Section 4 - Laboratory Equipment and Facilities

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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.

Each emergency eyewash must be activated weekly in accordance with Washington Administrative Code (WAC) 296-800-15035 to check that it works and provides 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, perhaps 30 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. Record this weekly test where it can be audited, such as in your lab notebook or lab equipment maintenance record book.

A hand held drench hose no longer qualifies as an approved eyewash station but may be used as a supplemental washing facility. Such drench hoses have been augmented with approved eyewashes through a special project. 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.

Emergency showers are tested annually by Facilities Services to ensure they continue to meet ANSI standard water flow requirements. A tag indicating the most recent test date should be found on the equipment. Contact your servicing Facilities Services organization (Appendix F) if a test or maintenance is needed.
B. FIRE SAFETY EQUIPMENT

1. 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. Incompatible Chemicals

Do not store incompatible chemicals in these cabinets.

f. Cabinet Doors

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

g. Secondary Containment

There should be a secondary containment on each shelf and at the bottom of the unit. These plastic or rubber trays retain spills.

h. Unapproved Storage

Tops of cabinets are not storage shelves. Do not store combustible materials on or beside these cabinets.
2. **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](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>
<thead>
<tr>
<th>Table 4-1 Safety-Related Signs</th>
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<tr>
<td><strong>Description of Required Sign</strong></td>
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<table>
<thead>
<tr>
<th>Lab Caution Sign</th>
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<tbody>
<tr>
<td>NFPA 704 Hazardous Materials</td>
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<tr>
<td>Biohazard</td>
</tr>
<tr>
<td>Radioactive Materials</td>
</tr>
<tr>
<td>Entry requirements</td>
</tr>
<tr>
<td>Food and drink prohibitions</td>
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<tr>
<td>Lab contacts/phone numbers</td>
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</tbody>
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<tr>
<th>Emergency Procedures for Laboratories (Flip Chart)</th>
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<tr>
<th>Laboratory floor plan</th>
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<table>
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<tr>
<th>Area and equipment warnings</th>
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</thead>
<tbody>
<tr>
<td>&quot;Chemical Treatment Log&quot; for waste disposal sink (See LSM Section 3.F.3)</td>
</tr>
<tr>
<td>&quot;Natural gas emergency shut off valve&quot; (Must be posted if valve is present.)</td>
</tr>
<tr>
<td>&quot;Laboratory water – do not drink&quot; (Must be posted on non-potable water outlets.)</td>
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</tbody>
</table>

1. **Lab Caution Sign**

A standard UW Lab Caution sign is required to be posted at each lab entrance in a plexiglass 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. To see a sample sign visit the EH&S website at [http://www.ehs.washington.edu/fsohazmat/labsign.shtm](http://www.ehs.washington.edu/fsohazmat/labsign.shtm)

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 personal (PI, Lab Manager, 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. More information on the contents of the signs is detailed below.
a. **NFPA 704 Hazardous Materials Sign**

The lab caution sign meets fire code requirements that visible hazard identification signs as specified in the NFPA 704 standard be placed at entrances to locations where hazardous materials are stored, dispensed, used or handled in quantities requiring a permit. For more information on this requirement visit the EH&S website at http://www.ehs.washington.edu/fsohazmat/labsign.shtm#diamond.

Below the NFPA diamond on the lab caution sign will be a list of chemical hazard classifications (as defined by the NFPA 704 standard) that are found in the lab inventory in amounts that meet or exceed the fire permit threshold. To see a list of hazard classifications and threshold limits visit the EH&S website at http://www.ehs.washington.edu/fsohazmat/thresholds.pdf.

b. **Biohazard Signs**

The Lab Caution Sign will display a biohazard symbol if the lab is approved for biohazard use at the BSL-1, BSL-2 or BSL-3 level. Additional signs are required for BSL-2 and BSL-3 labs. The lab caution sign does not replace the biohazard sign required to be posted on the lab door when agents are in use. For more information on biohazard warning signs and labels visit: http://www.ehs.washington.edu/rbsbiosafe/postbz.shtm.

