Owen Hall Cleanroom

Laboratory-Specific Chemical Hygiene Plan (LCHP)

Owen Hall rooms 427 through 445

9/4/2019

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# 1.0 PURPOSE

In accordance with *Oregon Administrative Rule (OAR) 437-002-0360 Toxic and Hazardous Substances* and the OSU CHP, the purpose of this Laboratory-Specific Chemical Hygiene Plan (LCHP) is to provide guidance and protocols for the protection of employees and visitors at Oregon State University (OSU) from the potential health hazards associated with chemicals used in the laboratory.

# 2.0 SCOPE

This LCHP applies to all employees and visitors working on laboratory scale operations involving laboratory use of hazardous chemicals in the Owen Hall cleanroom laboratory and is designed to serve as a guide to safely working in the laboratory. It shall also serve as a notice of some University policies and contains descriptions of best practices and standard operating procedures (SOPs) that should be followed in the Owen Hall cleanroom laboratory.

**This LCHP does not address all OSU and EH&S programs and policies relating to laboratory and chemical safety. Refer to the OSU CHP for additional information.**

ThisLCHP is a living document that shall be altered/updated as new information regarding safety, laboratory best practices, regulations, and procedures is discovered and as materials, processes, and equipment are added to or removed from the Owen Hall cleanroom laboratory.

# 3.0 DEFINITIONS

**Common Acronyms**

ACGIH American Conference of Governmental Industrial Hygienists

ANSI American National Standards Institute

CFR Code of Federal Regulations

DEQ Oregon Department of Environmental Quality

DOT Department of Transportation

EH&S OSU Department of Environmental Health and Safety

EPA Environmental Protection Agency

IARC International Agency for Research on Cancer

LCHP Laboratory-specific Chemical Hygiene Plan

LD50 Lethal Dose for 50% Mortality of a species exposed to a given chemical

LS/PI Laboratory Supervisor/Principal Investigator

MSDS Material Safety Data Sheets

NFPA National Fire Protection Association

NTP National Toxicology Program

OAR Oregon Administrative Rule

OSHA Occupational Safety and Health Administration

PEL Permissible Exposure Limit

PPE Personal Protective Equipment

SDS Safety Data Sheets (formerly known as MSDS)

SOP Standard Operating Procedure

**Action Level** -‑ A concentration designated in OSHA regulations for a specific substance, calculated as an 8‑hour time weighted average (TWA), that initiates certain required activities.

**Bloodborne Pathogen** --Pathogenic micro-organisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to, Hepatitis B Virus (HBV) and Human Immune Deficiency Virus (HIV).

**CHP** ‑‑ A written program developed and implemented that sets forth procedures, equipment, personal protective equipment and work practices that are capable of protecting employees from the health hazards presented by hazardous chemicals used in the laboratory.

**Combustible** --A material that has a Flash Point at or above 140° F.

**Contractor** -- An individual who is on site to complete a contracted responsibility and whose direct compensation is not being paid by OSU.

**Designated Area** ‑‑ An area that may be used for work with select carcinogens, reproductive toxins or substances that have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of a laboratory or a device such as a laboratory hood.

**Employee** -- An individual paid by OSU or a LS/PI who is employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments. This may include faculty, staff, post-doctoral fellows, graduate students, and student workers.

**Flammable Liquid** --A material that has a flash point below 140° F and a vapor pressure not exceeding 40 pounds per square inch, absolute (psia) at 100° F.

**Hazardous Chemical** ‑‑ A chemical for which there is statistically significant evidence, based on at least one study conducted in accordance with established scientific principles, that acute or chronic health effects may occur in exposed employees. The term “health hazard” includes chemicals that are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents that act on the hematopoietic systems and agents that damage the lungs, skin, eyes or mucous membranes.

**Laboratory** ‑‑ A workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

**Laboratory Scale** -‑ Work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person. Also may be called Bench Scale.

**Laboratory Standard** -- The procedures and standards encompassed by *OAR* *437-002-0360*

**Laboratory Use of Hazardous Chemicals** ‑- Handling or use of such chemicals in which all of the following conditions are met.

1. Chemical manipulations are carried out on a laboratory scale.
2. Multiple chemical procedures or chemicals are used.
3. The procedures involved are not part of a production process nor in any way simulate a production process.
4. Protective laboratory practices and equipment are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

**Permissible Exposure Limit (PEL)** -- For laboratory uses of OSHA regulated substances, the employer (i.e., OSU or the Principle Investigator responsible for the laboratory) shall assure that employees’ exposures to such substances do not exceed the permissible exposure limits specified in 29 CFR Part 1910, Subpart Z.

**Reproductive Toxins** ‑‑ Chemicals that affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogens).

**Select Carcinogen** -‑ Any substance that meets one of the following criteria:

1. It is regulated by OSHA as a carcinogen; or
2. It is listed under the category “Known to be Human Carcinogens”, in the latest Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or
3. It is listed under Group 1 (carcinogenic to humans) by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or
4. It is listed in either Group 2A or 2B by IARC or under the category “Reasonably Anticipated To Be Human Carcinogens” by NTP
5. It is designated by the OSU Chemical Safety Committee as an OSU-regulated extreme-hazard or high-hazard carcinogen.

**Shall/Should** -- In this document, "shall" indicates a required condition or action; "should" indicates a preferred laboratory practice or condition.

**Visitor** -- An individual on the OSU campus not defined as an employee, who is on site by invitation and is not present in a contractual capacity.

# 4.0 RIGHTS and RESPONSIBILITIES

## 4.1 Employee Rights

The University and all departments with labs conducting research are required to advise employees of their rights regarding the OSU CHP. It is to an employee’s advantage to read and understand the OSU CHP, the LCHP prepared by their LS/PI, and to understand their legal rights.

1. Employees shall receive training on the hazards associated with chemicals and on the measures they can take to protect themselves from those hazards.
2. Employees who may be exposed to hazardous chemicals shall have access to the following information upon request:

* Chemical exposure information
* Workplace chemical inventory
* Laboratory-specific CHP
* Safety Data Sheets
* Standard Operating Procedures

1. The employer shall provide employees with appropriate PPE free of charge.
2. Employees who have been exposed to hazardous chemicals shall have access to:

* Medical Consultation and Examinations
* Records of their Medical Consultations and Examinations
* Results of Exposure Monitoring

1. Employees have a right to file a complaint against the University regarding alleged violations of the Laboratory Standard *(OAR 437-002-0360)* without fear of retribution.

Questions about employee rights or any part of the CHP should be directed to EH&S.

## 4.2 Responsibilities

**Department Head** -- The Department Head (or their appointee) shall serve as a departmental point of contact for EH&S and shall:

1. Be responsible for helping communicate local, state, and federal regulations, as well as OSU policy to department faculty, staff, and employees.
2. Ensure that LSs/PIs vacating a laboratory space decontaminate and clean all equipment, work areas, and storage areas prior to another LS’s/PI’s use of the laboratory. A vacating LS/PI shall initiate the [*EH&S Chemical Laboratory Decontamination and Checkout Procedure*](http://oregonstate.edu/ehs/sites/default/files/pdf/si/chem_lab_decon_si031.pdf) by contacting EH&S as soon as said LS/PI knows they will be vacating a laboratory.

**Lab Supervisor/Principal Investigator** --The LS/PI is the individual who has primary responsibility for safety in the laboratories under their control. This individual shall:

1. Develop a laboratory-specific CHP (LCHP) for their laboratory. The LCHP shall contain detailed SOPs for each piece of laboratory equipment and process.
2. Prepare laboratory-specific SOP’s for all hazardous laboratory operations that reflect appropriate safety practices and precautions. Form 2 in Appendix I can be used to perform a job hazard assessment to aid in writing SOPs or may be used as a supplement to an SOP.
3. Have a working knowledge of the OSU CHP.
4. Maintain a copy of the current LCHP and SOPs in the laboratory and document that all employees have read and understood the LCHP and SOPs.
5. Ensure employees work in accordance with the LCHP and SOPs.
6. Review and update the LCHP at least annually and any time a new piece of equipment or process is added to the laboratory. The current LCHP and SOPs shall be maintained for easy access in either electronic (website, .pdf) or paper form. A Laboratory Safety Resources Folder, available from EH&S, can be used to house the LCHP and SOPs. EH&S will periodically ask to see these records.
7. Ensure PPE is available and in good condition.
8. Provide and document required safety training for employees and students that work in their laboratories. An example training acknowledgement form (Form 3, Appendix I) is available in this CHP. The training listed on these forms should be detailed and laboratory-specific. A new form shall be completed and filed as employees are trained to use new processes and equipment. Completed forms should be maintained in the Laboratory Safety Resources Folder and/or as .pdf documents.
9. Perform and record Laboratory Safety Assessments using Form 1 in Appendix I [*(current version available on the EH&S website)*](http://oregonstate.edu/ehs/sites/default/files/pdf/laboratory_safety_assessment.pdf). Completed forms should be filed in the Laboratory Safety Resources Folder and/or electronically as .pdf files. This assessment shall be completed at least annually, but EH&S strongly encourages performing this assessment regularly, preferably on a quarterly basis.
10. Investigate near-accidents/near-misses, and document these incidents (Appendix I, Form 4). With the goal of improving laboratory safety in mind, encourage employees to report near-accidents/near-misses, as these are important leaning opportunities. Safety improvements to equipment or procedures may occur as a result of discussing these incidents.
11. Investigate injuries and overexposure events. Appropriately document and report injuries/overexposure events to human resources. Request the help of Human Resources and EH&S as necessary.
12. Evaluate the need for PPE and/or chemical exposure/environmental monitoring. Job Hazard Assessment and PPE Recommendation forms are available in Appendix I of this CHP and should be completed prior to the use of new laboratory procedures, processes, or equipment. Employees should be involved in the hazard assessment process.
13. Be aware of activities that require EH&S oversight or approval prior to beginning work or purchasing equipment. Prior approval forms are available in Appendix I of this CHP. An [*Authorization Application*](http://oregonstate.edu/ehs/rso/rso_forms) shall be submitted prior to acquiring and using radioisotopes or x-ray emitting equipment. Work with potentially hazardous biological agents and/or recombinant DNA shall be registered with the [*Institutional Biosafety Committee*](http://oregonstate.edu/ehs/bio). Use of extreme-hazard or high-hazard carcinogens requires approval by or registration with the [*chemical safety committee*](http://oregonstate.edu/ehs/carcinogen-safety-manual)*.* Records related to research programs requiring EH&S oversight shall be maintained in the Laboratory Safety Resources Folder and/or electronically.
14. Report any deficiencies that require Departmental or higher-level action to the Department Head and EH&S.
15. Serve as a positive example to all other employees by wearing appropriate PPE upon entering and working in a laboratory, encouraging good housekeeping and chemical hygiene practices, and following the LCHP and SOPs.
16. Prior to the termination of an employee, ensure that any equipment, work areas or storage areas used by the employee are clean and decontaminated. Ensure that any hazardous or infectious waste generated by the vacating employee is properly labeled [*(label template available on the EH&S website)*](http://oregonstate.edu/ehs/sites/default/files/pdf/hwlabelfull.pdf) prior to the worker’s termination. Ensure work and storage areas are free of samples, chemical or biological residues, and hazardous and non-hazardous waste.
17. Initiate the [*EH&S Chemical Laboratory Decontamination and Checkout Procedure*](http://oregonstate.edu/ehs/sites/default/files/pdf/si/chem_lab_decon_si031.pdf) well before vacating a laboratory. Ensure that upon vacating a laboratory space, all equipment, work areas, and storage areas are clean and decontaminated prior to a new LS’s/PI’s use of the laboratory. Ensure that any hazardous or infectious waste is labeled and disposed of properly. Work and storage areas should be free of samples, chemical or biological residues, and hazardous and non-hazardous waste, in preparation for the next LS/PI that will occupy the laboratory.

