WSU Tri-Cities Laboratory Safety Manual

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Contents

Washington State University’s Laboratory Safety Manual is a tool to assist responsible parties with developing their laboratory specific Chemical Hygiene Plan and related laboratory safety programs. Implementation of the Laboratory Safety Manual/Chemical Hygiene Plan is a critical element in achieving a safe and healthful laboratory environment.

WSU's Laboratory Safety Manual coupled with the Chemical Hygiene Plan completed by each laboratory establishes laboratory specific policies and procedures. A Laboratory Safety Manual/Chemical Hygiene Plan Guide provides additional information for developing and implementing a plan.

Section I - Introduction

A. Purpose

Washington State University (WSU) has a commitment to create, maintain and enhance a safe and healthful environment for all individuals associated with the institution, including students, faculty, staff and visitors. (Policy Reference - WSU Safety Policies and Procedures Manual (S1.10)

Implementation of the Chemical Hygiene Plan (CHP) is a critical element in achieving a safe and healthful work environment in WSU laboratories. The purpose of the Chemical Hygiene Plan is to establish policies and procedures for a specific laboratory. In addition, it will provide general and specific guidelines and information which may be used to protect employees from health hazards associated with hazardous chemicals in the laboratory.

In fulfilling this purpose, the CHP also satisfies the state requirements for the standard entitled "Hazardous Chemicals in Laboratories" herein referred to as the Laboratory Safety Standard (WAC 296-828). A copy of this standard is provided as Appendix A. Implementation of a chemical hygiene plan in the laboratory will assist in minimizing chemical exposures and in complying with mandated exposure limits.

B. Scope and Application

This Chemical Hygiene Plan is intended to safely limit laboratory workers' exposure to hazardous chemicals regulated by the Washington Department of Safety and Health (DOSH). Laboratory workers must not be exposed to hazardous chemicals in excess of the permissible exposure limits listed in WAC 296-841, Airborne Contaminants. A copy of these limits is provided in Appendix B.

This standard applies where "laboratory use" of hazardous chemicals occurs. Laboratory use of hazardous chemicals refers to two factors: 1) when the handling or use of chemicals occurs on a "laboratory scale," that is, the work involves containers which can easily and safely be handled by one person for reactions, transfers and other handling and 2) when multiple chemicals or multiple procedures are used.

Applying the "laboratory use" criteria, all teaching, research and clinical laboratories at Washington State University are considered to be subject to the Laboratory Safety Standard. Certain non-traditional chemical use areas may be included under this standard at the option of individual departments within the University. Also, it is the policy of the University that students in laboratories, while not legally covered under this standard, are afforded the same level of protection as University employees. (Students are not covered by Workers' Compensation in the event of an injury.)

This standard does not apply to laboratories capable of producing commercial quantities of materials, part of or simulating a production process or quality control process, or a simulation of a process.

C. Implementation of the Chemical Hygiene Plan (CHP)

1. In order to meet the requirements of the Laboratory Safety Standard, a Chemical Hygiene Plan must be written for each Washington State University laboratory. The Chemical Hygiene Plan must contain:
    a. standard operating procedures for use of hazardous chemicals,
    b. designated area provisions,
    c. descriptions of or provisions for fume hoods and other protective equipment,
    d. provisions for employee information, training, and medical monitoring and examination,
    e. evaluation criteria the employer will use to reduce exposure,
    f. prior approval provisions for special laboratory projects,
    g. a designation of the chemical hygiene officer and other person(s) responsible for implementation of the CHP, and
    h. any extra protection provisions.
2. The Chemical Hygiene Plan must be readily available to all employees and students in the laboratory. The term "readily available" means accessible to all laboratory staff at any time during the work period, day or night. It must also be available on request to Environmental Health & Safety (EHS) staff and Washington State Division of Occupational Safety and Health (DOSH) representatives.
3. The area for which the Chemical Hygiene Plan is written may be adjoining rooms, a single room or an area within a room as long as the definition of "readily available," as stated above, is met. The spatial definition of a "laboratory" is left to the discretion of the individual who will ultimately take responsibility for the safety of all employees who work within that area. This individual should be a Principal Investigator (PI) or a laboratory supervisor.
4. Environmental Health and Safety has provided the basic elements of a "generic" or "core" Chemical Hygiene Plan. Included in this Plan are the established policies of Washington State University and various regulatory agencies. These are indicated in boldface text.
5. Each laboratory must provide additional information to make this Plan laboratory specific. The Chemical Hygiene Plan Guide (Appendix R) contains eight pages that have questions or prompts that must be filled out by the Principal Investigator or laboratory supervisor. The corresponding pages are color coded yellow in the Laboratory Safety Manual for easy identification. There is not a prescribed way to fill out these pages. If there is information already written concerning the questions, or if this information is available on a computer, attach copies or originals to the yellow pages. This information will be unique to the laboratory. It may be kept as an integral part of the Chemical Hygiene Plan or maintained as Section VI: Laboratory Specific Information in the Laboratory Safety Manual.

The pages that must be completed are contained in your Laboratory Specific Chemical Hygiene Plan Guide.

D. Responsibilities

Consistent with University policy, responsibility for chemical hygiene and safety in the laboratory is shared by administrators, faculty, principal investigators, managers, supervisors, employees and students at all levels. Delegation of specific responsibilities is described below.

1. The University Health and Safety Committee:
    a. The University Health and Safety Committee provides advice and support on matters of policy and procedure relating to health, safety and security.
2. Environmental Health & Safety:
    a. Promotes programs which are needed for compliance with safety and health regulations and for the protection of the health and safety employees, faculty, staff, students and the surrounding community.
    b. Provides a University Lab Safety Officer, who assists department Chairpersons/Directors, Principal Investigators, Faculty and Laboratory Supervisors in the implementation and maintenance of the chemical hygiene plans designed for individual laboratories.
    c. Cooperates with academic and service units by identifying health and safety hazards.
    d. Evaluates and reports on the status of compliance with health and safety regulations.
    e. Recommends and implements necessary modifications to the "generic" University Chemical Hygiene Plan.
    f. Records, evaluates and reports laboratory accidents and laboratory incidents related to chemical exposure.
    g. Develops and maintains training resources. Conducts regularly scheduled training courses in laboratory safety.
3. The Department Chairperson or Director:
    a. Is responsible for the safety of all employees, students and visitors in his/her areas of control.
    b. Reviews the control methods used by the Principal Investigator or laboratory supervisor and ensures that required authorizations to use restricted or regulated hazardous chemicals are on file in the department.
    c. Reviews all accident reports and ensures that appropriate corrections are made.
4. The Principal Investigator, Faculty or Laboratory Supervisor:
    a. Is the Chemical Hygiene Officer for the laboratory(ies). Enforces University laboratory safety rules and establishes specific procedures for the laboratory.
    b. Trains employees and students in safety procedures, corrects improper work practices, identifies defective environmental conditions which could result in personal injury, and develops a positive attitude among employees toward accident prevention.
    c. Prepares a Laboratory Specific Chemical Hygiene Plan keyed to the specific needs of each research and teaching activity under his or her direction. Reviews and evaluates

the Chemical Hygiene Plan at least annually and updates as necessary. Consults with the EHS Lab Safety Officer with questions, as needed, to ensure correct and adequate development of the plan.

d. Investigates and reports every accident (whether or not an injury occurs) and initiates corrective action that will ensure maximum safety for his or her employees.

5. The Employee or Student:

   a. Knows and complies with safety guidelines and policies required for the task assigned.

   b. Reports unsafe conditions to the Principal Investigator, faculty member, immediate supervisor, or the Environmental Health & Safety Department.

   c. Utilizes fume hoods, laboratory safety devices and personal protective equipment properly as trained.

Section II – General Policies and Recommendations

GOAL

It is prudent to minimize all chemical exposures. Washington State Department of Occupational Safety and Health has established Permissible Exposure Limits (PELs) for over 600 chemical agents. These chemicals and their exposure limits are listed in WAC 296-841 and in Appendix B. Exposure to these agents must be controlled in such a manner that the workers' exposure shall not exceed the applicable limits.

Because few laboratory chemicals are without hazards, the following general precautions for handling all laboratory chemicals are presented below. Precautions for handling specific chemicals are contained in Section IV.

METHODS

A. Basic Rules and Procedures

1. Safety Data Sheets (SDSs) for chemicals used or stored in laboratories must be readily available to employees. The Hazard Communication Standard states that laboratories must maintain any SDS received with incoming shipments of hazardous chemicals. If SDSs are not received with incoming shipments, contact Environmental Health & Safety (EH&S) at 372-7163 for assistance in obtaining them.
2. In accordance with **S**ection II.F. Personal Protective Equipment of this Laboratory Safety Manual, appropriate eye protection must be worn when working with chemicals.
3. Chemical containers must be labeled in accordance with appropriate hazard communication rules. It is recommended that labeling practices comply with guidelines provided in Lab Safety Manual Section II.H. Signage and Labeling.
4. Mouth suction must not be used to pipet chemicals or to start a siphon; instead a pipet bulb or an aspirator must be used to provide a vacuum. (Reference - Lab Safety Manual Appendix C and EH&S Fact Sheet - Pipetting)
5. Food and drink are potential routes of exposure to hazardous chemicals. Therefore, food and drink are prohibited from being stored, handled or consumed in laboratories using hazardous chemicals. Glassware or utensils that have been used for laboratory operations must never be used to prepare or consume food or beverages. Laboratory refrigerators, ice chests, and cold rooms must not be used for food storage. Storage or consumption of food or drink is also prohibited in laboratories where radioactive materials are stored or used. (Reference - Lab Safety Manual Appendix A and Appendix C)
6. Skin contact with chemicals should be avoided. Do not smell or taste chemicals.
7. Wash hands well before leaving the laboratory area. Never wash with organic solvent materials.
8. Avoid use of contact lenses in the laboratory. If contact lenses are worn, notify the Principal Investigator (PI) or laboratory supervisor that you are wearing them and always wear goggles or a face shield.
9. Do not work alone in the laboratory if procedures being conducted are hazardous.

10. Know the safety precautions that apply to the work that is being done. Determine the potential hazards from information available from the Safety Data Sheets (SDSs), department reference materials, or from Environmental Health & Safety (372-7163). Use appropriate ventilation systems as discussed in Section III.C of this Plan.
11. Know the types of protective equipment available including face shields, gloves, and other special clothing or footwear and use the proper type for each job. See Section II.F of this Chemical Hygiene Plan for information on use, ordering and selection of personal protective equipment.
12. Know the location of and how to use the emergency equipment in your area (see Section III.B).
13. Know how to obtain additional help in an emergency, and be familiar with emergency procedures (see Section II.I).
14. Be alert to and correct or report unsafe conditions in the laboratory. Report to your PI, laboratory supervisor, or to the Environmental Health & Safety (372-7163) unsafe conditions you cannot correct.
15. Equipment should be used only for its designed purpose.
16. Reagents should be combined in appropriate order to minimize violent chemical reactions.
17. Reaction apparatus should be positioned and clamped in order to permit manipulation without the need to move the apparatus until the entire reaction is completed.
18. Handle and store laboratory glassware with care to avoid damage; do not use damaged glassware. Use extra care with apparatus that evacuates air from glassware. Shield or wrap the glassware to contain chemicals and glass fragments should implosion occur.
19. While not recommended, if an operation is left unattended, leave laboratory room lights on, place an appropriate sign on the door indicating emergency shut-down procedures, and provided for containment of hazardous chemicals in the event of failure of a utility service (such as cooling water) to the operation.
20. Apparatus (vacuum pumps, distillation columns, etc.) which may discharge hazardous chemicals should be vented into local non-return building exhaust devices. Do not allow release of hazardous chemicals in cold or warm rooms, since these may have re-circulated atmospheres.
21. Appropriately use, label, store and transport gas cylinders. For additional information see the Fact Sheet - Compressed Gas Cylinders.
22. Wear cut/puncture resistant gloves when handling glass tubing. Don't force glass tubing through rubber stops. If the tube is stuck, slit the hose or stopper with a sharp instrument. Glass cuts can be minimized by the use of correct procedures, through appropriate use of protective equipment, and by careful attention to manipulation.

B. Chemical Procurement, Storage, and Distribution

The Principal Investigator or Lab Supervisor is responsible for access, storage, and use of hazardous chemicals in the laboratory environment. Hazardous chemical exposures and

hazardous waste management pose unique challenges in the laboratory. The following are some simple recommendations to get started.

1. Inventory:

Develop and implement an inventory control system in order to determine which chemicals are necessary to laboratory operation and which are not, reducing inventories of unneeded chemicals. In addition, an inventory control system can identify theft and abuse of laboratory chemicals, ensure SDS and other hazard information is available for each hazardous chemical used in the lab, and identify chemical substances which require special controls or surveillance (e.g., DHS Chemicals of Interest, Select Agents, Carcinogens, Pyrophoric chemicals and/or Reproductive Toxins).

Once an inventory is present, it can be updated when new chemicals are procured, when chemical stocks are consumed or old containers of chemicals are removed from the laboratory and on an annual basis. Inventory control is an essential aspect of a proper, workable chemical management system in the laboratory.

2. Procurement:

No container shall be accepted without an adequate identifying label (identity of chemical, hazard warnings, manufacturer's name and address).

Designate a person or persons who will be assigned as responsible for the acceptance or rejection of chemicals and materials brought into the laboratory. This designated person ensures that containers are properly labeled, and does not permit the material to be brought into the laboratory if improperly labeled.

No container of hazardous chemical waste may be transported into a laboratory from any other laboratory or room on- or off-campus. The person(s) responsible for acceptance or rejection of hazardous chemical substances must not permit any container of hazardous chemical waste to enter the laboratory. Exception: If a satellite accumulation area (SAA) is established outside a laboratory generation point, contact EH&S chemical waste management personnel (372-7163) for approval.

Peroxidizable chemicals must be dated when received into the lab and used or disposed of within the period specified in Appendix C of this manual.

3. Storage

A designated storage system with easily identified areas should be arranged by hazard classification rather than alphabetically. Further information on incompatibles and chemical reactivity is provided in Appendix C of this manual.

