Safety Office prior to public sale. Please contact the Radiation Safety Office at 206.543.6328. These items include:

- Gas chromatographs
- Germicidal UV lamps
- Lasers
- Scintillation counters
- X-ray equipment
- Any item with a radioactive sticker

The following items CANNOT be accepted by Surplus Property. Contact EH&S Environmental Programs at 206.616.5835 for information on how to dispose of these items:

- Capacitors and transformers

(Note: some equipment may contain transformers, such as x-ray equipment and electron microscopes. These may be accepted but must be drained of oil and the oil must have been tested and certified by EH&S as being non-PCB oil).

- Gas cylinders and other pressurized containers/vessels
- Instruments containing mercury
- Equipment containing asbestos, including but not limited to: autoclaves, laboratory ovens, and fireproof file cabinets; anything that produces high heat

The type of decontamination will vary depending on the hazardous material and the type of equipment. Note that personal protective equipment (PPE) should be used when decontaminating equipment. Below are some requirements and guidelines for decontamination, as well as contact information for questions.

1. Equipment Used to Process/Store Chemicals

Safely remove or drain chemicals from the equipment, including any oil or coolant. Collect the chemical(s) for reuse or dispose of as hazardous waste. If applicable, use an inert gas or liquid to purge or rinse out chemical residues. In some cases, rinseate will need to be disposed of as hazardous waste as well. See our website at www.ehs.washington.edu/epowaste or call EH&S Environmental Programs at 206.616.5835 for questions regarding hazardous waste disposal of chemicals and/or rinseate.

Decontaminate the equipment as necessary. For example, use solvents to remove viscous or non-water soluble contaminants. Then scrub decontaminated equipment thoroughly with warm, soapy water. Rinse and dry. Wash and/or rinse water and solvents may need to be managed as hazardous waste. Contact EH&S at 206.543.7388 for more specific information about decontamination.

2. Equipment Used to Process/Store Radionuclides

Conduct a thorough radiation survey of all accessible surfaces of the equipment with an appropriate instrument. If you detect radioactive contamination, you must clean the equipment with small amounts of warm detergent water. Avoid splash. Blot dry with paper towels. Commercial radiation decontamination solutions containing chelating agents may be helpful. Resurvey to assure that contamination is less than 100 counts per minute per 100 square centimeters of surface. If contamination persists or you have other questions, contact the EH&S Radiation Safety at 206.543.6328.

3. Equipment Used to Process/Store Biological Material

Remove all biological material from the equipment. Decontaminate with a 1:10 bleach solution. After 30 minutes of contact time, rinse metal surfaces. If you have specific biosafety questions, contact EH&S Research and Occupational Safety at 206.221.7770.

Before repair or relocation, biosafety cabinets (BSCs) must be decontaminated by EH&S or by a contractor approved by EH&S. For this service, contact EH&S at 206.543.0465.