**Employee** -‑ Each employee is responsible for planning and conducting all laboratory operations in accordance with the OSU CHP, their LS’s/PI’s LCHP and SOPs, developing good chemical hygiene and housekeeping habits, selecting and using appropriate PPE, reporting safety deficiencies to the LS/PI, and taking advantage of appropriate training opportunities.

# 5.0 GENERAL LABORATORY PROCEDURES

## 5.1 Behavior in the Laboratory

1. Employees should act in a professional manner at all times.
2. Employees should not conduct potentially dangerous experiments while alone.
3. Any visitor to the laboratory is to be escorted by an employee and is the responsibility of that employee. Refer to Section 15. Appropriate safety rules shall be observed.
4. While conducting unattended operations, employees shall leave lights on, place appropriate information on an *Overnight/Unattended Lab Reaction* form (Appendix I, Form 4) and provide for containment of hazardous substances in the event of a catastrophic failure (such as cooling water).

## 5.2 Avoidance of Routine Exposures

1. Avoid skin contact with chemicals.
2. Do not smell or taste chemicals.
3. Use a vacuum or pipette bulb. Do not pipette by mouth.
4. Vent any experiment that may discharge toxic or noxious chemicals into a local exhaust device (e.g., a chemical fume hood).
5. Flammable, corrosive, or toxic volatile materials shall be vented or trapped when they are evaporated, for example with rotary evaporators or similar devices.
6. Water aspirators are not to be used when trapping hazardous chemicals, including common flammable solvents.
7. Plan operations, equipment, and protective measures based on knowledge of the chemicals in use.
8. Employees shall be aware of the location and proper operation of lab safety/emergency equipment (first aid kit, fire extinguisher, chemical spill kit, eyewash, etc.).
9. Employees shall report unsafe laboratory practices or conditions to the LS/PI. The LS/PI should correct unsafe practices or conditions immediately.

## 5.3 Personal Habits in the Laboratory

1. Eating, drinking, and cosmetic application are not permitted in laboratories.
2. Food may not be stored in a refrigerator that has been used or is being used to store chemicals.
3. Ice produced by ice machines for laboratory use shall not be used for beverages, food, or food storage.
4. No glassware or utensils used for laboratory operations shall be used for storage, handling, or consumption of food or beverages.
5. Wash hands before using the restroom and before eating, smoking, or applying cosmetics. Wash areas of exposed skin, e.g. forearms, frequently if there is potential for contact with chemicals.
6. Confine long hair and loose clothing.
7. Wear closed-toe shoes at all times in the laboratory.
8. Wear appropriate PPE in the laboratory as necessary.
9. Employees shall be alert to unsafe conditions and shall ensure that such conditions are corrected when detected.
10. Clean up any spills on work surfaces as soon as possible to prevent chemical residue accumulation.
11. Eye protection shall be worn by employees whose jobs expose them to eye hazards in accordance with the[*OSU Safety Policy and Proceure Manual (Ex4: List of Personal Protective Equipment)*](http://oregonstate.edu/fa/manuals/saf/ex4) (also refer to Section 10.1).
12. Use engineering controls (e.g., hoods, centrifuge rotor hoods) appropriately to minimize chemical exposure.

## 5.4 Housekeeping

* + - 1. Each employee is responsible for maintaining a clean and uncluttered work space. This will help prevent spillage, breakage, personal injuries, and unnecessary contact with chemicals.
      2. Lab workers are jointly responsible for common areas of the laboratory.
      3. Spills shall be cleaned up immediately from work areas and floors.
      4. Doorways and walkways within the lab shall not be blocked or used for storage.
      5. Windows in lab doors shall not be covered. Windows allow for emergency response personnel to be able to see into the room to assess the situation without entering.
      6. Access to exits, hallways, emergency equipment, and utility controls shall not be blocked.
      7. Equipment and instrumentation shall be cleaned to remove spillage and contamination before repair or calibration service is requested, and service personnel shall be informed of any hazardous contamination prior to servicing.

# 6.0 CHEMICAL PROCUREMENT, DISTRIBUTION, STORAGE, and DISPOSAL

## 6.1 Procurement

1. The decision to purchase a chemical shall be a commitment to handle and use the chemical properly from receipt through disposal.
2. Before purchasing any new chemical the following information shall be considered:
   1. Proper storage and handling procedures,
   2. Proper disposal procedures,
   3. Presence of adequate facilities to handle and store the material safely, and
   4. Adequate training for personnel handling the material.
3. Workers shall be informed of how to access electronic or paper copies of SDSs.
4. No container should be accepted into a laboratory without an adequate identifying label. The label should include, at a minimum, the chemical name and an appropriate hazard warning, including target organ effects. This is particularly helpful for EH&S workers who handle chemical disposal. Chemical nomenclature or abbreviations alone are not sufficient.

## 6.2 Hazardous Chemical Inventory

Each laboratory shall maintain an [*electronic chemical inventory*](http://oregonstate.edu/ehs/cheminv), which shall be updated as chemicals are acquired by or removed from the laboratory. The inventory shall be maintained using EHSA software that is accessible via the EH&S website. Chemicals and samples created in the laboratory shall also be properly labeled (see sections 6.3 and 7.0) and entered into the electronic chemical inventory. Unused, expired, or unwanted chemicals should be donated to the [*Chemical Recycling Program*](http://oregonstate.edu/ehs/hmgnonhaz) or shall be submitted to [*EH&S for disposal*](http://oregonstate.edu/ehs/sites/default/files/webform/chempickup.html).

## 6.3 Storage

1. Stored and working amounts of hazardous chemicals shall be kept to a minimum.
2. Minimize storage of chemicals at the lab bench, in hoods, and other work areas.
3. All chemical containers shall have a legible and firmly attached label with, at a minimum, the name of the compound and appropriate hazard information. If the container is too small, the name of the compound is sufficient for storage.
4. Chemicals shall be stored in containers with which they are chemically compatible.
5. Liquids shall be stored in suitable secondary containment, such as polyethylene trays. Mineral acids shall be stored in acid-resistant secondary containment.
6. Chemical reagents shall be kept in closed containers when not in use.
7. Compressed gas cylinders shall be properly secured at all times. Cylinder caps should be in place on cylinders when not in use. Use straps, chains, or stands to support the cylinders. Straps or chains shall be firmly attached to a permanent structure and at the correct height for the cylinder that is being secured (i.e., in the top third of the cylinder but below the cylinder’s shoulder).
8. Incompatible chemicals shall be segregated. At a minimum, acids, bases, flammables, and oxidizers should be segregated within the laboratory. Water reactive materials shall be separated from all other chemicals. Separate oxidizers from flammable, combustible, and organic material. Separate acids from bases and acid-sensitive materials such as cyanides and sulfides.
9. Highly toxic materials should be stored in a secure manner.
10. Glass chemical containers shall not be stored on the floor.
11. See Appendix III, Table 1 for maximum allowable container sizes and types for flammable and combustible liquid storage.
12. Laboratories with chemical storage areas shall have a standard OSU "CAUTION" sign that identifies emergency contact personnel. Contact EH&S for signs and refer to the [*Lab Hazard Sign Safety Instruction*](http://oregonstate.edu/ehs/sites/default/files/pdf/si/lab_hazard_sign_si028.pdf)on the EH&S website.
13. Stored chemicals shall be inspected at least quarterly for expiration, deterioration, and container integrity. The inspection should detect corrosion, deterioration, or damage to the storage facility (cabinet, shelf, etc.) as a result of leaking chemicals. This information should be recorded, reported to the LS/PI, and any damage should be repaired.
14. Expired chemicals shall not be stored or used in laboratories and shall be relinquished to EH&S personnel for disposal.
15. Refer to the [*Chemical Storage Guidelines Safety Instruction*](http://oregonstate.edu/ehs/sites/default/files/pdf/si/chemical_storage_guidelines_si030.pdf) on the EH&S website.
16. Food shall not be stored in refrigerators with chemicals or in refrigerators that have ever been used to store chemicals. Refrigerators shall be appropriately labeled to indicate the materials stored inside.
17. It is recommended that rooms in which chemicals are used or stored be secured to prevent unauthorized access.

## 6.4 Disposal

Waste Disposal procedures for chemical, infectious, sharps and other hazardous wastes are contained on the [*Safety Instructions*](http://oregonstate.edu/ehs/safety-instructions) page on the EH&S website.