4. Distribution:

Distribution of chemicals should be overseen by a designated individual in order to maintain a current inventory. Distribution of chemicals includes moving them from the distribution area to the work area. When chemicals are hand carried, the original container should be placed in a secondary container such as a deep plastic tray or bucket to protect against breakage and spillage. Freight-only elevators should be used, wherever possible. In addition, if gloves must be utilized the carrying hand should be gloved and the other not so that there is a minimal risk of cross contamination from touching door handles or elevator buttons.

C. Exposure Monitoring

An employee's / student's exposure to any regulated hazardous chemical shall be monitored if there is reason to believe exposure levels for that chemical exceed the regulatory limits (See Appendix A, Appendix B).

Included in the list of regulated hazardous chemicals are specific substances with individual health standards. They are as follows:

LISTED CARCINOGENS:

(See Section II.N.1.b Listed Carcinogens)

4-Nitrobiphenyl	Benzidine
Alpha-Napthylamine	4-Aminodiphenyl
4,4'-Methylene bis (2-chloroaniline)	Ethyleneimine
Methyl Chloromethyl Ether	Beta-Propiolactone
3,3'-Dichlorobenzidine (and its salts)	Acetylaminofluorene
Bis-Chloromethyl ether	4-Dimethylaminoazobenzene
Beta-Naphthylamine	N-Nitrosodimethylamine

SPECIFIC CARCINOGENS:

(See Section II.N.1.c and applicable health standards in Appendix B)

Acrylonitrile	Butadiene
Cadmium	1,2-Dibromo-3 chloropropane
Ethylene Oxide	Inorganic arsenic
Methylene Chloride	Vinyl Chloride

SPECIFIC AIR CONTAMINANTS:

(See applicable health standards in Appendix B)

Asbestos	Benzene
Formaldehyde	Hexavalent Chromium
Lead	Methylenedianiline
Thiram	

Events or circumstances that might reasonably constitute overexposure to a hazardous chemical and require monitoring include:

1. An employee or student is working with a hazardous chemical outside a fume hood and manifests symptoms, such as a headache, rash, nausea, coughing, tearing, irritation or redness of eyes, irritation of nose or throat, dizziness, loss of motor dexterity or judgment, and
2. The symptoms are consistent with the Safety Data Sheet or other references. Some or all of the symptoms disappear when the person is taken away from the exposure area and breathes fresh air, and the symptoms reappear soon after returning to the exposure area; or
3. Two or more persons in the same work area have similar complaints;
4. An employee or student handled toxic solvents, corrosives, or other volatile chemicals in a defective fume hood or in a poorly ventilated room;
5. An employee / student had direct skin or eye contact with a hazardous chemical (e.g., employee reports signs or symptoms of dermal conditions associated with formaldehyde exposure);
6. Previous monitoring was conducted in the work area and results were below the regulatory limits; however, the process, procedure, or ventilation conditions (e.g., redesigns of fume hood) have changed; or
7. A hazardous chemical leaked, spilled, or was otherwise released in an uncontrolled manner;

If you suspect an over exposure to a hazardous chemical or work with any of the substances listed above (Listed Carcinogens / Specific Carcinogens / Specific Air Contaminants) and an evaluation has not been performed, contact Environmental Health and Safety (EH&S) at 372-7163. EH&S will promptly investigate reported events and circumstances.

Upon investigation, EH&S will determine if exposure monitoring is required. On occasion, monitoring may not be required because previous monitoring records indicate exposure levels below the regulatory limits. On a case by case basis, some of those records may or may not be used as representative samples to support the belief that exposure levels are below the regulatory limits. Therefore, if previous monitoring was performed in a work area and the results were below regulatory limits but conditions have changes (e.g., amount and concentration of chemical, ventilation design, process, etc.), contact EH&S for an evaluation.

For additional information on exposure monitoring, see Fact Sheet - Chemical Monitoring and Sampling.

D. Housekeeping

1. Do not use stairways, hallways, or mechanical spaces as storage areas.
2. Access to exits, emergency equipment, controls, and the like must never be blocked.
3. Floors should be cleaned regularly and kept free of obstructions. Washington State University (WSU) custodial services may clean floors in some laboratories. In the areas serviced by custodial staff, laboratory personnel must keep floors free of obstructions and hazards to allow custodial staff to do their jobs effectively and safely.
4. The number of chemicals in a laboratory should be kept to a minimum. Discard or recycle chemicals not being used. Avoid stockpiling of chemicals.
5. Small, non-hazardous spills should be cleaned up immediately by laboratory personnel. Hazardous chemical spills that cannot be cleaned up safely by laboratory personnel should be reported according to the procedures outlined in Section II.I.1.
6. Unlabeled containers and chemical wastes should be disposed of promptly by using appropriate procedures. (See Appendix E).
7. Equipment and chemicals should be stored properly; clutter should be minimized.
8. Questions about custodial services should be directed to the custodial supervisor at 372-7243. Questions about laboratory housekeeping practices should be directed to EH&S at 372-7163.
9. Waste should be deposited in appropriate receptacles. Custodial services will not collect waste containing improperly packaged waste glass, hazardous chemicals, radioactive materials, or pathological/ pathological waste materials. Proper disposal practices for waste glass are described in the WSU Safety Policies and Procedures Manual, Section S4.26. Pertinent disposal practices for hazardous chemical wastes are described in Appendix E of this manual. Also in this manual, required disposal practices for radioactive wastes are provided in Appendix J and applicable disposal practices for pathological/ biohazardous waste materials are presented in Appendix H and Appendix I.

E. Medical Surveillance

Laboratory employees who suspect they have been overexposed, or are having symptoms consistent with overexposure to a hazardous chemical, will be evaluated at a reasonable time and place without cost to the employee by or under the direct supervision of a licensed physician.

Employers must provide employees an opportunity for medical surveillance when they are:

1. exposed to hazardous chemicals (i.e., toxic substances, carcinogens, reproductive toxins, etc.) at or above established exposure limits or exposure monitoring reveals an overexposure; or
2. experiencing signs or symptoms (see chemical's Safety Data Sheet) associated with an exposure to a hazardous chemical; or
3. present when a non-routine event takes place (i.e., spill) resulting in the likelihood of an overexposure; or
4. frequently using specific amounts of certain hazardous chemicals (i.e., mercury, chlorinated solvents, formaldehyde, heavy metals, lead, cadmium, hexavalent chromium,

arsenic, etc.) and enclosures and local exhaust (i.e., fume hood) are not available or ineffective; or

5. using hazardous chemicals capable of rapid absorption through the skin (i.e., methylene chloride, pesticides, carbon tetrachloride, cyanides, etc.) and prolonged glove contact is necessary; or
6. working with a systemic poison (i.e., benzene) where oral exposure is possible from contaminated surfaces (e.g hand to mouth).

Medical consultation, exams and surveillance which may be required under the standard will be coordinated through Environmental Health & Safety and the Human Resource Services Department.

PERSONNEL INVOLVED IN ANY EMERGENCY SITUATION SHOULD GO DIRECTLY TO THE NEAREST EMERGENCY ROOM OR CALL 911 FOR ASSISTANCE.

If a question arises about the need to provide medical surveillance or if a concern regarding monitoring arises because of such a spill, leak or explosion, call Environmental Health & Safety at 372-7163.

F. Personal Protective Equipment

Principal Investigators (PIs) or laboratory Supervisors are required to provide adequate personal protective equipment to employees as required by the Washington State Department of Safety and Health. (WAC 296-800-160).

If personal protective equipment is used, Principal Investigators (PIs) or laboratory Supervisors are required to perform and certify a hazard assessment. A Template has been developed to assist you with this requirement and is attached to the Standard Operating Procedure Template located in Appendix M of this manual.

Protective equipment must be selected and specified for the protection of employees. Employees must be trained to properly don, use and care for the specified personal protective equipment. A written certificate must be completed that this training has been done. A template is attached with the Hazard Assessment Certification and is located in Appendix M of this manual

1. **General Requirements and Recommendations for Laboratory Apparel**
    a. Appropriate clothing must be worn, including a protective apron or laboratory coat to protect against chemical splashes or spills, cold, heat, moisture and radiation.. Use protective apparel, including face shields or goggles, gloves, and other special clothing or footwear as needed.

    b. Skin, eyes, and respiratory tract should always be protected from possible exposure by use of appropriate laboratory clothing, goggles/ face shields and respirators. For additional information see the Fact Sheet - Eye and Face Protection.

    c. Jewelry should be removed from wrists and hands to prevent chemicals from collecting underneath, contacting electrical sources, catching on laboratory equipment, and/or damaging the jewelry itself. For the same reasons, jewelry which loosely dangles from neck or ears should not be worn.

d. To prevent spreading contamination to family and friends, laboratory coats should be removed before leaving the laboratory.

e. Loose apparel should be confined.

f. Open-toed shoes or sandals should not be worn in the laboratory. For additional information, see the Fact Sheet - Foot and Leg Protection.

g. If laboratory coats are contaminated with hazardous chemicals, they should be removed immediately, and properly laundered, or disposed of as hazardous chemical waste.

h. If laboratory clothing is cleaned by a linen service contractor, contractor employees must be informed if contamination of laboratory clothing presents a danger to cleaning service employees.

2. **Gloves**

a. Gloves should be worn whenever working with chemicals, rough or sharp-edged objects, or very hot or very cold materials. Gloves are available from safety supply companies.

b. Select gloves based on the material being handled, the particular hazard involved, and their suitability for the procedures being conducted. Glove manufacturers list thickness and permeation rates of glove materials for various chemicals. In order to select the appropriate glove, refer to the links contained in Appendix F, read the SDS, or consult EH&S. EH&S has additional references designed to aid in proper glove selection available upon request.

c. Gloves are eventually permeated by chemicals. Inspect gloves before each use for discoloration, punctures, and tears.

d. Gloves should be changed often depending on their frequency of use and permeability to the chemical(s) handled.

e. Double-layering of gloves (wearing one pair of gloves over another) is encouraged whenever very hazardous chemicals are handled, or when glove surfaces are expected to protect the worker from more than one kind of hazard. For example:

i. For mixtures of chemicals, an interior glove may be chosen which protects the worker against exposure to chemical "A" of the mixture, while an over-glove protects the worker against exposure to chemical "B".

ii. A durable over-glove should be used by workers handling chemicals, and at the same time contacting equipment or surfaces which are abrasive. The inner glove is designed to protect the worker against skin exposure to the chemical, while the outer glove protects the inner glove from abrasion or puncture.

For additional information, see the Fact Sheets - Hand Protection.

3. **Respirators**

The WSU Respiratory Protection Program is established to insure a healthful working environment for WSU employees through the proper training in the use of respiratory protection equipment. All use of respirators at WSU comes under the requirements of the

WSU Respiratory Protection Program, including routine and non-routine operations, emergency response, and work in confined spaces.

If a hazard assessment determines that use of a respirator may be required for specific tasks WSU EH&S will assist you with meeting the requirements of WSU's Respiratory Protection Program.

Following are the requirements of the WSU Respiratory Program (SPPM S3.24)

a. A hazard assessment/work area evaluation conducted by Environmental Health & Safety.

b. Proper selection of respiratory equipment.

c. Respiratory protection training, fit testing, and certification conducted by Environmental Health & Safety.

d. An evaluation of the fitness of each respirator user to wear a respirator safely conducted by a qualified occupational health medical practitioner.

e. Respirator users must be re-certified at least annually.

For more information about the WSU Respiratory Protection Program call Environmental Health & Safety at 372-7163. See also the Fact sheet – Respiratory Protection.

G. Recordkeeping

1. The Chemical Hygiene Plan must be reviewed and evaluated at least annually by the PI or laboratory supervisor, be updated as necessary, and be available to all employees. (WAC 296-828).
2. Current chemical inventories should be maintained for each laboratory and made available in case of emergency. It is recommended that they be updated at least annually.
3. Employee Accident Report records, Employee Training records and Industrial Insurance records are maintained by Human Resource Services. The Departmental Administrator and the Principal Investigator or laboratory Supervisor should keep copies of all accident/incident reports filed.
4. Environmental Health & Safety maintains records of employee attendance at EH&S sponsored safety and health training. Laboratories should maintain records of all internal safety and health training related to hazard communication and/or laboratory safety.
5. Occupational Health Medical records for employees are maintained in medical office of the physician who performs consultation and/or physical examination or through Human Resource Services. Confidentiality of medical records is maintained.

H. Signage and Labeling

Labeling and signage are important devices with which employees may be informed of hazardous conditions. Labels are required on containers of hazardous substances. Signs or placards are required on entrances to areas in which an employee may be subject to hazardous conditions.