Biohazard areas are indicated by the symbol in Figure 4-1. All workers in the laboratory must be familiar with this symbol and aware of the presence of the hazard.

*Figure 4-1  Biohazard Warning Symbol*

![Biohazard Symbol](image1)

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c. **Radioactive Materials Sign**

The Lab Caution Sign will display a radiation propeller if the lab is approved for the use of radioactive materials. Separate signs are required for posting “radiation areas” and for X-ray radiation warnings.

Areas where radioactive materials are used or stored are indicated by the symbol in Figure 4-2. All workers in the laboratory must be familiar with this symbol and aware of the presence of the hazard.

For more information, refer to Section 10 of the UW Radiation Safety available online: http://www.ehs.washington.edu/manuals/rsmanual/10posting.pdf.

*Figure 4-2  Radiation Warning Symbol*

![Radiation Symbol](image2)
d. **Compressed Gas Symbol**

Fire codes require that rooms or cabinets containing compressed gases shall be conspicuously labeled. The lab caution sign will display the following symbol when compressed gases are in the lab.

![Compressed Gas Symbol](image)

**Figure 4-3** Compressed Gas Symbol

e. **Entry Requirements**

This area of the lab caution sign allows labs to indicate if there are personal protective clothing or eye protection requirements for entry into the lab. Occupational health requirements such as medical screening or immunizations can also be indicated here.

![Entry Requirements](image)

**Figure 4-4** Entry Requirements

f. **No Food or Drink in Laboratories**

Since numerous regulations prohibit food or drink consumption or storage in laboratories, the lab caution sign will always display a "no Food or Drink" image. In addition, lab personnel must label refrigerators, freezers, microwave ovens and other locations where food and beverages are not to be consumed or stored. Food prohibition stickers for refrigerators and freezers can be obtained from EH&S at 206-543-0465 or by emailing to uwcho@uw.edu.

![No Food or Drink in Laboratories](image)

**Figure 4-5** No Food or Drink in Laboratories
g. Lab Contact Information

There is space to enter up to four lab contacts on the lab caution sign with two phone numbers for each. One name with a work phone number is required. After-hours phone numbers are strongly recommended. If after hours home or cell phone numbers are not included on the lab caution sign for privacy/security reasons (since the sign is in public hallway) these numbers should be written on the Emergency Procedures for Laboratories flip chart posted inside the lab.

2. Emergency Procedures for Laboratories (Flip Chart)

Post the UW Emergency Procedures for Laboratories flip chart inside your lab in a prominent location. It contains detailed emergency procedures and phone numbers for eight different emergency situations. There is space on the front cover to write in emergency contact numbers for the lab. Provide numbers for lab personnel to be called in case of fire, accident, hazardous chemical spill or other emergency.

3. Laboratory Floor Plan

A plan showing evacuation route(s), as well as emergency and safety equipment locations should be posted prominently in each laboratory. See Appendix C for an example of a laboratory floor plan. If particularly hazardous substances are used in a designated area, the floor plan 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.

The Lab Caution Sign at the entrance to all laboratories displays a “No Food or Drink in Laboratories” image.

5. Area and Equipment Warnings

Operation and warning signs and labels must be posted on such items as alarm systems, biosafety cabinets, and fume hoods (sash opening height). Warnings may also need to 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. These signs may be mandatory depending on the degree of hazard and possibly on local codes. Contact EH&S for information on specific requirements.

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 at [http://www.ehs.washington.edu/fsfumehoods/approvedfumehoods.shtm](http://www.ehs.washington.edu/fsfumehoods/approvedfumehoods.shtm).

a. Fume Hood Use
   
   1) Training – Personnel using fume hoods should take the on-line training class (at [http://www.ehs.washington.edu/fsfumehoods/index.shtm](http://www.ehs.washington.edu/fsfumehoods/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. 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 of thumb 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 cap them. 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 the material must 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 the storage cabinets below the hood or to the sides of the hood. If this 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.