**Disposal of Materials of Uncertain Composition (“Chemical Unknowns”)**

Disposal of hazardous waste is dangerous and expensive, even when the contents of the waste are identified. Without mitigating information, all unknown materials have to be treated as if they are potentially hazardous. In all cases, chemical unknowns cannot be disposed of until a general profile of the unknown has been generated. Even then, the cost of disposal is a premium. Additionally, there is a threat of personal injury or death to the individuals required to handle these potentially dangerous materials.

The obvious goal is to reduce the number of “unknowns” to zero by labeling all chemical containers, disposing of all old, outdated and questionable chemicals and samples, recycling unneeded chemical reagents, and maintaining separate waste containers for different classes of chemical wastes. This will reduce the number of unknowns and **shall be considered standard laboratory practice**.

It is the responsibility of the generator to identify each “unknown” as completely as possible before submitting an “unknown” to EH&S. A Hazardous Waste Label [*(template and guidelines are on the EH&S website)*](http://oregonstate.edu/ehs/waste) shall be completed with as much information as possible and affixed to the container.

Liquid biological cultures that have been properly autoclaved may be disposed of via the sanitary sewer (down a sink drain), provided they contain no hazardous chemicals. Liquid environmental samples (rainwater, lake water, etc.) may be disposed of via the sanitary sewer with no prior treatment, provided no hazardous chemicals have been added to the sample. Solids, oils, and gels shall not be disposed of via the sanitary sewer.

**Note**: It is illegal to dispose of hazardous chemical waste in an inappropriate manner. If you are unsure of how to properly dispose of chemicals/material, contact EH&S.

# 7.0 LABELING CHEMICAL CONTAINERS

1. All chemical containers shall have a legible, firmly attached label showing the contents of the container and hazard information.
2. Contents shall be written legibly in plain English language in addition to any abbreviations.
3. Labels on incoming containers of hazardous chemicals shall not be removed or defaced.
4. SDSs for hazardous chemicals in a given laboratory shall be available to all employees in the laboratory by accessing the [*MSDS Online Database*](http://oregonstate.edu/ehs/msds) via the EH&S website.
5. If a chemical substance is produced in the laboratory for another use outside of the laboratory, the SDS and labeling provisions of the OSHA Hazard Communication Standard apply *(OAR 437-002-0360)*. The LS/PI shall ensure these requirements are met.
6. Chemical substances developed in the laboratory shall be assumed to be hazardous in the absence of other information. Such chemicals shall be labeled [*(label template available on the EH&S website)*](http://oregonstate.edu/ehs/sites/default/files/pdf/hwlabelfull.pdf) and stored in appropriate containers. Appropriate PPE shall be worn when handling chemical substances developed in the laboratory, and a SDS shall be created.

# 8.0 EXPOSURE MONITORING

1. EH&S shall be responsible for exposure monitoring.
2. Employee exposures to any substance regulated by an OSHA standard shall be measured when there is reason to believe that exposure levels routinely exceed the action levels specified in *29 CFR 1910, Subpart Z*.
3. Employee exposures to OSHA regulated substances shall not exceed the permissible exposure limit (PEL) specified in *29 CFR 1910, Subpart Z*. PPE and engineering controls should be used to prevent employee exposure.
4. Monitoring results shall be provided to EH&S, the LS/PI and to the employee.

# 9.0 MEDICAL PROGRAM

## 9.1 General Provisions

1. An opportunity for medical surveillance, including medical consultation and follow‑up, shall be provided under the following circumstances:
   1. Where exposure monitoring is over the action level for an OSHA regulated substance that has medical surveillance requirements.
   2. Whenever an employee develops signs or symptoms that may be associated with a hazardous chemical that the employee may have been exposed to in the laboratory.
   3. Whenever a spill, leak, or explosion results in the likelihood of a hazardous exposure, as determined by EH&S.
   4. To all employees required to wear a respirator.
   5. To all emergency response team members.
2. All examinations shall be provided by or under the supervision of a licensed physician, at no cost to the employee, without loss of pay, and at a reasonable time and place. A physician experienced in occupational medicine shall be used whenever possible.
3. Each laboratory should have a first aid kit (see Section 11.6) that shall be maintained and checked for expired or missing items. Medical assistance, if required, is available by calling 911 or (541) 737-7000 (OSU Public Safety). It is strongly recommended that laboratory personnel maintain proficiency in First Aid, including bloodborne pathogen protocols, through training courses from EH&S.
4. Where medical consultations or examinations are provided, the examining physician shall be provided with the following information:
   1. The identity of the hazardous chemical(s) to which employees may have been exposed.
   2. A description of the conditions under which the exposure occurred including quantitative exposure data, if available.
   3. A description of the signs and symptoms of exposure that the employee is experiencing, if any.
5. For examinations or consultations provided to employees, a written opinion from the examining physician shall be provided to the employee.

## 9.2 Accidents

1. Call 911 for laboratory accidents that involve a personal injury that requires medical assistance and notify Public Safety at (541) 737-7000. For both calls, provide any available information on the nature of the accident, including any possible chemical or biological hazards that may be present.
2. Personnel responding to an injury that appears to require emergency first aid shall notify the LS/PI at the first safe opportunity.
3. A Report of [*Accident/Illness Form*](http://oregonstate.edu/ehs/sites/default/files/pdf/si/accident_recording_system_si018.pdf) shall be completed by the LS/PI and filed with Human Resources. Refer to the [*Accident Recording System Safety Instruction*](http://oregonstate.edu/ehs/sites/default/files/pdf/si/accident_recording_system_si018.pdf) on the EH&S website.
4. If a spill or incident represents a hazard to other building occupants, it should be reported immediately to them, the building supervisor, Department Head(s), EH&S, and to Public Safety.

# 10.0 PERSONAL PROTECTIVE EQUIPMENT

The OSU PPE Policy States:

*A general rule to follow is "use of personal protective equipment is required when there is a reasonable probability that injury or illness can be prevented by such equipment."*

*Reasonable engineering controls, such as increased ventilation, are preferable to personal protective equipment.   When employees are required to wear personal protective equipment, the cost of the equipment shall be considered a departmental or research program expense.*

***Supervisor Responsibility****Supervisors or instructors should consult with EH&S (7-2273) or another qualified person to assess hazards in areas where their employees work.  A determination will be made as to which areas require the use of personal protective equipment and the type and quality of the necessary equipment.  Supervisors and instructors are responsible for ensuring that workers, students, and visitors wear the protective equipment as specified.*

*The cost of this equipment may be charged against any approved departmental account.  Supervisors may obtain personal protective equipment through any approved commercial safety equipment supplier.  Supervisors should consult EH&S to ensure that the type of equipment selected is appropriate.*

*Supervisors are responsible for training their employees so they are able to identify situations that require the use of personal protective equipment and know how to properly use, care for and maintain the equipment.*

***Employee Responsibilities*** *Employees are required to wear personal protective equipment when determined necessary.  See* [*SAF-Ex4: List of Personal Protective Equipment*](http://oregonstate.edu/fa/manuals/saf/ex4)*.*

EH&S further recommends that employees be advised on the proper selection, use and limitations of PPE before they are required to use the equipment as defined in appropriate SOPs and the Job Hazard Assessment (See Section 21.0 and Appendix I, Form 2). Personal protective equipment, excluding safety glasses and shoes, should be removed before leaving work areas.

## 10.1 Eye Protection

**EH&S Note Regarding Contact Lenses:**

EH&S does NOT recommend that contact lenses be worn in the laboratory for the following reasons:

* They can create a visual problem if suddenly displaced.
* Contact lenses are difficult to remove should chemicals get into the eyes and they tend to prevent the removal of contaminants by natural eye fluids.
* Soft contact lenses present special hazards. They discolor when they come into contact with many laboratory chemicals and can absorb chemicals and chemical vapors, causing extensive corneal damage before the wearer is aware of the problem.

## 10.2 Gloves

## 

## Nitrile gloves are available at the entrance to the Owen Hall cleanroom and are required to be worn in the laboratory at all times.

## Acid gloves are available at the wet bench and are required to be worn when performing wet etch.

## High temperature gloves are available at the oxidation/diffusion furnace and are required to be worn when operating the furnace.

## 10.3 Shoes

## Closed toed shoes are required in the Owen Hall cleanroom laboratory at all times, sandals and high heels are not allowed.

## 10.4 Clothing

## Full length pants are required in the Owen Hall cleanroom at all times.

## 10.5 Hearing Protection

## For special circumstances earplugs are available, but are not generally required in the Owen Hall cleanroom.

## 10.6 Respirators

## All processes that generate noxious fumes or vapors are to be carried out in a fume hood, consequently respirators are not commonly used in the Owen Hall cleanroom. If the need for a respirator application arises contact EHS for instructions.

# 11.0 EMERGENCY EQUIPMENT

## 11.1 General

Each employee shall be familiar with the location, application and correct use, where applicable, of the following equipment:

1. Fire extinguishers
2. Fire blankets
3. Fire alarms
4. Fire doors (shall remain closed and unobstructed)
5. Safety showers
6. Eye wash units
7. First aid kits
8. Spill Kits

## 11.2 Safety Showers and Eyewashes

1. Safety showers and eye washes should be easily accessible.
2. Eyewash units should be checked for adequate flow once a week by laboratory personnel who will run them until water is clear. Document this check on the tag that is hanging from or posted near the eyewash.
3. EH&S will test safety showers annually.

## 11.3 Fire Extinguishers

* 1. Fire extinguishers are provided in or near work areas and located along normal paths of travel. Access shall be maintained.
  2. Monthly inspections are performed by EH&S personnel, except when otherwise noted.
  3. University employees should not use fire extinguishers unless they have been formally trained in the proper operation of extinguisher use.
  4. Discharged and/or fire extinguishers that have lost pressure shall be immediately reported to EH&S [(541) 737-2273].