1. Labels

   Hazardous chemical labeling requirements are specified in OSHA and DOSH regulations.

   a. Labels on incoming containers of hazardous chemicals shall be readable and shall not be removed or defaced. If the package or container is sufficiently cleaned of residue and purged of vapors to remove any potential health or physical hazard, existing labels can be removed.

   b. WSU requires a written Chemical Hygiene Plan. As part of the Chemical Hygiene Plan, the Principal Investigator must develop a system for secondary labeling. The labeling system shall require hazardous chemical containers to be labeled with the following:

      i. Identity of the hazardous chemical(s) using either the chemical or common name, and

      ii. Appropriate hazard warnings which give information about the relevant health and physical hazards of the chemical(s). This includes health effects information, such as information about organs most likely to be affected by the chemical(s).

      iii. Along with these requirements, it is good chemical hygiene practice and recommended that the date the chemical(s) was placed in the secondary container and the person's name responsible for the container be provided on the label if more than one person will be working in the same laboratory work area and may not be in direct communication with the other laboratory workers and / or the container may include chemicals which will eventually become hazardous chemical waste. An exception is when the chemical will be used by one person within his/her work shift.

      iv. If the secondary container is too small for a label, the label can be affixed to the container with a wire or affixed to the tray or shelf that holds the secondary container.

      v. Using the form provided in the Chemical Hygiene Plan Guide the Principal Investigator or Supervisor must describe in detail, the secondary chemical labeling system used in their laboratory and the person responsible for ensuring the secondary labeling requirements are met.

   c. Principal Investigators or Supervisors must provide information and training to laboratory employees with regards to the labeling system so employees are able to protect themselves from the hazards. Also, principal investigators or supervisors must inform non-laboratory personnel (e.g., maintenance workers, custodial personnel, etc.) entering their laboratory of the potential hazards that may be present. Information can be obtained from the labels and Safety Data Sheets (SDSs). SDSs received with incoming shipments of hazardous chemicals must be readily accessible to laboratory employees / workers while they are in the laboratory.

   d. Contents of waste receptacles must be labeled following proper guidelines:

      - Uncontaminated waste glass/disposal of glass waste

- Hazardous chemical wastes
- Radioactive wastes
- Biohazardous waste materials and sharps

e. Secondary containers used in the laboratory must be labeled in a manner which meets the requirements of the Globally Harmonized System. Methods which may be used to meet this standard are:

i. Copying the label from the manufacturer's primary container

ii. Creating a blank label, which must include (at minimum) the identity of the chemical and the hazard warnings from the original label or SDS.

iii. Other methods of secondary labeling must be approved by EH&S

2. Signage / Placards

a. A laboratory signage program has been implemented to improve worker protection, emergency response capabilities, and enhance security for laboratories. A sign holder is provided at the entrance to each laboratory requiring signage. Using the Lab Signage Program, the Principal Investigator develops a sign with the requested information and displays the completed sign at the entrance to the laboratory. The completed sign provides important information regarding emergency contact (Department Name, Location, Contact Number During Business Hours and Non-Business Hours), Area Hazards and Warnings, and Minimum Personal Protective Equipment Required Before Entry. For detailed information, contact EH&S at 372-7163.

b. Laboratory warning placards typically contain a general indication of the type of hazard associated with the laboratory. Specific regulatory standards require specific placards. If a specific regulatory standard requires a placard (e.g., Radiation Symbol, Laser Warning Sign, Biohazard Symbol, etc.), then the Laboratory Signage Program does not replace these placards**.**

3. Stickers and Equipment Labels

a. Emergency response telephone numbers (e.g., fire, police, ambulance, etc.) should be posted on each telephone.

b. Location signs should be posted for safety showers, eyewash stations, fire extinguishers, first aid equipment, exits, and other safety equipment. Refrigerators and freezers are to be signed as "No Food or Drink" areas.

c. Laboratory water faucets should be labeled as "non-potable" (not for drinking purposes). Per the Uniform Plumbing Code and the WSU Cross-Connection Control Program, the faucet labels shall state "CAUTION: NON-POTABLE WATER. DO NOT DRINK". Laboratory safety showers and eyewash stations must also be labeled as containing non-potable water (Reference SPPM 5.15). Contact EH&S at 372-7163 for more information.

d. Warning signs should be posted in areas or on equipment where special or unusual hazards exist.

I. Chemical Spill Clean-up and Reporting

1. Chemical Spill Clean-Up By Employees

   Employees can clean-up minor chemical spills ONLY when all of the following conditions are met:

   a. The chemical is known and the spill can be cleaned-up in ten minutes or less.

   b. Employees are trained to safely clean-up chemical spills.

   c. Employees can wear the same personal protective equipment that they wear during normal work activities.

   d. Appropriate clean-up supplies are readily accessible.

   e. The chemical does not have a Ceiling Limit listed in WAC 296-841 or can create an Immediate Danger to Life and Health (IDLH) atmosphere. IDLH information can be found in the NIOSH Pocket Guide to Chemical Hazards.

   f. Clean-up materials are disposed of per SPPM 5.66.

2. Mercury Spills

   Employees cannot clean-up mercury spills. EH&S responds to all mercury releases; call 372-7163 during business hours and 372-7234 after business hours.

3. When to Call for Help

   If any of the above conditions cannot be met, then immediately evacuate all personnel from the area and call the campus emergency line at 372-7234. Qualified emergency response personnel will respond to clean-up the spill.

4. Recommended Spill Clean-Up Kit

   Each laboratory should assemble a chemical spill clean-up kit consisting of:

   - Personal protective equipment normally worn during routine work (e.g., gloves, safety goggles, lab coat)
   - Absorbent pads
   - One-gallon Ziploc bags
   - Dust pan and brush
   - Duct tape
   - Five-gallon bucket with lid

   The five-gallon bucket can be used to store spill clean-up materials and then can be used to store contaminated items, such as gloves and absorbent pads, used during the clean-up. Once the spill is cleaned up the bucket is to be closed and labeled as Dangerous Waste. Submit a Chemical Collection Request form and EH&S will pick-up the container.

J. Training, Information, and Factsheets

The Principal Investigator or laboratory Supervisor must provide employees with information and training to ensure that they are apprised of the hazards of chemicals present in their work area. (WAC 296-828).

1. Chemical hazard information must be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. This information must be provided by the employing department and may be supplemented by sending employees to appropriate EH&S laboratory safety training classes.

   Employees shall be informed of:

   a. The contents of the Laboratory Safety Standard: Appendix A.

   b. Location and availability of the Chemical Hygiene Plan.

   c. Permissible Exposure Limits (PELs): Appendix B.

   d. Signs and symptoms of overexposure

   e. Safety Data Sheets.

   f. Laboratory safety references: Appendix G.

   g. Labeling requirements: Section II.H.

2. Employee training shall include:

   a. Methods and observations that may be used to detect the presence or release of hazardous chemicals.

      i. Information should be provided on the SDS sheet which indicates whether or not a release of the hazardous chemical can be observed visually or can be detected by odor at concentrations below the PEL.

      ii. If no information can be found which indicates the detectability of the hazardous chemical, provisions may be made for environmental sampling by contacting Environmental Health & Safety, 372-7163.

   b. The physical and health hazards of chemicals in the work area.

   c. The measures employees can take to protect themselves from these hazards, such as appropriate work practices, the use of engineered control devices (such as fume hoods or other ventilation equipment), emergency procedures, and the proper use of personal protective equipment.

   d. The applicable details of the laboratory's Chemical Hygiene Plan.

3. Attendance at EH&S laboratory safety training classes may be used to fulfill part of this training requirement. Principal Investigators or laboratory supervisors must provide the majority of this training. EH&S supports the internal training programs through courses and resources made available to the employing department.

   a. An information meeting can be scheduled for administrators, faculty, PIs, and supervisors on the elements of the Laboratory Safety Standard.

b. Laboratory Safety Standard Supervisor training is offered to assist supervisors in setting up their internal training program.

c. EH&S has audio visual resources and laboratory safety references available for departmental use.

d. EH&S has factsheets available. Factsheets are one page introductory level safety-related information sheets. They can be mailed to you upon request. Call EH&S: 372-7163.

K. Hazardous Waste Disposal

See the following appendices:

Appendix E: RECYCLING OR DISPOSAL OF HAZARDOUS SUBSTANCES

Appendix H : DISPOSAL OF BIOHAZARDOUS WASTE

Appendix I: SHARPS DISPOSAL

Appendix J : RADIOACTIVE WASTE DISPOSAL

L. Inspections

1. Inspections should be performed regularly by the PI or laboratory supervisor. A form which may be used by the PI or lab supervisor to perform these inspections is presented at the end of this section.
2. Environmental Health & Safety also conducts periodic laboratory safety inspections and upon request.
   a. EH&S inspections will include a general safety and chemical safety audit and a review of the Chemical Hygiene Plan.
   b. Unsafe practices or conditions will be reported immediately to the PI or laboratory supervisor. A safety audit report will be sent to the PI or laboratory supervisor with recommendations for corrective action.
3. The Washington State Department of Safety and Health, the WSU Fire Department, and other regulatory agencies may also conduct safety and health compliance inspections.
4. The sample inspection form may be used by laboratory supervisors or Principal Investigators. A similar inspection form may be used by Environmental Health & Safety inspectors in performing laboratory surveys.

M. Safety Data Sheets (formerly Material Safety Data Sheets)

Note: The Globally Harmonized System (GHS) for Classification and Labeling of Chemicals was adopted by OSHA in 2012. GHS outlines new requirements for communication of chemical hazards, including new updates to safety information provided by manufacturers. The former Material Safety Data Sheets (MSDSs) will be phased out, replaced by Safety Data Sheets (SDSs) with new pictograms, signal words, hazard and precautionary statements, and slight differences in format and content. Many suppliers have already transitioned to the new form. The requirement for chemical users to maintain the SDSs has not changed.

1. Safety Data Sheets (SDSs) are documents provided by manufacturers describing the physical and health hazards of hazardous chemicals and trade name products and must be accessible to all employees on all work shifts. Laboratories must keep on file any SDS received with incoming shipments of hazardous chemicals. They may be stored in hard copy or electronic form. Employees must be able to access the information immediately 24/7.
2. It is strongly recommended that a person or persons be designated as responsible for obtaining and maintaining SDSs for hazardous chemicals used in the laboratory. This person would ensure that SDSs are available to all laboratory employees, and would obtain SDSs for laboratory chemicals for which none are present.
3. Environmental Health and Safety provides additional information about safety data sheets.

N. Carcinogens in Laboratories

Chemical carcinogens are known to cause tumors in mammalian species. Therefore, the use of chemical carcinogens in laboratories must involve specific controls and procedures to protect employees and meet regulatory requirements. 1. The State of Washington identifies carcinogens in three ways: "Select Carcinogens," "Listed "Carcinogens," and "Specific Carcinogens."

To help determine if a substance is a carcinogen:

- Inspect the links in Appendix K to see if your chemical is listed as a carcinogenic substance
- Review the requirements for Select, Listed or Specific Carcinogens Below.
- Look for words on the container label;
- Check the product's Safety Data Sheet (SDS) for hazard information; or
- Contact EH&S at 372-7163

1. Select Carcinogens:

In laboratories, carcinogens are classified as "select carcinogens" if the substance meets any of the following criteria:

a. Listed as a DOSH regulated carcinogen;

b. Listed as "known to be carcinogens" in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition);

c. Listed under Group 1 (carcinogenic to humans) by the International Agency for Research on Cancer (IARC) Monographs (latest editions);

d. Listed in either Groups 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by the NTP, and causes statistically significant tumor incidence in experimental animals; or

e. Listed as confirmed (A1) or suspected (A2) human carcinogens in the most current version of American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values.

If a substance is identified as a select carcinogen and used in the laboratory, the Principal Investigator / laboratory supervisor must:

a. Follow the policies and procedures established in the Laboratory Safety Manual / Chemical Hygiene Plan. For example, develop and follow written standard operating procedures. Written standard operating procedures identify the Procedure / Process, Chemical Name(s) and Associated Physical and Health Hazards, Location of Health and Safety Information, Protective Equipment, Waste Disposal Procedures, Designated Area Information, Decontamination Procedures, and Special Storage and Handling Procedures. (See Section IV. Standard Operating Procedures)

b. Follow additional regulatory requirements if the select carcinogen is classified by the State of Washington as Listed or Specific Carcinogens.

2. Listed Carcinogens:

The State of Washington classifies the following substances as "listed carcinogens" which have additional regulatory requirements:

4-Nitrobiphenyl	Benzidine
Alpha-Napthylamine	4-Aminodiphenyl
4,4'-Methylene bis (2-chloroaniline)	Ethyleneimine
Methyl Chloromethyl Ether	Beta-Propiolactone
3,3'-Dichlorobenzidine (and its salts)	Acetylaminofluorene
Bis-Chloromethyl ether	4-Dimethylaminoazobenzene
Beta-Naphthylamine	N-Nitrosodimethylamine

If a laboratory is using, repackaging, releasing, handling or storing any of the carcinogens listed above, and the carcinogens (solid or liquid) are .1 percent or greater by weight or volume, the Principal Investigator / laboratory supervisor must:

a. Follow the policies and procedures established in the Laboratory Safety Manual / Chemical Hygiene Plan (e.g., develop and follow written standard operating procedures, etc.);

b. Establish a designated area (an area which may be used for work with carcinogens, reproductive toxins or substances which have a high degree of acute toxicity. The designated area can be a fixed piece of equipment such as a fume hood or a small room or enclosure);

c. Establish a regulated area (an area where entry and exit is restricted and controlled);

d. Post sign at entrance to regulated area stating:

CANCER SUSPECT AGENT

AUTHORIZED PERSONNEL ONLY

e. Signs and instructions must be posted at the entrance to, and exit from, regulated areas, informing employees of the procedures that must be followed in entering and leaving a regulated area. The signs and instructions can be separate or included in the laboratory signage program.

f. Ensure mechanical pipetting aids are used for all pipetting procedures associated with the listed carcinogens;

g. Confine all experiments and procedures to a laboratory-type hood or glove box;

h. Protect surfaces on which these carcinogens will be used from contamination;

i. Collect contaminated wastes in impervious containers which are closed and decontaminated prior to removal from the work area and dispose of waste according to the procedures listed in the Standard Operating Procedures for that chemical.

j. Protect laboratory vacuum systems with high efficiency scrubbers or disposable absolute filters (if applicable);

k. Perform and certify a hazard assessment. Provide and require employees to wear clean change of appropriate laboratory clothing (e.g., solid front gown, surgical scrub suit, fully buttoned lab coat, etc.);

l. Require employees, prior to exiting from a regulated area, remove and leave protective clothing and equipment at the point of exit and at the last exit of the day. Place used clothing and equipment in impervious containers at the point of exit for purposes of decontamination or disposal. Containers must be labeled with the full chemical name, Chemical Abstracts Service Registry number and have the warning words "cancer-suspect agent" displayed. Containers with carcinogenic contents with corrosive or irritating properties must be labeled with statements warning of such hazards, and if appropriate, note particularly sensitive or affected portions of the body (For detailed decontamination procedures, see the laboratories Chemical Hygiene Plans written standard operating procedures / For standard operating procedure instructions, see Section IV. Standard Operating Procedures). DO NOT REMOVE CONTAMINATED CLOTHING FROM THE REGULATED AREA AND LAUNDER AT HOME. For questions concerning decontamination procedures, contact EH&S at 372-7163;

m. Require employees to wash hands, forearms, face and neck upon each exit from the regulated area close to the point of exit, and before engaging in other activities;

n. Ensure air pressure in the laboratory areas is negative in relation to the pressure in the surrounding areas. Exhaust air should not be discharged to regulated areas, non-regulated areas or the external environment unless decontaminated. There should be no connection between the regulated area and any other area through the ventilation system;

o. Maintain current inventories of the listed carcinogens; and

p. Ensure fume hoods are tested annually.