3) See Section G.2 below for details and the required form.

c. Fume Hood Performance and Testing

EH&S performs a functional performance test as part of its laboratory survey program. This test is to be performed at least every two years but is typically done closer to an annual frequency 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, containment and 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 - Using visual powder or dry ice, check for effective containment.

5) Monitor Alarm Properly Functioning:
   - Confirm that the monitor has power and that it is properly calibrated. Raise the sash to reduce the face velocity below 80 LFM (60 LFM for low flow hoods) and to confirm that both the visible and audible alarm signals function.
   - Test the monitor’s mute function by pressing the mute button. Test the reset button.
   - This test fails if the monitor fails to alarm, is more than 10 FPM out of calibration, or if it 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 laboratory from the biohazards (infectious agents) of the experiment by drawing air across the samples and away from the worker and into a HEPA filter.

   There are two types of BSCs. The 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 a 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 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 use of a “ductless hood” is requested for approval 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 and 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 your servicing Facilities Services organization (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. 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 where it would impede exit, either during normal operations (such as a file drawer which may open into an aisle) or in case of equipment failure (such as chemical reactions escaping a fume hood placed at the entrance to a room). Hoses and electrical cords should be strung along the ceiling instead of crossing aisles on the floor.

b. 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.

c. Plumbing Systems

Place a strainer or mesh pad over all sink drains to prevent objects 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.

d. 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 your servicing Facilities Services organization (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.

e. 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.

f. 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 your servicing Facilities Services organization (see Appendix F).

3) If an unknown odor persists, contact EH&S at 206-543-0465.
g. Asbestos, Lead and Other Hazardous Facility Components

1) Asbestos – Asbestos may be found in various building components (often in plumbing insulation and fireproofing, and sometimes in floor tiles, ceiling tiles, wall finishes and other building materials). Asbestos may also 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 by a work order through Facilities Services. Contact EH&S at 206-543-0465 concerning asbestos questions.

2) Lead – As a building or equipment component, lead is frequently found in old paints on walls and metal surfaces, in paints used on the exterior of ships and buildings, as a barrier when density is needed (such as in an x-ray radiation shield) or as a weight when a heavy material is needed (such as an equipment counter balance). 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 Building Materials – Other structural materials that could present a health hazard include polychlorinated biphenyls (PCBs) in fluorescent light fixtures 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).

h. 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 for your supporting Facilities Services contact).

2. Electrical Hazards

Even small electrical currents passing through the body may cause injury or death. Observe the following precautions to reduce electrical risks.

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 some 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
Equipment must be properly grounded (using three prong plugs for 110 volt power), especially in “wet” areas. Electrical outlets in “wet” areas must have ground fault circuit interrupters (GFCIs). (However, these devices only interrupt flow of electricity to ground and may not stop flow of electricity when completing an electric circuit with two “live” wires.)

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. If 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
   arrange for 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 overpressurizations include flying scraps and glass and spills of potentially harmful reaction compounds.

c. Small Scale/Low Pressure Procedures
Avoid damage during small scale/lower 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 by using dry ice) or heat (such as by using low temperature steam) instead of 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 and 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 chemicals.
2. Servicing of Lab Area or Equipment

To protect maintenance and facility workers, any laboratory area or equipment needing servicing is required to be unobstructed, emptied of chemicals, decontaminated with a decontaminating chemical as needed, washed with warm, soapy water, and rinsed. The area or equipment must have a signed Notice of Laboratory Equipment Decontamination (UoW 1803) attached 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 are trained to reject servicing the requested area or equipment if it has not been decontaminated and/or cleaned. Conditions which can lead to service rejection include such things as visible debris from absorbents or glassware, “diapers” or papers taped to surfaces which were supposedly decontaminated and cleaned, and visible or sticky spilled materials.

If the laboratory is expected to be unattended when service personnel arrive, an informal note should be left stating a contact name and phone number in case there are questions about the work area or if equipment needs to be moved.

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 (UoW 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 transformers 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, 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 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](http://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, 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.