## First Aid Kits

1. First aid kits are supplied in each lab for treatment of minor injuries or for short term emergency treatment until medical assistance arrives.
2. First aid kits shall be kept in an accessible and marked location in each laboratory.
3. The LS/PI shall ensure that first aid kits are adequately stocked and maintained. Expired items shall be replaced as discovered. First aid kits shall be inspected as part of each lab’s periodic Lab Safety Assessments.

## 11.7 Chemical Spill and Containment Kits

A liquid chemical spill kit is located at the entrance to the Owen hall cleanroom. The kit contains absorbent towels to soak up a spill and plastic bags with zip ties to contain the used towels.

Each laboratory or area in which hazardous chemicals are used shall maintain a spill kit that is suitable for the types and volume of chemicals present. Contact EH&S for help in designing an appropriate spill kit. Also, refer to the [*Chemical Spill Response Safety Instruction*](http://oregonstate.edu/ehs/sites/default/files/pdf/si/spill_response-chemicals_si.019.pdf) on the EH&S website.

# 12.0 EMERGENCY PROCEDURES

In case of emergency vacate the lab immediately.

## 12.1 Chemical Emergency

1. Chemical emergencies such as large spills, spills involving highly hazardous or flammable materials, releases of toxic or corrosive gasses or substances should be treated as other types of emergencies. Pull the fire alarm and evacuate the building.
2. Call 911. Notify the dispatcher of the type of emergency; they will notify appropriate emergency personnel. In the main campus area, request assistance from the OSU EH&S chemical response team.
3. If you call 911, be sure to meet emergency personnel at the door. Give them any relevant information about the nature of the emergency and chemicals involved. Direct them to the exact location of the emergency.
4. If there are injured victims, provide the minimum necessary first aid only if there is no danger to yourself. If providing assistance will endanger you, do not attempt intervention. Wait for emergency response personnel at the front of the building.
5. If chemicals have splashed into the victim’s eyes, flush the eyes at an eyewash station for at least 15 minutes or until emergency medical personnel arrive and evaluate the accident.
6. If chemicals have splashed onto the victim’s body, drench the victim with water at a safety shower, while removing any contaminated clothing. Have a clean lab coat available to protect the modesty of the victim.
7. For small, low hazard spills:
   * + 1. Restrict access to the area and notify surrounding personnel.
       2. Use appropriate personal protective equipment and use suitable spill clean-up equipment and products that are designed for the type of spilled chemical.
       3. Contact EH&S if you need equipment or would like help designing a chemical spill kit.
       4. Package and dispose of the waste in an appropriate manner.
       5. Complete an Incident Report and notify the LS/PI.
8. For larger spills that do not constitute an emergency:
9. Restrict access to the area and notify surrounding personnel.
10. Notify Public Safety by calling (541) 737-7000, and they will notify the appropriate personnel in EH&S.

# 13.0 RECORD KEEPING

1. Accident/Incident records (not including medical records) shall be retained by Human Resources.
2. Medical records shall be retained by the employee undergoing medical surveillance and the attending physician’s office.
3. The following should be maintained by the LS/PI for at least 5 years (or for as long as an employee works in an LS’s/PI’s laboratory, in the case of employee training and acknowledgement forms), either in the Laboratory Safety Resources Folder and/or electronically as .pdf files:
4. Employee Training and Acknowledgement Forms
5. Laboratory Self Assessment Forms
6. Prior approval forms
7. Job hazard assessment forms
8. Annual equipment inspection records
9. Accident, injury, overexposure, near-miss, and damage to equipment/facilities incident reports
10. Any other EH&S documents (IBC documentation, radiation safety documents, etc.)

# 14.0 EMPLOYEE TRAINING

## 14.1 Training

* + - 1. All employees shall receive general chemical/laboratory safety training from their Department or from EH&S. Additionally, the LS/PI shall provide all employees with laboratory-specific training that addresses the hazards associated with their laboratory.
      2. The aim of the training program is to ensure that all individuals at risk are adequately informed about the work in the laboratory, its risks, and what to do if an accident occurs.
      3. This training shall be provided at the time of an employee’s initial assignment to a work area where hazardous chemicals are present. It shall also be provided prior to assignments involving new exposure situations, equipment, and chemicals. The training shall be coordinated through the LS/PI and/or EH&S.
      4. The training should include:
      5. Handling hazardous chemicals
      6. Exposure signs and symptoms
      7. Fire training: prevention and response
      8. Emergency response and evacuation
      9. Interpretation of SDSs
      10. First aid
      11. Protective clothing
      12. Chemical or infectious waste disposal
      13. Contents and availability of the CHP
      14. Review of PELs
      15. Laboratory hazards specific to work area, and if necessary
      16. Respirator protection and fit testing program
      17. Training shall be documented with the following information (see Appendix I, Form 3):

1. Trainer and/or media use
2. Content of Training
3. Attendees by signature and printed name
4. Date
5. Location

## 14.2 Reference Materials

* + - * 1. Reference materials on the hazards, safe handling, storage and disposal of hazardous chemicals can be found on the EH&S website.
        2. Safety data sheets (SDS) shall be maintained by the LS/PI as needed. SDSs are available from [*MSDS Online software*](http://oregonstate.edu/ehs/msds) on the EH&S website.

## 14.3 Training Resources

Training video:  <http://oregonstate.edu/ehs/training/lab_safety_training>

Training video:  <http://oregonstate.edu/ehs/training/hazwaste>

Training video:  <http://oregonstate.edu/ehs/training-materials> under Laboratory and Chemical Safety/Safety Data Sheets

Slide presentation:  <http://oregonstate.edu/ehs/lab-hazard-awarness-training-non-lab-personnel>

# 16.0 HOOD SAFETY AND VENTILATION

## 16.1 General Guidelines

General laboratory ventilation shall provide air flow into the laboratory from non‑laboratory areas and out to the exterior of the building.

Laboratory doors should remain closed, except for entry and egress.

## 16.2 Hood Use

All reactions that produce unpleasant and/or potentially hazardous fumes, vapors, and gases shall be performed within a fume hood.

The hood sash should remain closed when the hood is not in use. When adjustments need to be made to laboratory equipment or operations within the hood while chemical emissions are being produced, the hood sash should not be raised past the sash height indicated by the line on the inspection tag placed on the hood by EH&S.

## 16.3 Hood Maintenance and Inspections

Daily hood function inspections should be conducted by employees.

1. Visually inspect the hood area for storage of materials and baffle blockages.
2. Check flow monitor for airflow > 100 fpm.
3. If hood does not have a flow monitor, place a 1 inch wide by 6 inch piece of soft tissue paper at the hood opening and observe it for appropriate directional flow into the hood.
4. If the hood is not operating properly, notify your LS/PI and EH&S. An improperly functioning hood is considered a safety issue and needs to be remedied as quickly as possible, ideally the day the malfunction is noticed.
5. Annual hood inspections shall be performed and recorded by EH&S.

## 16.4 Ventilation Failure

* + - * 1. Questionable ventilation or requests to evaluate ventilation throughput or efficiency should be made to EH&S.
        2. Ventilation problems or fume hood alarms that are sounding should be reported to EH&S.
        3. In the event of a total or catastrophic ventilation failure:

1. Stop operations if possible. This may include stabilizing the experiment, shutting off utilities, closing the sash, and closing the laboratory door.
2. Otherwise, keep people from entering the lab.
3. Notify Public Safety at (541) 737-7000, and they will contact EH&S. Also notify the lab’s LS/PI.

# 17.0 WORK WITH CARCINOGENS AND HIGHLY TOXIC MATERIALS

The following safeguards shall be used for all work with “Select Carcinogens,” reproductive toxins (Appendix III, Table 8), and substances that have a high degree of acute toxicity.

Establish a “designated area”, unless the Chemical Safety Committee and EH&S decides after a case-by-case review that it is not necessary. The designated area may be an entire laboratory, an area of a laboratory, or a device in the lab, such as a hood. This area shall be clearly marked. Suggested signage is illustrated in Appendix II, Figures 1-3.

For chemicals that require prior approval (see Section 18), approval from EH&S is required before conducting work.

Control equipment (glove box, hood, etc.) is required.

Use proper storage procedures and PPE.

Keep records for the amounts of these materials on hand and the names of the workers using them.

Procedures for the prevention of spills and accidents, as well as emergency response, shall be implemented and understood by workers.

Follow procedures for decontamination or disposal of wastes and decontaminating the designated area.

The LS/PI shall prepare SOPs for all laboratory operations that involve substances that require designated areas for use. The SOPs shall include provisions for appropriate signs, labels and approvals for use.

Guidelines for classification of toxic or highly toxic substances based on the LD50 in albino rats are listed in Appendix III, Table 9.

A listing of a lab’s carcinogens, toxic, or highly toxic materials can be viewed from the on-line chemical inventory. Check with EH&S for current procedure.

# 18.0 OPERATIONS REQUIRING PRIOR APPROVAL

Use and storage of certain chemicals, mainly carcinogens and highly toxic chemicals, may require prior approval and registration with EH&S. A list of these [*chemicals, along with policies, procedures, and registration/authorization forms*](http://oregonstate.edu/ehs/carcinogen-safety-manual), can be found on the EH&S website.

Research with recombinant or synthetic nucleic acids, pathogenic microorganisms and toxins requires oversight by the OSU Institutional Biosafety Committee.  Information about the [*Biosafety Program*](http://oregonstate.edu/ehs/bio) can be found on the EH&S website. Research and education that involving the use of vertebrate animals requires oversight by the [*OSU Institutional Animal Care and Use Committee IACUC*](http://oregonstate.edu/research/iacuc/).

The Office of Radiation Safety (a Division of EH&S) has policies and procedures for the handling, use and disposal of radioactive materials. Seethe [“*Radiation Safety Manual”*](http://oregonstate.edu/ehs/rso) on the EHS website. The purchase and use of radiation-emitting equipment shall be approved by the Radiation Safety Officer prior to purchase.