In addition to the requirements listed above, if employees work in a laboratory that uses, repackages, releases, handles or stores any of the listed carcinogens (.1 percent or greater by weight or volume) and engages in animal support activities, the principal investigator / laboratory supervisor must:

a. Perform and certify a hazard assessment that includes animal support activities. Provide and require employees to wear clean protective clothing each day of use (i.e., coveralls or pants and shirt, foot covers, head covers, gloves, and appropriate respiratory protective equipment or devices;

b. Collect contaminated carcasses in impervious containers which are closed and decontaminated prior to removal from the work area and dispose of waste according to Biohazardous Waste disposal procedures; and

c. Require employees to shower after exiting for the day.

3. Specific Carcinogens:

The State of Washington classifies the following substances as "specific carcinogens" which have detailed regulatory requirements:

Vinyl Chloride	Ethylene Oxide
Acrylonitrile	Cadmium
1,2-Dibromo-3 chloropropane	Butadiene
Inorganic arsenic	Methylene Chloride

If laboratory personnel work with any of these specific carcinogens, the Principal Investigator/Supervisor must:

a. Follow the policies and procedures established in the Laboratory Safety Manual / Chemical Hygiene Plan (i.e., develop and follow written standard operating procedures, etc.);

b. Follow the detailed individual health standard that applies to the specific carcinogen if the exposure limits are exceeded; and

c. Contact Environmental Health and Safety (EH&S) at 372-7163, if an EH&S evaluation for the specific carcinogen has not been performed.

Section III – Laboratory Facilities

GOAL

In working with hazardous chemicals, chemical exposures must be prevented whenever possible by using auxiliary local ventilation devices and safety equipment. (Policy Reference - WAC 296-828).

METHODS

A. Laboratory Floor Plan

Draw a floor plan for each room of your laboratory. Note the location of the following safety equipment and other safety features as appropriate.

1. Eyewash stations
2. Emergency showers
3. Flammable liquid storage cabinets
4. Fire extinguishers
5. First Aid kits
6. Auxiliary local ventilation systems
7. Laboratory spill kit
8. Emergency phone number sheet
9. Direction of exit
10. Gas turn-off valve
11. Circuit breaker box
12. Designated Area for hazardous chemical use[1]
13. Laboratory Floor Plan for Each Room

Sample Floor Plan

A designated area must be established for work with select carcinogens, reproductive toxins, or chemicals which have a high degree of acute toxicity (see Section IV). The entire laboratory, a fume hood, or a portion of the laboratory may be considered as a designated area.

B. Safety Equipment

This section contains a general list of types of safety equipment found in University laboratories, including information on use and maintenance.

1. Eye Wash Stations
    a. Flush the eyewash stations in your laboratory at least weekly. Submit a **Facilities maintenance request** or call Facilities for maintenance, 372-7605. Eyewash stations should provide a soft stream or spray of water no less than 1.5 liters per minute for at least fifteen minutes.
    b. Laboratory personnel must be able to reach eyewash stations and/or emergency showers within ten seconds. Emergency washing facilities must be present within 50 feet of the employee's work station. DO NOT BLOCK ACCESS TO THE EYEWASH STATION.
    c. Because chemical splashes to the eyes may impair vision, laboratory workers should memorize the location and usage of all eyewash stations in their area. The presence of an emergency eyewash station does not replace the need for personal protective equipment.
    d. When using an eyewash station, hold the eye lids open and flush eyes for at least fifteen minutes or according to the Safety Data Sheet or available safety information.
    e. Eyewash stations should be designed to meet the ANSI Standard. When actuated, the water delivery device should distribute water continuously without having to be held "on" or in the hand. This is to allow the injured person to use both hands to hold open the eyelids. Many laboratories on the WSU campus have drench hoses. Drench hoses do not meet the ANSI Standard as an eyewash station. If the laboratory has a drench hose, the drench hose can be used as a supplement in case of an emergency; however, an ANSI approved eyewash should be installed as soon as possible. Until installed, provisions should be made to always have two or more persons in the laboratory when working with chemicals that could damage the eye. One person can then assist the injured party by holding and directing the drench hose while the injured party is free to hold the eyelid open.
    f. For additional information see Fact Sheets, **Emergency Washing Facilities - Determining Need & Location**, and **Emergency Washing Facilities - Specifications, Responsibilities, & Training**.
2. Emergency Showers
    a. Emergency showers are needed when there is potential for major portions of an employee's body to contact corrosives, strong irritants, toxic or skin-absorptive chemicals.
    b. Emergency showers consist of a shower head controlled by a stay-open valve, operated by an approved control valve actuator, and capable of delivering water over the user's entire body. Emergency showers are tested annually by Facilities Operations to ensure the valve is operating, all debris is removed from the system, and there is sufficient water flow.

c. Where required, emergency safety showers must be present within 50 feet of the potential hazard and it should take no more than ten seconds for laboratory personnel to reach the safety shower. DO NOT BLOCK ACCESS TO THE SAFETY SHOWER.

d. Every laboratory worker should know the location of all safety showers in the area and how to use them.

e. When used, remove contaminated apparel, flush contaminated area of body for fifteen minutes or according to the Safety Data Sheet or other available safety information and obtain medical attention.

f. The presence of an emergency shower does not replace the need for personal protective equipment.

g. For additional information, see Fact Sheets **Emergency Washing Facilities-Determining Need & Location** and **Emergency Washing Facilities-Specifications, Responsibilities, & Training**."

3. Flammable Liquid Storage Cabinets

a. Maximum capacity. Not more than 60 gallons of Class I flammable liquids or Class II combustible liquids, nor more than 120 gallons of Class III combustible liquids may be stored in a storage cabinet. No more than three of these cabinets may be stored in the same fire area unless there is a separation of greater than 100 feet. (WAC 296-24-33009).

b. Cabinets must be labeled "Flammable - Keep Fire Away," to meet specifications set forth in WAC 296-24-33009. Do not place storage cabinets in hallways, stairways, bathrooms, or routes of egress.

c. Storage of flammable liquids in excess of ten gallons must be stored in an UL listed, Factory Mutual (FM) approved, flammable liquid storage cabinet. (Policy Reference - UFC Article 79).

d. Flammable liquid storage cabinets should be used for the storage of flammable and combustible liquids only.

e. Flammable liquid storage cabinets are available from safety suppliers.

f. Flammable liquid storage cabinets do not require venting for fire protection purposes. However, for safety and health reasons, venting may be necessary; therefore, storage cabinets often come with capped bung openings that allow for ventilation. EH&S recommends venting flammable storage cabinets. If the cabinet is ventilated, the cabinet must be properly vented, and where possible, equipped with slotted or wire mesh screen shelving to facilitate proper airing. If a cabinet is not ventilated, the vent openings must be sealed with the bungs supplied by the manufacturer. For concerns regarding ventilation of flammable liquid cabinets, contact EH&S at 372-7163.

Note: A storage cabinet for flammable liquids is not fireproof, but only protects the contents from extreme temperatures for a limited time to allow evacuation of personnel and prompt entry of fire fighters.

4. Flammable Storage Refrigerators or Freezers

   Flammable chemicals or chemical mixtures which are required to be stored below room temperature must be stored in refrigerators or freezers specifically designed by the manufacturer to be explosion proof. All other refrigerators or freezers not specifically designed to be explosion proof should be labeled with a prominent warning sign indicating that they are unsuitable for the storage of flammable substances.

   See Fact Sheet – Laboratory Refrigerator and Freezers.

5. Fire Extinguishers

   University laboratories using chemicals should have a fire extinguisher available for the types of fire hazards that may exist in the particular laboratory. The selection of the fire extinguisher for the given situation is determined by the character of the fire anticipated. In most WSU laboratories, a class BC or ABC rated (i.e., 2A 10BC), dry chemical fire extinguisher within 30 feet of any exit will be sufficient for small ordinary combustibles, flammable liquids, and electrical fires. If pressurized water fire extinguishers are available, they are suitable only for use on ordinary combustible fires (i.e., paper, wood, etc.).

   If a fire extinguisher is installed in the laboratory, ensure its location is identified on the Laboratory Floor Plan (see Section III.A). Access to fire extinguishers should be free of obstructions.

   If the laboratories emergency plan (i.e., Standard Operating Procedures, Unit's Emergency Plans, Accident Prevention Program, etc.) designate laboratory personnel to use fire extinguishers for small fires, make sure the proper extinguishers are available and all laboratory personnel are trained when first hired and annually thereafter. Trained personnel should know where the extinguishers are located, what types of fires they can be used for, how to operate them correctly, and the hazards involved with firefighting.

   Even though a small fire can sometimes be extinguished with a fire extinguisher, attempt to put out such a fire only if you have been trained, are confident you can do so successfully and quickly, and are in a position in which you are always between the fire and an exit to avoid being trapped. Consult your laboratory standard operating procedures, Unit Emergency Response Plan, and Accident Prevention Program for additional information regarding fire emergencies.

   If additional extinguishers are needed for a laboratory, or for fire related questions, contact EH&S (372-7163).

6. First Aid Kits

   The Washington State Division of Safety and Health requires first aid supplies be readily accessible for employees. The size, quantity and contents of first aid kits are determined by the number of personnel served by each kit and the type of hazards. Refer to the Safety Policies and Procedures Manual Section S2.42, First Aid Kits. (WAC 296-800-15020).

Contact Environmental Health & Safety for information for assistance in determining the appropriate size first aid kit (372-7163).

C. Ventilation

Permissible Exposure Limits (PELs), established by the Washington Department of Safety and Health (DOSH), shall not be exceeded (see Appendix B). Eight-hour and short-term permissible exposure limits to many chemicals have been set by DOSH to prevent adverse health effects in workers. Local exhaust ventilation systems may be required in order to reduce exposure levels to these acceptable limits. For assistance in measuring chemical exposures and in comparing them to the appropriate limits, please contact Environmental Health & Safety at 372-7163.

1. Fume Hood Use

   Chemical exposure may be controlled by dilution ventilation or by capture of chemical vapors and particles by local exhaust ventilation. The primary means of control should be by local exhaust ventilation with dilution ventilation as a back up to remove contaminants that escape local exhaust fume hoods.

   a. When working with perchloric acid, specialized ventilation may be required. When working with cold perchloric acid (less than five percent), a specialized independent fume hood is not required; however, the work must be performed in a properly functioning fume hood. When working with heated or concentrated perchloric acid, a specialized independent hood (perchloric acid hood) with a built in wash down system must be used.

   b. When perchloric acid is heated above ambient temperature, it will vaporize and condense on hood, duct, and fan components. In addition to being highly corrosive, condensed vapors can react with organic materials such as gaskets, greases, and chemical residues to form explosive perchlorate salts and esters. By washing down the hood following each use, materials deposited in the perchloric acid hood are removed, preventing the buildup of shock, heat, and friction sensitive perchlorates.

   c. The hood should be dedicated to perchloric acid use only. Organic materials and those incompatible with perchloric acid should not be used in the perchloric acid hood. The user is responsible for ensuring that perchloric acid hoods are washed down after each use. The hoods are certified on an annual basis.

   d. The effectiveness with which contaminants are captured from the air by a fume hood is seriously reduced by cross drafts and eddy currents. Cross-drafts occur when people walk in front of a fume hood, when nearby windows or doors are open, or when directional air supply diffusers are placed too close to the fume hood. Eddy currents also 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 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 opening. Hoods should be operated with the front sash drawn down as far as practical, so the face and upper body of the hood user are protected from splash, explosion, or fume inhalation.

   e. In some laboratories, fume hoods are used not only as local exhaust facilities, but also serve as the sole air exhaust for the laboratory. It is necessary for

laboratories dependent on fume hoods as the sole air exhaust to assure these hoods are continuously operating (on a 24-hour basis) as long as hazardous chemicals are present in the laboratory. The need for operation of the hood during periods when workers are not present in the laboratory is for the removal of fumes from an accidental chemical spill or release which, if unventilated, may impact other rooms and personnel in the building.

f. Operations such as ongoing reactions, heating or evaporating solvents, and transfer of chemicals from one container to another should normally be performed in a hood.

g. If especially hazardous or corrosive vapors will be evolved, these exit gases should be passed through scrubbers or absorption trains.

h. Control the rate and velocity of the released vapors and particles from chemical reactions in order to minimize risk of exposure.

i. Sliding sashes should be kept closed to improve overall performance of the hood. Note that reacting chemicals placed in a fume hood with the sash closed places a physical barrier between workers and chemical reactions as well. Use a separate safety shield when appropriate.

j. The fume hood also acts as a containment device for accidental spills of chemicals.

k. There should be an adequate number of fume hoods to accommodate research needs. Recommended guidelines are: One fume hood for each two workers, and the fume hoods should be large enough to provide each worker with at least 2.5 linear feet of working space at the face.

l. Fume hoods should not be regarded as the means for disposing of chemicals. Apparatus used in hoods should be fitted with condensers, traps, or scrubbers to contain and collect waste solvents or hazardous vapors or dusts. Highly hazardous or offensive vapors should always be scrubbed or absorbed before the exit gases are released into the fume hood exhaust.

m. Fume hoods are tested annually by EHS. Labels are placed on the side airfoil on the front of each hood indicating the measured velocity at specific sash heights. To ensure that adequate personal protection is provided, make sure the fume hood velocity, as posted on the label, is adequate for the processes being carried out in the hood. It may be necessary to use a closed system such as a glove box or bag for highly hazardous chemicals/materials. Call EH&S for assistance at 2-7163. If the annual test results do not meet specification, Facilities Operations will affix a sign to the fume hood warning laboratory personnel not to use the hood until it has been repaired.

n. Whenever practical, chemicals or apparatus should be moved from fume hoods to vented cabinets for storage until needed.

o. An emergency plan should be prepared for the event of ventilation failure or other unexpected occurrences that could disrupt fume hood function. The minimum contents of such a plan should include:

i. Procedure for warning laboratory users that ventilation protective devices are non-operational.

ii. Instructions to laboratory users as to the risk of their continued presence in the laboratory.

iii. Instructions to laboratory users about which processes and/or activities are to be curtailed or eliminated during the period of time ventilation systems are disrupted.

iv. Instructions for use of alternative laboratories or laboratory facilities, including safety orientation toward the use of these alternate facilities.

v. This emergency plan/information should be included in your Laboratory Safety Manual / Chemical Hygiene Plan. The site specific information may be kept as an integral part of your Chemical Hygiene Plan or filed under Section VI. Laboratory Specific Information Provided, in your laboratory manual.

vi. For Power Failure in Laboratories, see EH&S Fact Sheet – Power Failure: Laboratory Procedures.

p. Use only explosion proof electrical equipment in fume hoods where flammable liquids/vapors are present.

2. Other Ventilation Systems

a. If other local exhaust systems are used in the laboratory, they should be designed by a ventilation engineer

b. Do not attach canopy hoods, flammable storage cabinet exhausts, or snorkel systems to existing fume hood exhaust ducts without consulting a ventilation engineer.

c. Glove boxes generally operate under negative pressure, though some operate under positive pressure in which case leaks could cause problems. Positive pressure 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 shutoff valve or a pressure gauge designed into it).

d. Isolation rooms or clean rooms typically operate under negative pressure and require considerable engineering. Procedures for entering and exiting these areas should be written out and employees should be trained accordingly.

e. Environmental rooms, either as refrigeration cold rooms or as warm rooms for growth or organisms and cells are usually closed air-circulation systems, thus the release of hazardous chemicals in these areas poses potential dangers.

Refrigerant Leaks: Since release of refrigerant chemicals in such an enclosed area may cause asphyxia, it is recommended that direct reading monitor(s) tied to an alarm system be installed to warn personnel of potentially hazardous exposures prior to entering the room. If direct reading monitors have not been installed in the area, it is recommended that warning signs be posted on entrances and hand-held direct reading monitor(s) for refrigerant gases be provided prior to accessing the room. In the interim, if alarms are not installed and hand-held direct reading monitors are not

available, procedures should be put in place to inform supervisor prior to accessing these enclosures (i.e. location, time of entry, approximate time of departure, etc.). List any special instruction in Section III.C.4 Site Specific Ventilation Information.

f. Magnetic latches or breakaway handles on doors of environmental rooms should be installed to allow a trapped person to open the door(s).

g. The electrical system within environmental rooms should be independent of the main power supply so that persons are never left in these areas without light.

h. Volatile flammable solvents should not be used in cold rooms due to fire hazards from ignition sources. For additional information, see Section III.F.3 Laboratory Equipment, Refrigerators and Freezers.

i. The use of volatile acids should be avoided in cold rooms because such acids can corrode the cooling coils in the refrigeration system, which can lead to the development of leaks of hazardous refrigerants.

j. Hazardous chemicals should be stored in cabinets fitted with auxiliary local ventilation.

k. Laboratory apparatus that may discharge hazardous vapors (vacuum pumps, gas chromatographs, liquid chromatographs, and distillation columns) should be vented to an auxiliary local exhaust canopy or a snorkel system.

3. Maintenance of Ventilation Systems

a. Laboratory ventilation systems including fume hoods are the primary methods of protection from hazardous chemical vapors, fumes and potential contamination. These systems must be maintained regularly to ensure proper performance. To request repairs or changes to the ventilations system, **Facilities maintenance request** or call Facilities for maintenance, 372-7605.

b. For further information see Fact Sheet – Chemical Fume Hoods.

c. EHS coordinates periodic maintenance and testing of fume hood and other protective equipment to ensure that they are functioning properly. The maintenance and testing includes annual testing of fume hood face velocity to determine that an appropriate volume and velocity of air is entering the fume hood.

- The fume hood testing technician affixes a sticker to the fume hood which indicates the last measured face velocity of the fume hood and the date of measurement. If the face velocity tested on the fume hood is significantly lower (or higher) than the allowable limit indicated, the technician will tag out the fume hood until repairs are made. The fume hood must not be operated until the tag has been removed by Facilities Operations.
- Complaints or concerns submitted by fume hood operators will be investigated by Facilities Operations and EHS.

d. Laboratory ventilation equipment scheduled for maintenance or repair work must be cleaned and/or decontaminated by laboratory personnel under the supervision of the

PI or laboratory supervisor. Maintenance workers have the right to refuse to do work if the area or equipment is not clear of hazards.

e. All ventilation systems require 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/or minor component failure.

f. Filters should be replaced periodically in certain types of ventilation systems, such as electrostatic precipitators and cyclones for dust collection.

g. Monitoring devices are installed in ventilation systems to keep the user aware of malfunctions.

4. Site Specific Ventilation Information

   Identify all ventilation systems available in the laboratory. Include information on restrictions, special precautions or procedures, preventative maintenance schedules and any other information relevant to safe operation in the laboratory. An **example** of site specific ventilation information is provided.

D. Biosafety Facilities

Refer to the **Biosafety webpage** for further contact information

E. Facility Services

The Safety and Health Core Rules (WAC 296-800) include hazard communication in multi-employer workplaces. Service department employees who perform services in laboratories at WSU must be informed of the hazards they may encounter in laboratory workspaces. Similarly, laboratory employees must be informed of hazards which may be caused by service employees performing operations in the laboratory.

Service departments at Washington State University must comply with provisions of the Employee Chemical Hazard Communication Standard (WAC 296-800-170). Prior to the time a service employee performs service duties in a laboratory, the service employee's supervisor must obtain information about the laboratory's labeling system and the accessibility of hazard information (e.g. SDSs) for hazardous chemical substances which may present a danger to the service employee working in the laboratory. The supervisor must inform his/her employee of hazards present, and how they can be avoided.

Prior to the time a service department employee uses chemicals (e.g. cleaning chemicals) in the laboratory which may present a health risk to laboratory employees, the laboratory supervisor or Principal Investigator (PI) must obtain information from the service department regarding the service department's labeling system and the accessibility of hazard information (e.g. SDSs), for hazardous chemicals which may present a danger to the laboratory employee. The laboratory supervisor or PI must inform the laboratory employee of hazards present, and how they can be avoided.

1. Custodial Services

   Custodians may perform services in laboratories which include floor sweeping, mopping and waxing. Custodians performing services in laboratories after-hours may encounter spilled or released hazardous chemicals, radioactive materials, or biohazardous materials. Custodial employees are never required to come into contact with such materials.

a. If a custodian observes what appears to be spilled or released hazardous material, the following should be done:

   i. The custodian should immediately leave the area and contact his/her supervisor. Information about the release is provided to the custodial supervisor.

   ii. The custodian's supervisor investigates the spill/release circumstance, and makes a decision concerning one of two courses of action:

   - If satisfactory information provided by the laboratory emergency contact is received by the custodial supervisor, demonstrating that the spilled/released material is not dangerous or damaging, the custodial supervisor locks the laboratory door and leaves a message concerning the released material. Laboratory employees can manage the non-dangerous spilled material the following work day. Custodial employees are *never* permitted to clean up *any* spilled or released laboratory hazardous chemical material.

   - If the spilled /released material appears not to be immediately dangerous or life-threatening, the custodial supervisor should contact the emergency contact (PI or lab supervisor) listed on the laboratory door. From information provided by the emergency contact, the custodial supervisor can make a decision about the continued work activity of the custodial employee in the area.

     If no emergency laboratory contact can be reached, the custodial supervisor then places a notice of the release on all laboratory doors leading **directly into the laboratory.** Access to the laboratory is then prohibited until released by Environmental Health & Safety. An example notice is located in Appendix S.

     If there is no apparent life safety concern associated with the spill (fire/explosion, medical emergency), the custodial supervisor will call the campus emergency line at 2-7234 to notify EH&S of the spill. **In the event of any life safety concern, call 911 first**.

     If EH&S responds to the spill and finds dangerous conditions, the door is posted with the danger notice or barricade-taped, as per SOP. EH&S then arranges for containment and/or cleanup of the spilled/released material. After the spill is properly managed, or if no dangerous conditions are found, the room is released for normal work activities.

b. Custodians may perform the removal of trash from the laboratory trash receptacles. If a custodian suspects the presence of improperly disposed waste material in the trash, he/she immediately informs the custodial supervisor. The custodial supervisor determines whether the trash may be safely removed. If the custodial supervisor suspects improper disposal practices, the trash is left in place, and a “Notice of Improper Disposal Practices” (Appendix S) is placed on the laboratory door. A copy of the notice is sent to Environmental Health & Safety the following work day. Laboratory personnel must properly dispose of the material the following work day.

2. Solid Waste Collection and Disposal

   Custodial Services periodically finds materials in the solid waste receptacles or dumpsters which are suspected to be regulated as hazardous chemical waste, radioactive waste, or pathological/biohazardous waste materials.

   a. If a personnel observe materials present in the solid waste collection system believed to be hazardous, contact Environmental Health & Safety (EH&S) at 372-7163. Do NOT remove the material from the dumpster or receptacle.

   b. EH&S will coordinate with Principal Investigators (PIs) and/or laboratory supervisors to determine the source of the material, and determine if the material is illegally or inappropriately disposed of in the solid waste receptacle. PIs and/or laboratory supervisors are responsible for removal and proper disposal of any materials illegally or improperly disposed of through the solid waste management system.

3. Maintenance and Construction Activities in Laboratories

   Maintenance/construction personnel perform many services in laboratories. Installation and/or modification of ventilation systems, or equipment requiring plumbing, electrical, or gas service may involve Facilities Operations or other contractor shop personnel. Occasionally, floors, walls, lab benches, or other structures which may be contaminated by chemical, biological and radioactive hazards in the laboratory must be removed, remodeled, or repaired by carpentry or other shop personnel. These personnel must be protected from exposure to hazardous substances when they are working in laboratories.

   Facilities Operations or other contractor shop personnel may use chemical or other hazardous substances in their work in laboratories. Paints and lacquers, adhesives, sealants, and other volatile chemicals may be used by shop or contract workers. Laboratory workers must be protected from exposure to chemicals which are used by maintenance/construction personnel.

   The performance of maintenance and construction activities in laboratory facilities creates special safety and research considerations; therefore, operating procedures have been developed to coordinate construction and maintenance work occurring in WSU laboratories. In general, the purpose of the procedures is to assure construction and maintenance work conducted in laboratories is performed in a safe and timely manner with minimal interruption of research. Specifically, the goals of the procedures are as follows:

   a. Protect research during construction or maintenance activities (e.g., utility interruptions);

   b. Promote safer and more efficient maintenance and construction activities in laboratories;

   c. Protect maintenance and construction personnel from the chemical, biological, and radiological hazards found in laboratories; and

   d. Protect laboratory personnel from the potential hazards associated with maintenance and construction activities

The detailed procedures are located in Appendix N. The "Work Permit" is located in Appendix O.

These procedures are to be followed when laboratory personnel request Facilities Operations perform maintenance and construction activities in laboratories. The procedures do not have to be followed when routine custodial services are being conducted in WSU laboratories or in dry laboratories (e.g., computer labs).

4. Disposal of Contaminated Equipment Systems

   Occasionally, old equipment, benches, ventilation hoods, ductwork, and/or parts of gas, plumbing, or other services are removed from laboratories. Equipment such as refrigerators or freezers, fume hoods, etc. may be disposed of through the University scrap metal salvaging system. Laboratory work benches, plumbing waste line fixtures, flooring, and other laboratory surface structures may be disposed of as solid waste.

   There are several reasons for certifying that equipment used in shops and laboratories is not contaminated with biological, chemical, or radioactive contaminants. Protecting the safety and health of WSU staff, faculty, and students as they handle the equipment is essential. WSU also strives to protect the environment by properly managing contaminated wastes in accordance with environmental regulations.

   a. Equipment (such as refrigerators, fume hoods, centrifuges, autoclaves, etc.) used in laboratories, shops, and other areas of the university can become contaminated with biological, chemical, or radioactive materials. The equipment must be decontaminated where reasonable and practical. If decontamination is not reasonable and practical, protective clothing and/or engineering controls must be identified which will adequately protect workers who must handle the equipment. The equipment must also be labeled to warn others of the contamination. If it is contaminated with human blood, the equipment must be managed according to the provisions of the WSU Bloodborne Pathogen Exposure Control Plan.

      Occasionally, fume hoods, refrigerators, and other similar devices may be used for storage of hazardous chemical, radiological, or biological substances. These materials must be removed from the equipment prior to the time the equipment is serviced or removed by service or maintenance employees. Adequate temporary storage for hazardous materials removed form hoods or other equipment must be provided and used so that workers are not put at risk.

      Surplus stores provides a form in BPPM 20.77 to assist laboratory, staff, and maintenance personnel with documentation of decontamination of equipment. *It is the responsibility of the owners/users of contaminated laboratory or shop equipment to decontaminate such equipment and certify that it has been properly decontaminated prior to releasing it for maintenance, salvage, or disposal.*

   b. Remodeling or demolition activities: Plumbing waste line fixtures may be contaminated if hazardous materials are disposed of by dumping down drains. Ventilation ductwork, filters, etc., and other service systems or surfaces which are removed during remodeling or demolition activity may be contaminated by spills or release of hazardous materials. The laboratory supervisor or PI must:

i. Complete the Maintenance /Construction Permit verifying that handling of the material by Facilities Operations shop and/or other contract workers will not result in illness or injury due to exposure to hazardous chemical, radioactive, or biohazard materials, and will not result in violation of hazardous materials disposal laws and regulations, and
ii. Provide information to Facilities Operations and/or other contract employees which will identify safe handling procedures and proper protective clothing and devices

F. Laboratory Equipment

Appendix T contains a general list of equipment found in University laboratories with links to existing factsheets.