# 19.0 STANDARD OPERATING PROCEDURE AND JOB HAZARD ASSESSEMNT GUIDELINES

Each laboratory should develop standard operating procedures (SOPs) specific to its operation. SOPs should be included for all commonly repeated procedures used by more than one employee and for procedures in which sufficient protection for an employee is not provided by the general practices described in the CHP. A detailed description of safe work practices and a Job Hazard Assessment outlining specific restrictions and the selection and use of personal protective equipment should be a part of each SOP (See Appendix I, Form 2).

## 19.1 Laboratory-Specific SOP Information

* + - 1. A laboratory-specific SOP is required when the general requirements cited in the CHP are insufficient to direct and protect employees in a commonly required and repeated laboratory procedure.
      2. See the EH&S website for examples of SOPs. SOP's shall be modified or created for use within specific laboratories.
      3. Lab-specific SOPs are included as Appendix IV of this LCHP.

# 20.0 REVIEW AND REVISION OF LCHP

The LS/PI shall review this LCHP at least annually, and revisions shall be made whenever a new process or potentially hazardous piece of equipment is added or removed from the laboratory.

# 21.0 PROCEDURES RELATING TO THE LCHP

## 21.1 Procedure 1 – Employee or LS/PI Vacating a Laboratory

The intention of the LCHP is to reduce exposure to hazardous chemicals in the laboratory. Materials left by departing employees can provide an unexpected source of exposure if proper clean-up, disposal, storage, and transfer of responsibility for hazardous materials is not accomplished.

LSs/PIs, students, graduate students and post-doctoral fellows shall be responsible for cleaning their laboratory area and apparatus, for storing chemicals and materials appropriately, and for disposing of waste materials correctly before leaving a department or laboratory space.

LSs/PIs shall be responsible for certifying, with documentation, that prior to termination of a employee, the following conditions have been met:

* + - 1. Laboratory area has been cleaned and glassware, apparatus and chemicals have been stored properly.
      2. All employee-generated chemicals have been properly identified, labeled [*(label template available on the EH&S website)*](http://oregonstate.edu/ehs/sites/default/files/pdf/hwlabelfull.pdf), and inventoried.
      3. All wastes and hazardous materials have been either disposed of or responsibility for them has been transferred to a continuing employee.
      4. All laboratory safety responsibilities have been reassigned to continuing employees.

The Department Head and EH&S shall be responsible for ensuring the above conditions have been met by PIs leaving the university or vacating a laboratory space. Cleaning and waste disposal for laboratory spaces shall NOT be the responsibility of new/incoming faculty, staff, students, or post-doctoral fellows. Refer to the [*Chemical Lab Decontamination and Checkout Safety Instruction*](http://oregonstate.edu/ehs/sites/default/files/pdf/si/chem_lab_decon_si031.pdf) on the EH&S website for additional information. Also refer to the [*Equipment Release Safety Instruction*](http://oregonstate.edu/ehs/sites/default/files/pdf/si/equipment_clearance_si064.pdf) on the EH&S website.

## 21.2 Procedure 2 - Safety Enforcement

OSU, specifically the President, faculty and staff, recognizes that we must comply with a variety of Federal, State, and Local mandates, including those issued by the Environmental Protection Agency (EPA), the Occupational Health and Safety Administration (OSHA) and the State of Oregon (DEQ, OR-OSHA, Administrative Rules, Building and Fire Codes). Each employee, therefore, has an obligation to understand and comply with applicable environmental, health and safety regulations as well as those policies established by OSU. This means that all faculty, emeritus faculty, staff, graduate students, post-doctoral fellows, employees, contractors, visitors and guests shall:

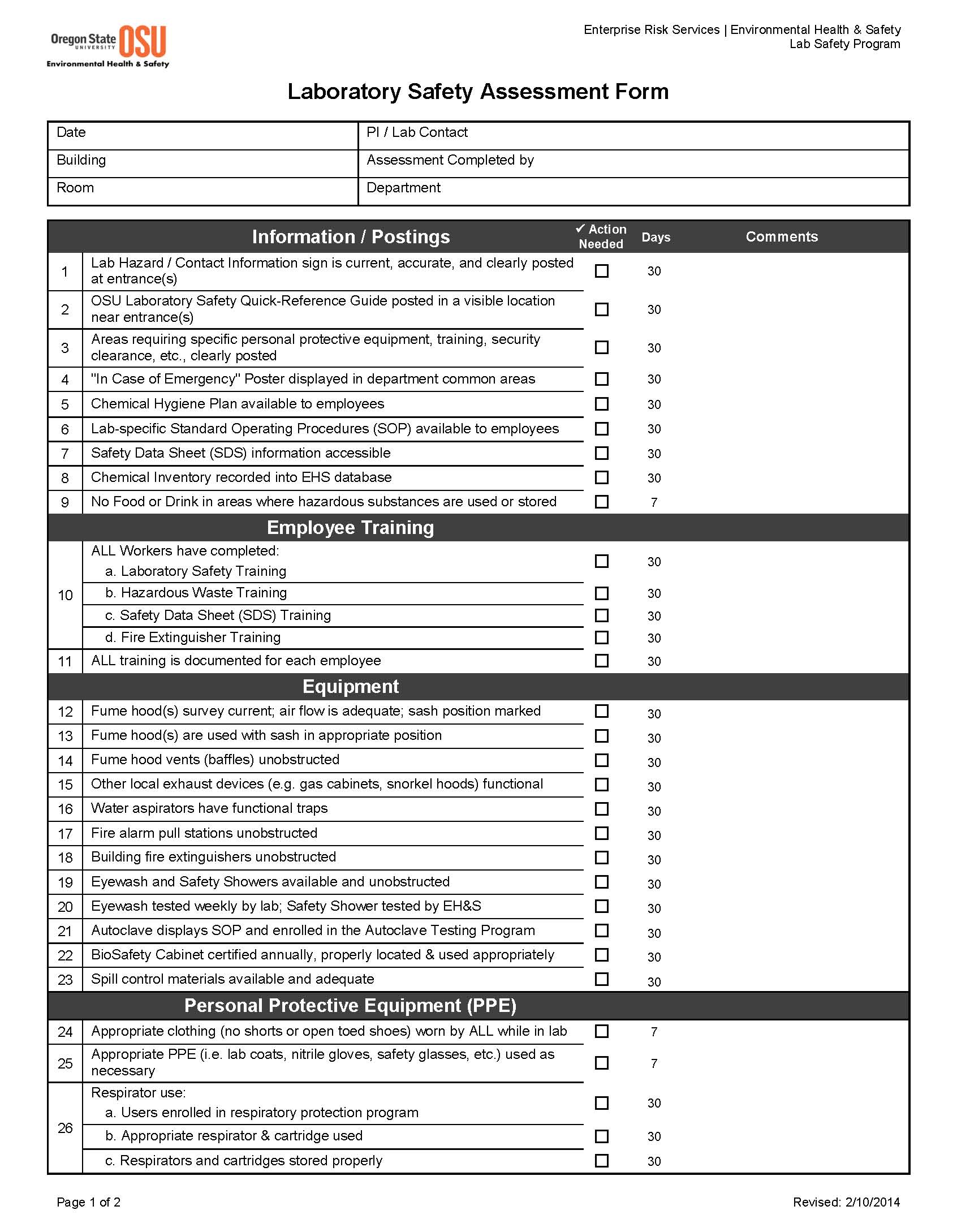
* Observe health and safety related signs, warning signals and directions.
* Review the University's emergency procedures.
* Have an awareness of potential work hazards.
* Complete appropriate health and safety training.
* Follow all health and safety policies, [*safety instructions*](http://oregonstate.edu/ehs/safety-instructions), SOPs, and precautions.
* Warn coworkers about defective equipment and notify appropriate personnel.
* Use PPE and safety engineering equipment appropriate to their work.
* Stop work that poses imminent danger to health and safety and notify appropriate personnel.
* Participate in required inspection and monitoring activities.
* Report unsafe conditions to a supervisor or the Department Head.

All LSs/PIs are responsible for the safe operation of their laboratories or areas. They shall:

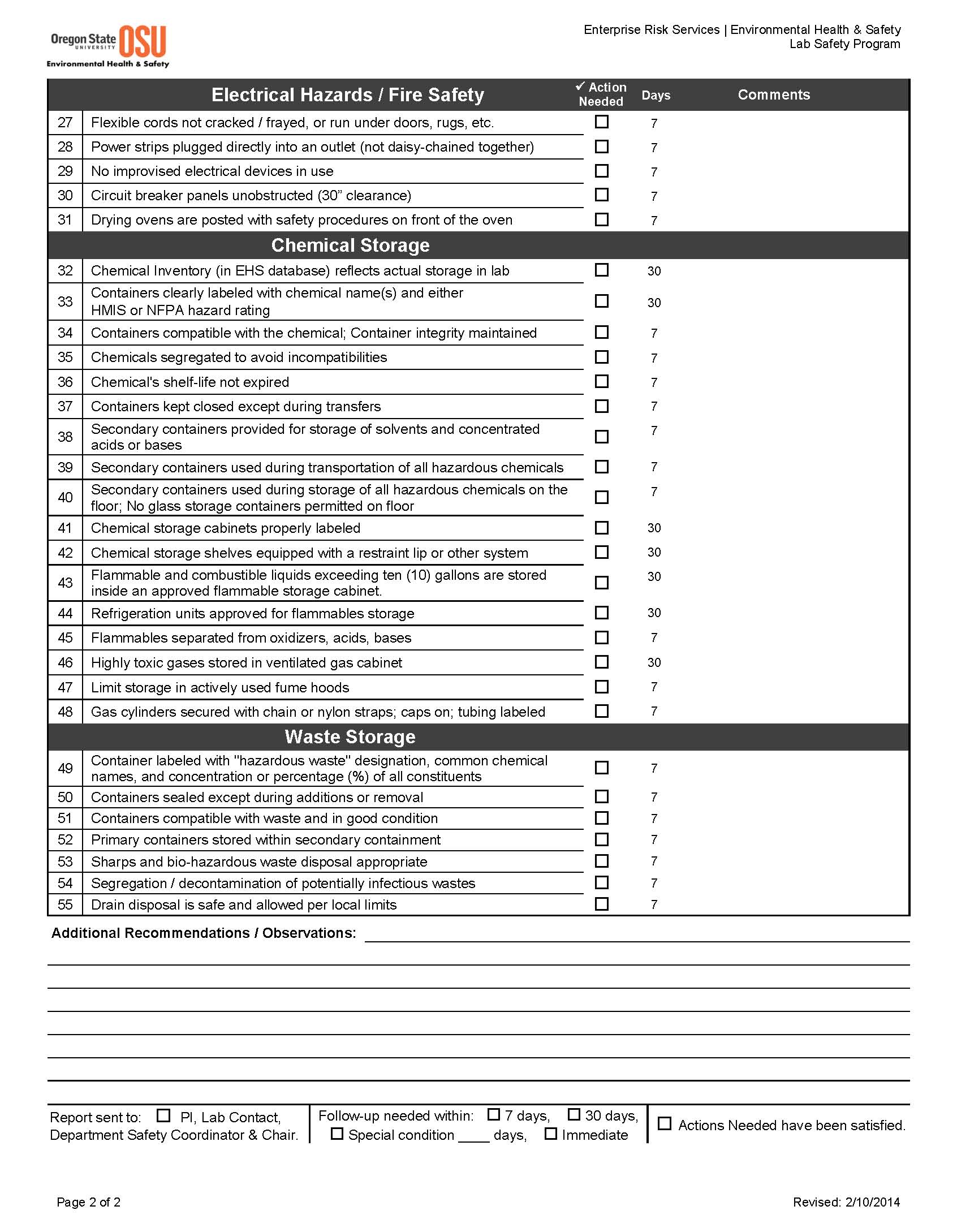
* Ensure, with documentation, that all employees are trained to identify and mitigate potential hazards. This includes requiring all employees to read the OSU CHP and LCHP.
* Maintain and routinely update a chemical inventory as required by the OSU CHP.
* Develop and implement SOPs and practices as required by the OSU CHP and LCHP.
* Analyze work procedures for hazard identification and correction.
* Promote regular Laboratory Safety Assessments to identify and correct equipment and safety deficiencies.
* Implement measures to prevent, eliminate, or control workplace hazards.
* Encourage prompt employee reporting of health and safety problems without fear of reprisal.
* Stop any work that poses imminent danger.