1. Centrifuges
2. Electrophoresis Power Supply Safety
3. Refrigerators & Freezers
4. Pipetting
5. Laboratory Vacuum Pumps
6. Laboratory Autoclaves
7. Chemical Fume Hoods

Additional equipment will be added as factsheets are created.

Section IV – Standard Operating Procedures

GOAL

Laboratories must provide employees with standard operating procedures (SOPs) to be followed when laboratory work involves the use of hazardous chemicals. (WAC 296-828-20005)

METHODS

A. Standard Operating Procedures (SOPs) for Hazardous Chemicals and for Particularly Hazardous Substances

1. Guidelines

   Standard Operating Procedures (SOPs) are required to be written for chemicals currently in use in the laboratory. When new chemicals are introduced for use they must be included in existing SOPs or in a new SOP.

   In Appendix M there are examples of Standard Operating Procedure formats and the required Hazard Assessment certification and training documents for PPE. If you already have SOPs for pieces of equipment, chemical processes, mixture preparation, etc., attach those to this portion of the Chemical Hygiene Plan (CHP).

2. Definitions

   Standard Operating Procedures (SOPs) are written safety and health guidelines required for work with hazardous chemicals. "Hazardous chemicals" are defined as having 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.

   Included in the definition of hazardous chemical is a select group of chemicals that will require additional handling provisions. This group is referred to in the Laboratory Safety Standard as "particularly hazardous substances" and includes chemicals that meet any of the following criteria:

   a. High degree of acute toxicity:

      The Environmental Protection Agency (EPA) has adopted the following criteria to identify acutely toxic chemicals based on data from mammalian testing.

      i. Dermal route: the median lethal dose (LD50) is less than or equal to 50 mg/kg.

      ii. Oral route: the median lethal dose (LD50) is less than or equal to 25 mg/kg.

      iii. Inhalation route: the median lethal concentration (LC50) is less than or equal to 0.5 mg/l where time of exposure is any time up to 8 hours.(LD50) is a single dose of a material expected to kill 50% of a group of test animals. (LC50) is a calculated concentration of a material in air, exposure to which for a specified length of time is expected to cause death of 50% of a defined experimental animal population.

b. Select carcinogens:

   i. listed as "known to be carcinogens" in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition), or

   ii. listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer (IARC) Monographs (latest editions), or

   iii. listed in either Groups 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by the NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

      I. after inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m3; or

      II. after repeated skin application of less than 300 mg/kg of body weight per week; or

      III. after oral dosages of less than 50 mg/kg of body weight per day.

   iv. listed as a DOSH regulated carcinogen in WAC 296-62-073(see Appendix K). substances

   v. listed as confirmed (A1) or suspected (A2) human carcinogens in the most current version of ACGIH Threshold Limit Values.

   See the Addendum to Appendix K, the "List of Known Carcinogens and Non-Carcinogens," for further information.

c. Reproductive Toxins (See Appendix L)

   Reproductive Toxins are chemicals that affect the reproductive capabilities of males or females including chromosomal damage (mutations) and fetal effects (teratogenesis). Safety Data Sheets generally employ the following keywords to designate a reproductive toxin: congenital malformation, fetal toxicity, fetal death, fatal effects to the newborn, neoplastic, teratogenic, mutagenic, maternal effects, paternal effects, fertility and infertility. Use Appendix L or Safety Data Sheets (SDSs) to help in determining whether a chemical may be a reproductive toxin. Appendix L was generated from the Hazardous Substances Databank (HSDB), a database of the National Library of Medicine's TOXNET System and from the Catalog of Teratogenic Agents by T.H. Shepard.

d. To aid in determining whether a chemical is hazardous or particularly hazardous, use the links available through Appendix K, Appendix L, and SDSs. If assistance is needed or questions arise, contact EH&S at 372-7163.

B. Personal Protective Equipment Hazard Assessment Certification and Training

The personal protective equipment regulation requires that each employer assess the workplace to determine if hazards are present, or likely to be present, which necessitate the use of personal protective equipment. If such hazards are present, or are likely to be present, the employer must have each affected employee use the proper equipment to protect him/her from workplace hazards. Each employee must be trained how to make proper decisions about

protective equipment to be used in the workplace. The protective equipment selected must fit the affected employee.

The employer is required to verify that the required workplace hazard assessment has been performed. For purposes of the laboratory safety program requirements, each PI or lab instructor is required to certify the proper assessment has been performed. Also, a certification that affected employees are properly trained must be prepared. Included on this certificate is information containing the name of each employee trained, the date(s) of training, and the subject of certification.

Blank certificates which comply with the personal protective equipment rule are provided with each "SOP" form, for convenience. For further information about the personal protective equipment rule and its certification requirements, please refer to the WSU Safety Policies and Procedures Manual Section 3.10.

For additional information on PPE, see the following Fact Sheets:

1. Work Place Hazard Assessment: PPE
2. Eye and Face Protection
3. Foot and Leg Protection
4. Hand Protection
5. Latex Allergies
6. Respiratory Protection

C. Instructions for Standard Operating Procedures for Hazardous Chemicals and Particularly Hazardous Chemicals

1. Instructions for completing Standard Operating Procedures (SOPs) for Hazardous Chemicals and Particularly Hazardous Substances A form titled "Standard Operating Procedures for Hazardous Chemicals and Particularly Hazardous Substances," contains "fill-in-the-blank" areas that correspond to the specific items listed below.

   The following elements must be included in your SOPs:

   a. Description of Experiment/Identification of Procedure: An identification or description of the experiment or research proposal in which an employee may be exposed to a hazardous chemical in the laboratory (e.g., "dissection of rat", or "synthesis of polypeptide"). Note that the description applies to both teaching and research laboratory activities. Typically the experiment or research will be associated with one or more laboratory *procedures*. Often these laboratory procedures are written, and may be described in technical journals or textbooks. The intent is communication to the laboratory employee precisely which part or parts of laboratory research or teaching activity in which there may be exposure to a hazardous chemical substance.

   b. Identification of Chemical Hazard: An identification of each hazardous chemical substance, as well as each *physical hazard* and/or each *toxicity hazard* which may be encountered due to exposure to that hazardous chemical substance. For example, a procedure calls for use of a distillation process in the purification of benzene. In the

distillation process, explosion or fire may be a hazardous condition which may be encountered. Explosion or fire is a *physical hazard* which may be associated with the hazardous chemical. Also, the solvent, itself, may have a toxic principle (*a toxicity hazard*) which needs to be considered in addition to the possible fire or explosion hazard.

c. Identity of Trainer/Resource Person: An identification of the person or organization responsible for health and safety training, specifically for the procedure or process in which a physical or toxicity hazard is present. This person or organization should also be a resource for any health and safety related question which may arise about the hazards associated with a particular chemical used in a particular procedure or process. Typically, this resource/training person is the Principal Investigator, the Instructor, or the Laboratory Supervisor for the particular laboratory in which the employee is working.

d. Location of Health & Safety Information: Note that labeling requirements, SDS information, the location of emergency equipment, and chemical spill management and/or evacuation procedures are provided in other parts of this chemical hygiene plan. For purposes of simplicity and the minimization of redundancy, the SDS may be attached to the SOP. If an SDS is *not* available, or if there are special requirements related to spills and/or emergencies, they must be explicitly presented to the employee in the SOP.

e. Protective Equipment: Note that ventilation controls (like a fume hood, for example), personal protective equipment (i.e., goggles, gloves, respirator), special handling procedures and storage requirements are typically provided in the SDS for a specific hazardous chemical. However, the SDS may not adequately communicate protective equipment information. For instance, the SDS may state "wear impervious rubber gloves." Since there are many kinds of "rubber" gloves, some of which are impervious and some of which are not, supplemental information must be communicated through the use of another source, and the location of this source must be identified (a person, written document, publication, etc.). If information provided by the SDS is insufficient, more specific information must be provided in a written form in the SOP. As an example, the SDS for acetaldehyde indicates the use of "rubber gloves," but you determine from Appendix F that neoprene gloves are good but latex gloves are poor for handling acetaldehyde, then you must specify in the SOP that neoprene gloves must be used. Note that if an employee is required to wear a respirator, the employee must contact EH&S and comply with the respiratory protection program. It should also be understood that certain aspects of personal protective equipment are addressed in regulations outside the lab safety rule

f. Waste Disposal: Typically SDSs do not provide adequate or appropriate information about disposal of waste. Clear directions for waste management are presented in Section II.K. and Appendices E, H, I and J of this manual. It is important that specific information be provided to employees in laboratories about the proper management of chemical, biological and radioactive wastes, and these should be placed in the SOP. If you have questions about classification of waste items, please contact EH&S at 372-7163.

i. Certain chemical wastes are regulated as "Dangerous Wastes" by the Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology). Consult with Environmental Health & Safety if a question arises concerning whether a chemical waste is regulated as "dangerous" or not. Generally, EPA/Ecology considers laboratories, or in some cases a group or suite of laboratories, to be "satellite accumulation areas" (SAAs) for dangerous wastes. A separate container must be used for each type of waste generated. SAAs are permitted to accumulate, over an indefinite period of time, up to 55 gallons per each type of "dangerous waste" and up to a quart of "extremely hazardous waste." At the point that these volume limits are reached the waste must be transferred from the SAA (laboratory) to a 90-day accumulation area (e.g. a central chemical waste storage area) within 72 hours.

   It is of great importance that hazardous chemical wastes not be disposed of in the regular solid waste collection system. Under some circumstances, chemical wastes mixed or thrown away with regular solid wastes in a dumpster or trash can cause all of the waste in the dumpster to become "dangerous waste", resulting in large disposal costs. PIs or departments are liable for costs of improper disposal of hazardous chemical waste. See Appendix E for procedures for disposal of hazardous chemical wastes. Contact Environmental Health & Safety (372-7163) with questions about hazardous chemical wastes.

ii. Waste materials which are radioactive are classified as "high-level" or "low level" wastes. All radioactive wastes are managed by the WSU Radiation Safety Office. Some wastes may be a mixture of radioactive material and hazardous chemical material. "High-level" wastes, even if in a mixture, are regulated and managed under WSU's radioactive license issued by the Washington Department of Health (WDOH). "Low-level" wastes mixed with hazardous chemicals are regulated under both radioactive waste and hazardous waste regulations. See Appendix J for procedures for disposal of radioactive wastes. Contact Environmental Health & Safety (372-7163) with questions about radioactive wastes.

iii. Waste materials are considered to be "pathological" or "biohazardous" if contaminated, or possibly contaminated, by infectious agents. Dead animals, animal parts, blood and blood products, syringes and sharps, animal waste products, and other similar kinds of materials may be considered to be "pathological" or "biohazardous" wastes. See Appendices H and I for procedures for disposal of pathological/ bio-hazardous wastes. Contact Environmental Health & Safety (372-7163) with questions about "pathological" or "biohazardous" wastes.

iv. Uncontaminated glass waste must be disposed of in such a manner that laboratory personnel, custodians, and sanitation workers are not exposed to cuts, abrasions, or back injuries. See the new Safety Policies and Procedures Manual section entitled "Disposal of Glass Waste, SPPM S4.26."

v. For handling or disposal of materials which may contain blood or human secretions, refer to the WSU Bloodborne Pathogen Exposure Control Plan.

vi. Waste materials which are considered to be non-hazardous, or which do not come under regulatory definition as "hazardous" are normally disposed of through the regular solid waste collection system. See Chemical Waste Management for information about comingling of solid and hazardous wastes

vii. Note that waste from animals may contain toxic, radioactive and/or biohazardous substances. If special management of this waste is required in order to protect human health and the environment, specific information should be provided in the waste disposal section of the SOP.

g. If the chemical is a particularly hazardous substance see Section IV.A. WAC 296-828 Table 2 (included in Appendix A) specifies additional regulatory requirements for employee protection if the hazardous chemical is (1) of high acute toxicity, (2) a reproductive toxin, or (3) is a select carcinogen. These requirements are:

i. Establishment of a "designated area". A designated area is a space whose boundaries are identified for specific or exclusive use of a particularly hazardous chemical. A designated area can be a fixed piece of equipment such as a fume hood or it may be a small room or enclosure. The designated area must be labeled, and its labeling must serve two purposes:

I. The designated area must have warning signs which will prohibit access by persons who do not have special information and training which would allow safe handling of the chemical. It is highly recommended that the warning sign contain the name(s) of persons authorized to use the particularly hazardous chemical in question, so that the(se) person(s) may be contacted in the event of an emergency or if questions arise.

II. The boundaries of the designated area must be clearly demarcated (i.e., with colored tape, or by the door to a specific small room or enclosure).

ii. Use of containment devices such as fume hoods or glove boxes.

iii. Procedures for safe removal of contaminated waste.

iv. Decontamination procedures which provide specific directions for decontamination of surfaces of benches, walls, ceilings, surfaces of fixed equipment, and surfaces of portable equipment which may be contaminated by the particularly hazardous substance. They provide information about the use of special protective equipment, such as gloves, face shields, goggles, body and foot coverings which may be necessary to protect the person(s) performing decontamination. Further, specific directions are given about handling and disposal of contaminated waste.

v. Special Storage and Handling Procedures. This section is not required; however, it is a section to provide additional information if needed.

Section V – Appendices

CONTENTS

A: Laboratory Safety Standard

WAC 296-828	Hazardous Chemicals in Laboratories

Chapter 296-828 WAC
Safety Standards for Hazardous Chemicals in Laboratories
(Form Number F414-135-000)

LAST UPDATED 05/01/2014

This book contains rules for Safety Standards for hazardous chemicals in laboratories, as adopted under the Washington Industrial Safety and Health Act of 1973 (Chapter 49.17 RCW).

DATE: The new issue date of this book is May 2014. A brief promulgation history, set within brackets at the end of each section, gives statutory authority, administrative order of promulgation, and date of adoption of filing.

TO RECEIVE E-MAIL UPDATES:

- Sign up for our Listserv at www.Lni.wa.gov/main/Listservs/SafetyStandards.asp

TO PRINT YOUR OWN PAPER COPY OR TO VIEW THE RULE ONLINE:

- Go to: http://www.lni.wa.gov/Safety/Rules/Find/

TO REQUEST A SAFETY CD THAT INCLUDES ALL OF OUR RULES:

- E-mail your CD request to: RulesRequests@Lni.wa.gov

TO REQUEST A HARD COPY:

- E-Mail your mailing address and the book request to: rulesrequest@lni.wa.gov

DOSH CONTACT INFORMATION:

- Physical address: 7273 Linderson Way, Tumwater, WA 98501-5414, located off I-5 Exit 101 south of Tumwater.
- Mailing address: DOSH Standards and Information, PO Box 44810, Olympia, WA 98504-4810.
- Information phone number is 1-800-4BESAFE

Also available on the WISHA web site:

• WISHA Core Rules • Other General WISHA Rules • Industry and Task-Specific Rules • Proposed Rules and Hearings • Newly Adopted Rules and New Rule Information	• WISHA Regional Directives (WRDs) • WISHA Interim Operations and Interpretive Memoranda (WHM) • Memoranda of Understanding (MOU)

HAZARDOUS CHEMICALS IN LABORATORIES
Chapter 296-828 WAC

LAST UPDATED 05/01/2014

WAC 296-828-100 Scope

This Chapter applies to the laboratory use of hazardous chemicals. To determine if this Chapter applies to your workplace, use Table 1

Table 1
Chapter Application

Are "Hazardous Chemicals" used? — YES / NO

Definition:
Hazardous chemicals are any chemicals that have been shown (in at least one scientific study) to cause acute or chronic health effects in exposed employees. 296-901 WAC contains information that can be used to determine if a chemical is considered hazardous for this rule

Are the hazardous chemicals used in "laboratory scale operations"? — YES / NO

Note:
Laboratory scale operations use containers that have been designed to be easily and safely handled by one person for reactions, transfers and other handling of the hazardous chemicals.

Laboratory scale operations **are not**

- Capable of producing commercial quantities of materials
- Part of a production process or simulate a production process
- Part of a quality control process that directs how a process operates.
- A simulation of a production process such as a pilot plant

*If any one of your answers brought you here, the Laboratory Standard **does not apply**, but other WISHA rules still apply*

Are multiple chemicals or multiple procedures used? — YES / NO

Are protective practices or protective equipment generally available for employee protection? — YES / NO

Note:
Protective practices and equipment are those procedures, practices, or equipment accepted by laboratory health and safety experts as effective at controlling employee exposures to hazardous chemicals. For example laboratory fume hoods, chemical splash goggles, protective gloves, etc.
OR
Those practices, procedures or equipment the employer can show are effective at controlling employee exposures to hazardous chemicals.

If your answers brought you here, the Laboratory Standard **applies** to your workplace.

WAC 296-828-100 (Cont.)

IMPORTANT:

- When your laboratory operation is covered by this Chapter, and you use any of the substances in Table 2, the following applies with the exception of formaldehyde use in histology, pathology, and anatomy laboratories. In histology, pathology, and anatomy laboratories you must follow the requirements in chapter 296-856 WAC, Formaldehyde. This chapter applies to all other formaldehyde laboratory uses as defined in Table 1:
  - The exposure limits and any requirement protecting employees from skin and eye contact in the rules listed in Table 2 will still apply.
  - Where the action level (or where no action level exists, the permissible exposure limit) is exceeded for a substance listed in Table 2, the exposure evaluation and medical surveillance requirements in the substance rule will still apply.
  - You are not required to meet other requirements of the substance rule.
- To get the permissible exposure limits (PELs) for hazardous chemicals used in your laboratory, see Chapter 296-841 WAC, Airborne contaminants.

Table 2 WISHA Regulated Hazardous Chemicals
Acrylonitrile
Arsenic (inorganic)
Asbestos
Benzene
Utadiene
Cadmium
Coke ovens
Cotton dust
1, 2-Dibromo-3-chloropropane
Ethylene oxide
Formaldehyde
Lead
Methylene chloride
Methylenedianiline
Vinyl chloride
Ionizing radiation
4-Nitrobiphenyl

WAC 296-828-100 (Cont.)

Table 2 WISHA Regulated Hazardous Chemicals
Alpha-Naphthylamine
4,4' Methylene bis (2 - chloroaniline)
Methyl chloromethyl ether
3,3'-Dichlorobenzidine (and its salts)
Bis-Chloromethyl ether
Beta-Naphthylamine benzidine
4-Aminodiphenyl
Ethyleneimine
Beta-Propiolactone
2-Acetylaminofluorene
4-Dimethylaminoazobenzene
N-Nitrosodimethylamine

[Statutory Authority: Statutory Authority: RCW 49.17.010, .040, .050, and .060. 10-15-106 (Order 10-15), § 296-828-100, filed 07/20/10, effective 09/01/10. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 07-05-062, 07-06-005 (Order 06-38), § 296-828-100, filed 02/20/07, effective 04/01/07. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 06-02-060 (Order 05-19), § 296-828-100, filed 01/03/06, effective 04/01/06.]

WAC 296-828-200 Using Hazardous Chemicals in Laboratories

Your responsibility:

To protect employees from laboratory use of hazardous chemicals

WAC 296-828-20005
Chemical hygiene plan

WAC 296-828-20010
Exposure evaluation

WAC 296-828-20015
Training

WAC 296-828-20020
Labeling and safety data sheets (SDSs)

WAC 296-828-20025
Chemicals produced in laboratories

WAC 296-828-20030
Medical evaluations

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 14-07-086 (Order 13-08), § 296-828-200, filed 03/18/14, effective 05/01/14. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 06-02-060 (Order 05-19), § 296-828-200, filed 01/03/06, effective 04/01/06.]

WAC 296-828-20005 Chemical Hygiene Plan

You must

- Develop and carry out a written chemical hygiene plan (CHP) that will protect your employees from hazardous substances in the laboratory and keep exposure levels below those listed in chapter 298-841 WAC, Airborne contaminants.
- Make sure the written plan is readily available to employees and their representatives.
- Include the following elements in your written CHP:
  - The names or job titles of the chemical hygiene officer, other personnel responsible for implementing the CHP, or when appropriate, the members of a chemical hygiene committee
  - Standard operating procedures that provide employee protection when working with hazardous substances
  - Criteria for how you will select and use control measures to reduce employee exposures to hazardous chemicals, especially chemicals known to be extremely hazardous
  - Additional employee protection for select carcinogens, reproductive toxins, and chemicals with high degree of acute toxicity. The following will be considered, when appropriate:
    - The establishment of exposure control areas
    - Containment devices, such as fume hoods or glove boxes
    - The safe removal of contaminated waste
    - Procedures for decontamination
  - Specific measures to make sure fume hoods and other protective equipment provide proper and adequate performance and are properly functioning
  - The circumstances when specific laboratory operation, activity, or procedure requires prior approval from the employer or their designated representative before implementation
  - A description of how you are going to train and inform your employees about laboratory use of hazardous chemicals
  - A description of your provisions for medical consultations and medical examinations
- Review and evaluate the effectiveness of your written CHP at least annually and update as necessary.

Reference:

- *This publication can provide you with additional information to help you with your written chemical hygiene plan:*
  - *National Research Council, Prudent Practices for Disposal of Chemicals from Laboratories, National Academy Press, Washington, DC, 1995.*

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 07-05-062, 07-06-005 (Order 06-38), § 296-828-20005, filed 02/20/07, effective 04/01/07. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 06-02-060 (Order 05-19), § 296-828-20005, filed 01/03/06, effective 04/01/06.]

WAC 296-828-20010 Exposure Evaluation

IMPORTANT:

- For any of the specific substances listed in Table 2 of the scope of this Chapter, you need to follow the exposure evaluation procedures found in the Chapters regulating those substances if employee exposure routinely exceeds the AL or PEL. For all other employee exposures follow this section to determine exposure evaluation procedures.

You must

- Determine if you could have a respiratory hazard as described in Chapter 296-841 WAC, Airborne contaminants.

Reference:

- *For additional requirements relating to airborne contaminants , see:*
  - *Chapter 296-841 WAC, Airborne contaminants*
  - *Chapter 296-842 WAC, Respirators*
  - *The specific rule for your chemical*

You must

- Provide written notification of exposure monitoring results to employees represented by your exposure evaluation, within 5 business days after the results become known to you.

Note:

- *You can notify employees either individually or by posting the notification in areas readily accessible to all affected employees.*
- *Posted notifications may need information that allows affected employees to determine which monitoring results apply to them.*
- *Notification may be:*
  - *In any written form, such as hand-written or e-mail.*
  - *Limited to the required information, such as exposure monitoring results.*

Reference:

- *For additional requirements relating to employee exposure records, go to chapter 296-802 WAC, Employee medical and exposure records.*

[Statutory Authority: RCW 49.17.010, .020, .040, .050, and .060. 07-03-163 (Order 06-30), § 296-828-20010, filed 01/24/07, effective 04/01/07. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 06-02-060 (Order 05-19), § 296-828-20010, filed 01/03/06, effective 04/01/06.]

WAC 296-828-20015 Training

You must

- Inform employees about the presence of hazardous chemicals at the following times:
  - At the time of initial assignment to a work area where hazardous chemicals are present
  - Prior to situations involving a new exposure to hazardous chemicals
- Train employees on all of the following:
  - Methods and observations for detecting the presence or release of hazardous substances. Examples of these methods and observations may include:
  - Monitoring conducted by you
  - Continuous monitoring devices
  - Visual appearance or odor of hazardous chemicals when being released.
  - The physical and health hazards of chemicals in the work area
  - The procedures and measures employees can use to protect themselves from hazardous substances. Examples of these include:
    - Appropriate work practices
    - Emergency procedures
    - Personal protective equipment
- Provide refresher training to fit your needs
- Provide information to employees on all of the following:
  - The contents of this Chapter and where to find a copy
  - Permissible exposure limits found in Chapter 296-841 WAC, Airborne contaminants
  - Any recommended exposure levels for compounds without an exposure limit in the WISHA rules. Examples include:
    - The PELs found in the National Institute for Occupational Safety and Health (NIOSH) NIOSH Pocket Guide to Chemical Hazards 2004
      or
    - The American Conference of Governmental Industrial Hygienists (ACGIH®) Documentation of the Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs), 7th Edition.
  - Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory.
  - Where to find a copy of:
    - Your chemical hygiene plan
    - Safety data sheets (SDSs), including those received from the chemical suppliers
    - Reference material on the hazards, safe handling, storage, and disposal of hazardous chemicals found in the laboratory.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 14-07-086 (Order 13-08), § 296-828-20015, filed 03/18/14, effective 05/01/14. Statutory Authority: RCW 49.17.010, .020, .040, .050, and .060. 07-03-163 (Order 06-30), § 296-828-20015, filed 01/24/07, effective 04/01/07. : Statutory Authority: RCW 49.17.010, .040, .050, and .060. 06-02-060 (Order 05-19), § 296-828-20015, filed 01/03/06, effective 04/01/06.]

WAC 296-828-20020 Labeling and Safety Data Sheets (SDSs)

You must:

- Make sure labels on incoming containers are not removed or defaced.
- Keep and make available to employees any SDS received with an incoming container of hazardous chemicals.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 14-07-086 (Order 13-08), § 296-828-20020, filed 03/18/14, effective 05/01/14. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 06-02-060 (Order 05-19), § 296-828-20020, filed 01/03/06, effective 04/01/06.]

WAC 296-828-20025 Chemicals Produced in Laboratories

You must

- Follow Table 3 for chemical substances produced in your laboratory.

Table 3 Lab Produced Chemical Substance Requirements

If	Then
The chemical is a hazardous chemical	Follow all appropriate requirements of this Chapter
A chemical by-product is produced and its composition is unknown	Assume it is a hazardous chemical **and** Follow your chemical hygiene plan to protect employees
You produce chemicals in your laboratory for users outside the laboratory	Follow WAC 296-901-14014, Safety data sheets and WAC 296-901-14012, Labels and other forms of warning

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 14-07-086 (Order 13-08), § 296-828-20025, filed 03/18/14, effective 05/01/14. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 06-02-060 (Order 05-19), § 296-828-20025, filed 01/03/06, effective 04/01/06.]

WAC 296-828-20030 Medical Evaluations

IMPORTANT:

- For any of the specific substances listed in Table 2 of the scope of this Chapter, you need to follow the medical evaluation procedures found in the Chapters regulating those substances if employee exposure routinely exceeds the AL or PEL. For all other employee exposures follow this section to determine medical evaluation procedures.

You must

(1) Make medical evaluations available when:

- An employee develops signs or symptoms associated with a hazardous substance from laboratory exposure.
- Any emergency situation that could cause a hazardous exposure, such as a spill, leak, or explosion, occurs.
- A medical provider recommends a follow-up evaluation.
- Exposure monitoring for any of the substances found in Table 2 reveals exposures routinely over the action level (AL) or in the absence of an AL the permissible exposure level (PEL).

(2) Make sure medical evaluations are provided at reasonable times and places, and at no cost to employees.

WAC 296-828-20030 (Cont.)

Note: This includes travel costs and wages associated with any time spent obtaining the medical evaluation.

You must

- Provide the LHCP the following information before the medical evaluation is performed:
  - The name of the hazardous chemicals the employee may have been exposed to:
    - Any signs or symptoms of exposure the employee has.
    - A description of the conditions under which the exposure occurred.
    - The exposure monitoring results for the conditions, if available.
- Obtain the LHCP's written opinion for each medical evaluation that includes the following:
  - Recommendations for medical follow-up
  - Any medical conditions found that would increase the employee's risk for impairment from exposure to a hazardous chemical
  - A statement that the employee has been informed of exposure-related medical results and conditions that require further examination or treatment
  - A written opinion that does not contain any medical information unrelated to the employee's occupational exposures
- If the written opinion contains any medical information unrelated to occupational exposures, return it to the LHCP and obtain a revised version without the additional medical information

Reference: *For additional requirements relating to employee medical records, go to chapter 296-802 WAC, Employee medical and exposure records.*

[Statutory Authority: RCW 49.17.010, .020, .040, .050, and .060. 07-03-163 (Order 06-30), § 296-828-20030, filed 01/24/07, effective 04/01/07. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 06-02-060 (Order 05-19), § 296-828-20030, filed 01/03/06, effective 04/01/06.]