# APPENDIX I - FORMS RELATING TO THE CHP

## Form 1 - Laboratory Safety Assessment Form



**Form 1 - Laboratory Safety Assessment Form (cont.)**



## Form 2 - Job Hazard Assessment and PPE Recommendation

Job Hazard Assessment And

**Personal Protective Equipment (PPE) Recommendation**

All LSs/PIs must survey the work areas and activities under their control to determine: what hazards exist, steps to take to minimize those hazards, and what PPE may be required.

**Instructions:** Identify the workplace location and the general nature of the task. Conduct a walkthrough survey of the workplace and list the task or job functions or pieces of equipment that are hazardous and/or require PPE. Consult EH&S for assistance. Sign and date this assessment. Keep this form with your other safety and training records, preferably in the Laboratory Safety Resources folder from EH&S.

**Please note:**

When determining if a potential hazard exists, consideration should be given to the following:

* history of injuries or illnesses related to the workplace or job
* history of employee complaints or concerns
* employee's perception of hazards

**Location:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Task:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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| --- | --- | --- |
| **Specific Tasks or Steps or Pieces of Equipment** | **Potential Hazard(s)** | **Methods to Reduce Hazard and Specific PPE Required** |
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I, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ , certify that the above location has been evaluated for potential hazards and the appropriate PPE, and that operation-specific training has been performed.

Signature of Lab Supervisor/Principal Investigator:­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## Form 3 - Sample Employee Training Documentation Form

Training Date and Time:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Building and Room:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Training Topic:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Content or Outline of Topics Covered:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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I/we, the undersigned, acknowledge receipt of the above training, have had the opportunity to discuss the training and ask questions, and understand where to find additional information, should the need arise.

Attendees:

Print Name Signature

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## Form 4 - Near-Miss Report Form

**Near-Miss Report**

Near-accidents/Near-misses are incidents that may or may not result in damage to property but do not result in an injury to employees or other individuals. Near-misses are potential learning opportunities that should be used to promote discussion about changes to policies, procedures, engineering controls and personal protective equipment in an attempt to prevent future accidents and near-misses. Employees should report near misses within 24 hours after an incident. This form should be used to describe and discuss the causes and outcomes of a near-miss.

**Date and Time of incident:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Date and** **Time incident was reported:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Parties involved:**

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Job Title:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Witnesses:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Location of Incident:**

Department:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Room:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Location in room:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Equipment involved:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Describe the incident:**

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**Form 4 - Near-Miss Report Form (cont.)**

**Was the incident caused by faulty equipment?**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

If yes, preserve evidence. Identify:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Was the incident caused by another person?**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Employee’s Signature:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **Date:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Lab Supervisor’s Signature:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **Date:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Dates of Investigation:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**What was the immediate cause of the incident (lack of training or supervision, rule enforcement, equipment maintenance, other)?**

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**What were the contributing factors that led up to the incident?**

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**Corrective actions taken:**

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## Form 5 - Overnight/Unattended Lab Reaction Form

**Overnight/Unattended Lab Reaction**

|  |
| --- |
| **This notice must be posted on the fume hood sash near each reaction left unattended in the fume hood.** |

Responsible Person:

Overnight contact number:

Supervisor/PI:

**Reaction scheme and conditions (for chemists):**

**Hazards present (for non-chemists: e.g., toxic, flammable, corrosive, etc.)**

Use full names for chemicals, not abbreviations or chemical formulas

**Additional copies of this form are available from the EH&S website.**

([*http://oregonstate.edu/ehs/sites/default/files/pdf/overnight.pdf*](http://oregonstate.edu/ehs/sites/default/files/pdf/overnight.pdf))

# APPENDIX II - DESIGNATED AREA MARKINGS

## Figure 1 - Designated Area Marking for Carcinogens

|  |
| --- |
| Designated Area:  Chemical Carcinogens  http://www.labelmaster.com/images/products/400x400/GHIS0128.jpg |

## Figure 2 - Designated Area Marking for Reproductive Toxins

|  |
| --- |
| Designated Area:  Reproductive Toxins  http://www.labelmaster.com/images/products/400x400/GHIS0128.jpg |

## Figure 3 - Designated Area Marking for Highly Toxic Chemicals

|  |
| --- |
| Designated Area:  Highly Toxic Chemicals  http://www.labelmaster.com/images/products/400x400/GHIS0125.jpg |

# APPENDIX III - REFERENCE TABLES

## Table 1 - Flammable and Combustible Liquids - Allowable Container Size

Laboratories using chemicals shall comply with National Fire Protection Association (NFPA) 45 Standard on Fire Protection for Laboratories Using Chemicals.

**NFPA 45 (2011 Edition)**

**MAXIMUM ALLOWABLE CONTAINER CAPACITY**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Container type** | **Flammable liquids** | | | **Combustible liquids** | |
| **Class IA** | **Class IB** | **Class IC** | **Class II** | **Class IIIA** |
| Glass | 500 ml1 | 1 L1 | 4 L | 4 L | 20 L |
| Metal (other than DOT drums) or approved plastic | 4 L | 20 L | 20 L | 20 L | 20 L |
| Safety cans | 10 L | 20 L | 20 L | 20 L | 20 L |
| Metal container (DOT specification) | 4 L | 20 L | 20 L | 227 L | 227 L |
| Polyethylene (DOT specification 34) | 4 L | 20 L | 20 L | 227 L | 227 L |
| Pressurized liquid dispensing container | 20 L | 227 L | 227 L | 227 L | 227 L |

**Note:**

1Glass containers as large as 4 L shall be permitted to be used if needed and if the required purity would be adversely affected by storage in a metal or an approved plastic container, or if the liquid would cause excessive corrosion or degradation of a metal or approved plastic container.

|  |  |  |  |
| --- | --- | --- | --- |
| **Flammable & Combustible Liquids – classification definitions** | | | |
| Class | Flash Point | Boiling Point | NFPA Rating  (see inventory report) |
| IA | < 73°F (22.8°C) | < 100°F (37.8°C) | 4 |
| IB | < 73°F (22.8°C) | > 100°F (37.8°C) | 3 |
| IC | > 73°F (22.8°C) and < 100°F (37.8°C) | -- | 3 |
| II | > 100°F (37.8°C) and <140°F (60°C) | -- | 2 |
| IIIA | > 140°F (60°C) and < 200°F (93°C) | -- | 1 |
| IIIB | > 200°F (93°C) | -- | 0 |

## Table 2 - Corrosive Chemicals - Partial List

|  |  |
| --- | --- |
| **Acids** | **Bases** |
| Acetic | Ammonium hydroxide |
| Chloroacetic | Barium carbonate |
| Chromic | Barium hydroxide |
| Cresylic | Calcium hydroxide |
| Formic | Calcium Oxide |
| Hydriodic | Potassium carbonate |
| Hydrochloric | Potassium hydroxide |
| Hydrofluoric | Sodium Carbonate |
| Nitric | Sodium hydroxide |
| Perchloric | Trisodium phosphate |
| Periodic |  |
| Phosphoric |  |
| Sulfuric |  |
| **Others** | |
| Bromine | Amines |
| Iodine |  |
| Chlorine |  |

## Table 3 - Water Reactive Chemicals - Partial List

|  |
| --- |
| Alkali metals, such as Na, Li, K  Alkali metal hydrides, such as LiH, CaH2 , LiAlH4 , NaBH4 , alkali metal amides, such as NaNH2  Metal alkyls, such as lithium and aluminum alkyls  Grignard reagents, RMgX  Halides of nonmetals, such as BCl3 , BF3 , PCl3, PCl5 , SiCl4, S2, Cl2  Inorganic acid halides, such as POCl3, SOCl2, SO2, Cl2  Anhydrous metal halides, such as AlCl3, TiCl4, ZrCl4, SnCl4  Phosphorus pentoxide  Calcium carbide  Organic acid halides and anhydrides of low molecular weight, such as acetylchloride and acetic anhydride |

## Table 4 - Pyrophoric Chemicals - Partial List

|  |
| --- |
| Grignard reagents, RMgX  Metal alkyls and aryls, such as RLi, RNa, R3Al, R2Zn  Metal carbonyls, such as Ni(CO)4, Fe(CO)5, Co2 (CO)8  Alkali metals such as Na, K  Metal powders, such as Al, Co, Fe, Mg, Mn, Pd, Pt, Ti, Sn, Zn, Zr  Metal hydrides, such as NaH, LiAlH4  Nonmetal hydrides, such as B2H6 and other boranes, PH3 , AsH3  Nonmetal alkyls, such as R3B, R3P, R3As  Phosphorus (white) |

## Table 5 - Strong Oxidizers - Partial List

|  |  |
| --- | --- |
| Ammonium perchlorate  Ammonium permanganate  Barium peroxide  Bromine  Calcium chlorate  Calcium hypochlorite  Chlorine trifluoride  Chromium anhydride  Chromic acid  Dibenzoyl peroxide  Fluorine  Hydrogen peroxide | Magnesium peroxide  Nitrogen trioxide  Perchloric acid  Potassium bromate  Potassium chlorate  Potassium peroxide  Propyl nitrate  Sodium chlorate  Sodium chlorite  Sodium perchlorate  Sodium peroxide |
| Source: CRC Handbook of Laboratory Safety, 3rd edition. | |

## Table 6 - Common Peroxide Forming Chemicals

|  |  |
| --- | --- |
| ***List A: Severe Peroxide Hazard on Storage with Exposure to Air***  Discard within 3 months | |
| Diisopropyl ether (isopropyl ether) | Potassium amide |
| Divinylacetylene (DVA) | Sodium amide (sodamide) |
| Vinylidene Chloride | Potassium metal |
| ***List B: Peroxide Hazard on Concentration -*** Do not distill or evaporate without first testing for the presence of peroxides.  Discard or test for peroxides after 6 months | |
| Acetaldehyde diethyl acetal (acetal) | Ethylene glycol dimethyl ether (glyme) |
| Cumene (isopropyl benzene) | Ethylene glycol ether acetates |
| Cyclohexene | Ethylene glycol monoethers (cellosolves) |
| Cyclopentene | Furan |
| Decalin (decahydronaphthalene) | Methylacetylene |
| Diacetylene (butadiene) | Methylcyclopentane |
| Diethyl ether (ether) | Tetrahydrofuran (THF) |
| Diethylene glycol dimethyl ether (diglyme) | Tetralin (tetrahydronapthalene) |
| Dioxane | Vinyl ethers |
| ***List C: Hazard of Rapid Polymerization Initiated by Internally Formed Peroxides - Liquids***  Discard or test for peroxides after 6 months | |
| Chloroprene (2-chloro-1, 3-butadiene) | Vinyl acetate |
| Styrene | Vinyl pyridine |
| ***List D: Hazard of Rapid Polymerization Initiated by Internally Formed Peroxides – Gases***  Discard after 12 months | |
| Butadiene | Vinyl acetylene (MVA) |
| Tetrafluroethylene (TFE) | Vinyl chloride |

## Table 7 - Common Gas Properties

Substances with TLV1 < 50 PPM or less should only be used in properly operating chemical fume hood.

|  |  |  |  |
| --- | --- | --- | --- |
| **Gas (state in cylinder)** | **TLV, ppm1**  **C=Ceiling limit** | **Flammability Limits in Air % by Vol2** | **Major Hazards** |
| Acetylene (Dissolved) | Not established (nontoxic, produces anesthetic effects) | 2.5‑81.0 | Flammable; asphyxiant |
| Ammonia (Liquid) | 25 | 15‑28 | Toxic |
| Argon | Not established (nontoxic) | None | Asphyxiant |
| Boron trifluoride | 1 C | None | Toxic; causes burns |
| 1,3‑Butadiene (Liquid) | 2 | 2‑11.5 | Flammable; skin irritant; suspect carcinogen |
| Butane (Liquid) | 800 (nontoxic, produces anesthetic effects) | 1.9‑8.5 | Flammable, narcosis |
| Carbon dioxide (Liquid) | 5000  C=30,000 | None | Asphyxiant |
| Carbon monoxide | 25 | 12.5‑74.0 | Toxic; chemical asphyxiant |
| Chlorine (Liquid) | 0.5  C=1.0 | None | Irritant; causes burns; corrosive |
| Ethane (Liquid) | Not established (nontoxic, produces anesthetic effects) | 3.0‑12.5 | Flammable; asphyxiant |
| Ethylene | Not established (nontoxic, produces anesthetic effects) | 3.1‑32.0 | Flammable; asphyxiant |
| Ethylene oxide (Liquid pure) | 1 ppm | 3.0‑100.0 | Flammable; toxic can cause burns when trapped by clothing or shoes; affects multiple organs, carcinogen |
| Helium | Not established (nontoxic) | None | Asphyxiant |
| Hydrogen | Not established | 4.0‑75.0 | Flammable; asphyxiant |
| Hydrogen bromide (Liquid) | C=3.0 | None | Toxic; causes burns; corrosive |
| Hydrogen chloride (Liquid) | C=5.0 | None | Toxic; causes burns; corrosive |
| Hydrogen fluoride (Liquid) | C=3.0 | None | Toxic; causes severe slow healing burns; corrosive |
| Hydrogen sulfide (Liquid) | 10  C=15 | 4.3‑45.0 | Toxic; flammable; irritant |
| Methane | Not established | 5.3‑14.0 | Flammable; asphyxiant |
| Methyl bromide (Liquid) | 1 | 13.5‑14.5 | Toxic; causes burns |
| Methyl chloride (Liquid) | 50  C=100 | 10.7‑17.4 | Toxic; flammable |
| Methyl mercaptan (Liquid) | 0.5 | Unknown | Irritant; flammable |
| Nitrogen (nontoxic) | Not established | None | Asphyxiant |
| Nitrogen dioxide (Liquid) | 3  C=5.0 | None | Toxic; corrosive |
| Oxygen | Nontoxic | None | Highly reactive, oxidizer |
| Phosgene (Liquid) | 0.1 | None | Toxic |
| Propane (Liquid) | Not established (nontoxic, produces anesthetic effects) | 2.2‑9.5 | Flammable; asphyxiant |
| Sulfur dioxide (Liquid) | 2  C=5.0 | None | Toxic; causes burns |
| Vinyl chloride | 1 | 4.0‑22.0 | Flammable; causes burns, human carcinogen |
| 1 Threshold Limit Values (2000) ACGIH, Cincinnati, Ohio | | | |
| 2 Zabetakis, M. G. Flammability "Characteristics of Combustible Gases and Vapors" Bulletin 627, U.S. Bureau of Mines, U.S. Gov't Printing Office, WASH. D.C. | | | |

## Table 8 - Reproductive Toxins - Partial List

(From: “Reproductive Hazards of the Workplace” by Linda M. Frazier, MD, MPH & Marvin L. Hage, MD)

|  |  |
| --- | --- |
| **CHEMICAL / ROUTE OF ENTRY** | **COMMENTS / POTENTIAL PROBLEMS** |
| acrylamide [resp/skin] | animal-decrease copulatory behavior & fertility, possible fetotoxin |
| acrylates [resp/skin] | animal-possible fetotoxin, decrease in fetal size |
| aflatoxin B1 [oral/resp] | human-mutagen, decrease male fertility, animal-teratogen, fetotoxin, decrease sperm counts, increase sperm abnormalities |
| aldicarb [resp/skin/oral] | human-at near toxic levels may cause stillbirth |
| aluminum [resp] | animal-neurotoxin mid to late term |
| ammonia [resp] | human-spermicide |
| anesthetic gases (enflurane, halothane, nitrous oxide) [resp] | human-decrease in female fertility when exposed to nitrous oxide > 5 hours a week, mixed gases may increase chance of spontaneous abortion, decrease birth weight, animal-teratogen, embryotoxin, nitrous oxide- reduced sperm counts, mixed gases-possible reduced fertility, |
| aniline & derivatives [resp/skin] | human-possible menstrual & ovarian disorders, reduction of , maternal and fetal blood oxygen |
| antimony [resp] | animal-increase spontaneous abortion rate |
| antineoplastic agent [resp/oral/skin] | human-testicular & ovarian dysfunction, permanent sterility, increased rate of spontaneous abortion, ectopic pregnancy, decrease birth weight, animal-teratogen, embryolethal |
| arsine [resp] | animal-teratogen |
| arsenic [resp/skin/oral] | human-possible chromosomal and testicular toxin, increased rate of spontaneous abortion, teratogen, mutagen, fetotoxin |
| barium [resp/oral] | animal-soluble compound (carbonate, chloride) acute testicular toxicity |
| benomyl [resp/oral] | human-possible teratogen, animal-possible teratogen, testicular toxin, increase rate of post implantation mortality, |
| benzene [resp/skin] | animal-fetal death, delayed ossification |
| beryllium [resp] | possible human mutagen (sperm), fetal stunting, pre-implantation mortality |
| boric acid [skin/resp] | animal-high dose tests- borax is testicular toxin, female impaired fertility |
| 1,3-butadiene [resp] | human-increased rate of abnormal sperm, animal-reduced fetal weight |
| cadmium [resp/oral] | human mutagen, decrease in motility counts, testicular necrosis, may prevent egg implantation, increase stillbirth rate, animal-teratogen, fetotoxic |
| captan [oral/resp] | human-mutagen, possible teratogen, animal-possible teratogen, testicular toxin, increase post implant mortality |
| carbaryl [oral/resp/skin] | human-weak mutagen, animal-increased rate of sperm abnormality, decreased sperm counts & function, teratogen only at toxic levels |
| carbon disulfide [resp/skin] | human-reduced male libido, alterations of menstrual cycle, increased rate of spontaneous abortion and neurobehavioral abnormalities after birth |
| carbon monoxide [resp] | human-fetal asphyxiation, increased rate of neurological abnormalities, malformations, animal-reduced fetal weight, |
| chlordecone [skin/resp/oral/ocular] | human-decreased motility, animal-reduced male fertility, reduced litter size, increase in mouse resorptions, subtle neurobehavioral changes |
| chlorine dioxide, chlorite, chlorate [resp/skin/oral] | animal-reduced weight between birth and weaning |
| chloroform [resp/skin] | animal-increased rate of fetal loss, reduced fertility |
| chloroprene [resp] | human-possible increase in spontaneous abortion rate , animal-reduced male fertility |
| chlorpryrifos [oral/skin] | animal-near lethal doses decrease sperm motility, possible neurotoxin |
| chromium [resp] | human genotoxin, decreased motility counts |
| cobalt [resp] | animal-seminiferous tubule degeneration |
| copper [resp] | human-direct contact is toxic to sperm, low motility counts |

**Table 8 - Reproductive Toxins - Partial List (cont.)**

|  |  |
| --- | --- |
| **CHEMICAL / ROUTE OF ENTRY** | **COMMENTS / POTENTIAL PROBLEMS** |
| cyfluthrin [oral/resp/skin] | animal-large exposures through pregnancy caused neurological dysfunction |
| cypermethrin [oral/resp] | animal-large exposures through pregnancy caused neurological dysfunction |
| 2,4-D [skin] | human-(reversible) abnormal sperm, animal-possible teratogen at toxic levels |
| DDT [resp/ocular/skin/oral] | human-possible male infertility, |
| DEET (N,N-diethyl-m-toluamide) [skin/oral] | human-at (maternal) high dose exposures there is an increase in acute neurotoxic symptoms in children |
| diazinon [oral/skin] | animal-teratogen, reduced genital weight, decreased motility, increase in sperm mortality |
| dibromochloropropane [oral/skin/resp] | human-testicular damage, animal-mutagen, genotoxin |
| dicamba [skin/resp] | animal-(single study) induced unscheduled DNA synthesis |
| 1,3-dichloropropene and 1,2-dichloropropane [resp/skin] | animal-mutagen, causes testicular degeneration, reduced sperm counts, abnormal sperm |
| dimethylformamide [resp/skin] | human-possible testicular cancer, inconsistent data indicates teratogen |
| epichlorhydrin [resp/skin] | animal-male reproductive toxin, sterility, |
| ethidium bromide [skin/resp] | animal-mutagen, embryotoxin |
| ethyl alcohol [resp/oral/skin] | human-high doses suggest an increased rate of miscarriages & stillbirths, fetal alcohol syndrome, occupational exposure problems rarely encountered |
| ethylene bisdithiocarbamate [resp] | animal-possible teratogen near lethal dose |
| ethylene oxide [resp] | human-teratogen, increased rate of spontaneous abortions, animal-teratogen, testicular toxin, increased rate of sterility, decreased fertility |
| formaldehyde [resp] | human-one study suggests a slight % increase in spontaneous abortion and subtle neurobehavioral abnormalities, animal-decreased sperm motility, reduced fetal & maternal weight |
| glutaraldehyde [resp/oral/skin] | animal-cytotoxin (bacteria) |
| glycidyl ethers [skin/resp] | animal-testicular atrophy |
| glyphosate [oral/skin] | animal-sperm count reduction at high concentrations |
| hair dyes [skin] | human-may cause neuroblastoma, animal-bacterial mutagen (coal tar) |
| hexachlorobenzene [oral/resp] | human-long half life, excessive exposures can result from breast milk, animal-menstrual irregularities, neonatal lethality at high doses |
| hexane (n-) [resp] | animal-testicular toxin, reduced fetal weight |
| hydrazine & derivatives [resp] | animal-abnormal sperm, reduced fetal weight, increased rate of resorptions, |
| hydrogen cyanide [resp/skin] | animal-impaired spermatogenesis & fertility, reduced brain function |
| hydrogen sulfide [resp] | human-fetal asphyxiation, increased rate of menstrual irregularities, |
| hydroquinone [resp/skin] | animal-reduced testicular weight, increased rate of resorptions, recent studies suggest that hydroquinone is not a reproductive toxin |
| indium [resp] | animal-teratogen, testicular and sperm abnormalities |
| iron [resp] | human-decline in semen parameters, |
| isocyanates [resp] | human-increased risk of spontaneous abortion and stillbirths, animal-male decrease in successful matings, female persistent diestrus, increased rate of resorptions, |
| lead [resp/oral/skin] | human-decrease in motility counts, increased rate of preterm deliveries, stillbirths, neurological abnormalities |
| lindane [resp/skin] | animal-testicular degeneration, altered fetal steroid metabolism |
| malathion [oral/skin] | human-(applicators) increase in chromosomal abnormalities, animal-testicular atrophy |

**Table 8 - Reproductive Toxins - Partial List (cont.)**

|  |  |
| --- | --- |
| **CHEMICAL / ROUTE OF ENTRY** | **COMMENTS / POTENTIAL PROBLEMS** |
| manganese [resp] | human-possible decline in sperm parameters (excessive exposure & manganese deficient), animal-adverse neurodevelopmental effects from breast milk, retarded offspring growth |
| mercury [resp/oral/skin] | human-mutagen, teratogen, neurotoxin, increased rate of spontaneous abortion, embryolethal, menstrual irregularities |
| methyl alcohol [resp/oral/skin] | animal-decrease testicle size, reduced sperm counts, high dose (inhale >5,000 ppm) teratogen, |
| methyl bromide [resp] | animal-(high dose studies near toxic levels) mutagen, genotoxin |
| methyl chloride [resp] | animal-reduced male fertility, testicular degeneration, heart valve defects |
| methyl ethyl ketone [resp] | animal-at high doses (3,000 ppm-7 hour days) minor birth defects |
| methylene chloride [resp/skin] | animal-fetotoxic, neurologic deficits because it is metabolized into CO |
| methylpyrrolidone (N)[resp/skin] | animal-fetotoxin |
| molybdenum [resp/oral] | human-mutagen, animal-embryolethal |
| nickel [resp/oral] | human-mutagen, decline in semen parameters, animal-embryolethal, increased rate of fetal growth retardation and skeletal anomalies |
| nitriles [resp/skin] | animal-teratogen, reduced sperm counts, increased rate of resorptions, |
| nitrates, nitrites & organic nitro compounds [resp/skin/oral] | human-reduced oxygen uptake causing oxygen debt, animal-testicular toxin, abortifacient |
| paraquat [resp/oral/skin] | animal-mutagen, embryotoxin |
| pentamidine [resp/skin/oral] | animal-increased rate of resorptions |
| perchloroethylene [resp] | human-possible increased rate of spontaneous abortion (only a few studies were completed) |
| permethrin [oral/resp] | animal-large exposures through pregnancy caused neurological dysfunction |
| phenol [skin/resp/oral] | animal-minimal embryotoxin |
| phenoxyacid herbicides [oral] | animal-fetotoxin at high doses |
| phthalates [oral/resp/skin] | animal-possible teratogen, testicular toxin, increased rate of resorptions & stillbirths |
| polybrominated biphenyls [oral/skin/resp] | animal-possible prolonged menstrual cycles, blocked implantation, increased rate of resorptions, increased fetal liver weight |
| polychloronated biphenyls [skin/oral] | human-hyperpigmentaion, possible reduction of birth weights do to shortened gestation, neurological delay, animal-testicular toxin, reduced female conception rates, fetotoxin at high dose, decrease birth weight, |
| polycyclic aromatic hydrocarbons [resp/oral] | animal-gonadotoxin, increased rate of stillbirths & resorptions, |
| providone-iodine [skin/oral] | human-possible fetal goiter due to elevated iodine levels |
| selenium [resp/oral] | animal-teratogen, embryolethal |
| sodium azide [oral/resp] | animal-embryotoxin, increased rate of resorptions |
| styrene [resp/skin] | human-associated with sperm abnormalities, menstrual disorders, animal-possible genotoxin |
| tellurium [resp] | human-does not cross the placenta, animal-mutagen |
| thallium [resp/oral/skin] | human-induces abortion, absorbed by testicles, animal-lethal mutagen, teratogen |
| tin [resp/skin] | animal-possible increase in subtle neurological & skeletal deformities |
| titanium dioxide [resp] | animal-embryolethal, reduction in litter sizes |
| toluene [resp/skin] | human-increased rate of spontaneous abortion at 50-150 ppm TWA, intentional inhalation-microcephali, growth retardation, learning delayed |
| 1,1,1-trichloroethane [resp/skin] | human-acute exposure at high concentrations cause fetal death (drug abuse) |
| trichloroethylene [resp/skin] | human-decreased libido, increase in menstrual disorders at levels that effect CNS |
| tungsten [resp] | animal-possible embryolethal (single study) |

**Table 8 - Reproductive Toxins - Partial List (cont.)**

|  |  |
| --- | --- |
| **CHEMICAL / ROUTE OF ENTRY** | **COMMENTS / POTENTIAL PROBLEMS** |
| uranium [resp/oral] | animal-nephrotoxin, genotoxin (from radiation) |
| vanadium pentoxide [resp] | animal-mutagen (at high doses), decrease in fertility rates |
| vinyl chloride [resp] | human-increased rate of impotence, decreased libido, decreased testosterone, change in menstrual cycles, pregnancy complications |
| xylene [resp/skin] | animal-increased rate of abnormal sperm, may also be genotoxic and mutagenic (rats only) |
| zinc chloride & oxide [resp] | human-deficiency is teratogenic and can cause behavioral abnormalities, zinc salts are spermicidal |

## Table 9 - Definitions of High Degree of Acute Toxicity

|  |  |  |
| --- | --- | --- |
| **Protocol** | **Toxic** | **Highly Toxic** |
| **Oral LD50** (albino rats) | 50-500 mg/kg | <50 mg/kg |
| **Skin Contact LD50** (albino rabbits) | 200-1000 mg/kg | <200 mg/kg |
| **Inhalation LD50** (albino rats) | 200-2000 ppm/air | <200 ppm/air |

# APPENDIX IV – OWEN HALL CLEANROOM LABORATORY STANDARD OPERATING PROCEDURES