WAC 296-828-300 Definitions

Action level - An airborne concentration of a hazardous substance that is calculated as an 8-hour time-weighted average, and initiates certain requirements to be followed such as exposure monitoring or medical surveillance.

Carcinogens - See "Select carcinogen"

Chemical hygiene officer - An employee designated by the employer who is qualified by training or experience to provide technical guidance in the development and implementation of the chemical hygiene plan. This definition is not intended to place limitations on the designated employee's position description or job classification within the employer's organization.

Chemical hygiene plan - A written program developed and implemented by the employer that establishes procedures, equipment, personal protective equipment, and work practices to protect employees from the health hazards of the chemicals used in the laboratory.

WAC 296-828-300 (Cont.)

Container - Any container, except for pipes or piping systems that contains a hazardous substance. For example it can be any of the following:

- Barrel
- Bottle
- Can
- Cylinder
- Drum
- Reaction vessel
- Storage tank

Day - Any part of a calendar day.

Designated representative - Any one of the following:

- Any individual or organization to which an employee gives written authorization
- A recognized or certified collective bargaining agent without regard to written employee authorization
- The legal representative of a deceased or legally incapacitated employee.

Emergency - Any event that could or does result in the unexpected, significant release of a hazardous substance. Examples of emergencies include equipment failure, container rupture, or control equipment failure.

Exposure - The contact an employee has with a hazardous substance, whether or not protection is provided by respirators or other personal protective equipment (PPE). Exposure can occur through various routes of entry such as inhalation, ingestion, skin contact, or skin absorption.

Hazardous chemical - Means any chemical which is classified as health hazard or simple asphyxiant in accordance with the Hazard Communication Standard, WAC 296-901-140.

Health hazard - Means a chemical that is classified as posing one of the following hazardous effects: Explosive; flammable (gases, aerosols, liquids, or solids); oxidizer (liquid, solid, or gas); self-reactive; pyrophoric (gas, liquid, or solid); self-heating; organic peroxide; corrosive to metal; gas under pressure; in contact with water emits flammable gas; or combustible dust. The criteria for determining whether a chemical is classified as a physical hazard are in Appendix B of the Hazard Communication Standard, WAC 296-901-14024 and 296-901-14006 (definitions of “combustible dust” and “pyrophoric gas”).

Laboratory - A facility where the “laboratory use of hazardous substances” takes place. A workplace where relatively small amounts of hazardous substances are used on a nonproduction basis.

Laboratory-type hood - A device located in a laboratory, enclosure on 5 sides with a moveable sash or fixed partial enclosed on the remaining side, constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory, and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.

Note: Walk-in hoods with adjustable sashes meet the above definition provided that the sashes are adjusted during use so that the airflow and the exhaust of air contaminants are not compromised and employees do not work inside the enclosure during the release of airborne hazardous substances.

WAC 296-828-300 (Cont.)

Laboratory scale - Work with substances in which the containers used for reactions, transfers and other handling of the substances are designed to be easily and safely manipulated by one person. "Laboratory scale" **does not** include workplaces producing commercial quantities of materials.

Laboratory use - The handling or use of hazardous substances that includes **all** the following:

- Chemical manipulations conducted on a "laboratory scale"
- Multiple chemical procedures or chemicals are used
- The procedures are not part of a production process, nor in any way simulate a production process.
- "Protective laboratory practices and equipment" are available and are commonly used to minimize the potential for employee exposures to hazardous substances.

Licensed healthcare professional (LHCP) - An individual whose legally permitted scope of practice allows him or her to provide some or all of the healthcare services required for medical evaluations

Mutagen - Means chemicals that cause permanent changes in the amount or structure of the genetic material in a cell. Chemicals classified as mutagens in accordance with the Hazard Communication Standard, WAC 296-901-140 must be considered mutagens for purposes of this section.

Permissible exposure limits (PELs) - PELs are employee exposures to toxic substances or harmful physical agents that must not be exceeded. PELs are also specified in WISHA rules found in other chapters.

Physical hazard - Means a chemical that is classified as posing one of the following hazardous effects: Explosive; flammable (gases, aerosols, liquids, or solids); oxidizer (liquid, solid, or gas); self-reactive; pyrophoric (gas, liquid, or solid); self-heating; organic peroxide; corrosive to metal; gas under pressure; in contact with water emits flammable gas; or combustible dust. The criteria for determining whether a chemical is classified as a physical hazard are in Appendix B of the Hazard Communication Standard, WAC 296-901-14024 and 296-901-14006 (definitions of "combustible dust" and "pyrophoric gas").

Protective laboratory practices and equipment - Laboratory procedures, practices, and equipment accepted by laboratory health and safety experts as effective, that can be shown to be effective, in minimizing the potential for employee exposure to hazardous substances.

Reproductive toxin - Mean chemicals that affect the reproductive capabilities including adverse effects on sexual function and fertility in adult males and females, as well as adverse effects on the development of the offspring. Chemicals classified as reproductive toxins in accordance with the Hazard Communication Standard, WAC 296-901-140 shall be considered reproductive toxins for purposes of this section.

Safety data sheet (SDS) - Written, printed, or electronic information (on paper, microfiche, or on-screen) that informs manufacturers, distributors, employers or employees about a hazardous substance, its hazards, and protective measures as required by safety data sheet and label preparation, WAC 296-901-14012 and 296-901-14014.

Select carcinogen - Any substance meeting one of the following criteria:

- Regulated by WISHA as a carcinogen
- Listed in the "known to be carcinogens" category in the latest edition of the Annual Report on Carcinogens by the National Toxicity Program (NTP).
- Listed in Group I (carcinogenic to humans) in the latest editions of the International Agency for Research on Cancer (IARC) Monographs.

WAC 296-828-300 (Cont.)

- Listed in either group 2A or 2B by IARC or in the category "reasonably anticipated to be carcinogens" by the NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

  – After an inhalation exposure of 6 to 7 hours a day, 5 days a week, for a significant portion of a lifetime to dosages of less than 10 mg/m^3
  or
  – After repeated skin application of less than 300 mg/kg of body weight per week
  or
  – After oral dosages of less than 50 mg/kg of body weight per day.

Time-weighted average (TWA_8) - An exposure limit averaged over an 8-hour period that must not be exceeded during an employee's workday.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 14-07-086 (Order 13-08), § 296-828-300, filed 03/18/14, effective 05/01/14. Statutory Authority: RCW 49.17.010, .020, .040, .050, and .060. 07-03-163 (Order 06-30), § 296-828-300, filed 01/24/07, effective 04/01/07. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 06-02-060 (Order 05-19), § 296-828-300, filed 01/03/06, effective 04/01/06.]

B:Respiratory Hazards and Personal Exposure Limits (PELs)

WAC 296-841	Airborne Contaminants

In addition to those exposure limits listed in WAC 296-841, Table 3, if any of the hazards listed below are present in the workplace, additional rules apply as specified below:

Hazard	**Rule that Applies**
Acrylonitrile	WAC 296-62-07336
Arsenic (inorganic)	WAC 296-848
Asbestos, Tremolite, Anthophyllite, and Actinolite	WAC 296-62-077
Benzene	WAC 296-849
Butadiene	WAC 296-62-07460
Cadmium	WAC 296-62-074
Carcinogens	Chapter 296-62 WAC, Part F
Coke ovens	Chapter 296-62 WAC, Part O
Cotton dust	Chapter 296-62 WAC, Part N
1, 2-Dibromo-3-chloropropane	WAC 296-62-07342
Ethylene oxide	WAC 296-855
Formaldehyde	WAC 296-856
Lead	WAC 296-62-07521
Hazardous Drugs	WAC 296-62-500
Hexavalent Chromium	WAC 296-62-08003
Methylene chloride	WAC 296-62-07470
Methylenedianiline	WAC 296-62-076
Thiram	WAC 296-62-07519
Vinyl Chloride	WAC 296-62-07329

Chapter 296-841 WAC
Safety Standards for Airborne Contaminants
(Form Number F414-118-000)

LAST UPDATED 05/01/14

This book contains rules for Safety Standards for airborne contaminants, as adopted under the Washington Industrial Safety and Health Act of 1973 (Chapter 49.17 RCW).

DATE: The new issue date of this book is May 2014. A brief promulgation history, set within brackets at the end of each section, gives statutory authority, administrative order of promulgation, and date of adoption of filing.

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- Physical address: 7273 Linderson Way, Tumwater, WA 98501-5414, located off I-5 Exit 101 south of Tumwater.
- Mailing address: DOSH Standards and Information, PO Box 44810, Olympia, WA 98504-4810.
- Information phone number is 1-800-4BESAFE

Also available on the WISHA web site:

• WISHA Core Rules • Other General WISHA Rules • Industry and Task-Specific Rules • Proposed Rules and Hearings • Newly Adopted Rules and New Rule Information	• WISHA Regional Directives (WRDs) • WISHA Interim Operations and Interpretive Memoranda (WHM) • Memoranda of Understanding (MOU)

Chapter 296-841 WAC
AIRBORNE CONTAMINANTS

LAST UPDATED 05/01/14

WAC 296-841-100 Scope.

This chapter applies when your employees are, or could be, exposed to an airborne hazard.

- The following are examples of airborne contaminants that may become airborne hazards in some workplaces:
  - Chemicals listed in Table 3, Permissible Exposure Limits (PELs) for Airborne Contaminants.
  - Any substance:
    - Listed in the latest edition of the NIOSH Registry of Toxic Effects of Chemical Substances
    - For which positive evidence of an acute or chronic health hazard exists through tests conducted by, or known to, the employer
    - That may pose a hazard to human health as stated on a safety data sheet (SDS) kept by, or known to, the employer
  - Biological agents such as harmful bacteria, viruses or fungi
    - Examples include TB aerosols and anthrax
  - Pesticides
  - Chemicals used as crowd control agents, such as pepper spray
  - Chemicals present at clandestine drug labs
- Airborne contaminants exist in a variety of physical forms such as dusts, fibers, fogs, fumes, mists, gases, smoke, sprays, vapors, or aerosols.

Definition:

Exposed or exposure: The contact an employee has with a toxic substance, harmful physical agent or oxygen-deficient condition, whether or not protection is provided by respirators or other personal protective equipment (PPE). Exposure can occur through various routes of entry, such as inhalation, ingestion, skin contact, or skin absorption.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 14-07-086 (Order 13-08), § 296-841-100, filed 03/18/14, effective 05/01/14. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 07-05-062, 07-06-005 (Order 06-38), § 296-841-100, filed 02/20/07, effective 04/01/07].

WAC 296-841-200 Evaluate and control employee exposures.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 07-05-062, 07-06-005 (Order 06-38), § 296-841-200, filed 02/20/07, effective 04/01/07. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 03-20-115 (Order 03-09), § 296-841-200, filed 10/01/03, effective 01/01/04.]

WAC 296-841-20003 Employee protective measures.

Protect employees from potentially hazardous exposure while you perform your exposure evaluation, using all available resources to determine adequate protective measures.

Note:

- *Resources include product labels, safety data sheets (SDSs), manufacturer recommendations, and industry protocols.*

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 14-07-086 (Order 13-08), § 296-841-20003, filed 03/18/14, effective 05/01/14. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 07-05-062, 07-06-005 (Order 06-38), § 296-841-20003, filed 02/20/07, effective 04/01/07].

WAC 296-841-20005 Exposure evaluations.

(1) Conduct an exposure evaluation to determine or reasonably estimate whether an employee is or could be exposed to either of the following:
  - An airborne contaminant above a permissible exposure limit (PEL) listed in Table 3;
    OR
  - Other airborne hazards, such as biological hazards.

WAC 296-841-20005 (Cont.)

Note:

- *When evaluating air contaminants, keep in mind that oxygen deficient conditions may also occur due to:*
  - *Processes such as fermentation, decomposition of organic matter, or combustion of fossil fuels*
  - *Displacement by another gas such as nitrogen or carbon dioxide*
- *Rules for specific substances may contain additional requirements for determining employee exposure*
- *Samples from a representative group of employees may be used for other employees performing the same work activities, when the duration and level of exposure are similar.*

(2) Conclude that an atmosphere is immediately dangerous to life or health (IDLH) when you cannot determine or reasonably estimate employee exposure.

(3) Do all of the following when you perform your evaluation:

(a) Determine the form of the airborne contaminant, such as dust, mist, gas, or biological agent.

(b) Make sure you do not use the amount of protection provided to employees by respirators as a factor in determining whether employees are exposed to an airborne hazard.

(c) Make sure any air monitoring results used to determine employee exposures are based on personal air samples taken from, or representative of, the employee's breathing zone.

- You may use area sampling to screen for the presence of an airborne contaminant; however, results from area sampling cannot be used if they do not adequately represent exposure of affected employees.

(d) Include potential emergency and rescue situations that may occur, such as equipment or power failures, uncontrolled chemical reactions, fire, explosion, or human error.

(e) Include workplace conditions such as work processes, types of material, exposure control methods, work practices, and environmental conditions.

(f) Address extended work periods. For work shifts longer than 8 hours, evaluate the continuous 8-hour portion of the shift expected to have the highest average exposure concentration.

(4) Use either of the following types of documentation to conclusively demonstrate that employee exposure cannot meet or exceed any PEL for the airborne contaminant during any reasonably anticipated conditions:

– Personal air samples that represent an employee's usual or worst-case exposure during the entire shift.

OR

– Specific information about products, materials, or activities that provide for an estimate of the level of employee exposure such as safety data sheets (SDSs), observations, previous air sampling results, other measurements, calculations, or pesticide labels.

Note:

- *You should use methods of sampling and analysis that have been validated by the laboratory performing the analysis.*

WAC 296-841-20005 (Cont.)

(5) Use the following formula to evaluate employee exposure to 2 or more substances that have additive health effects:

$$E_m = \frac{C_1}{L_1} + \frac{C_2}{L_2} + \ldots + \frac{C_n}{L_n}$$

The symbol	Is the . . .
E	Equivalent exposure for the mixture. **When the value of E is greater than 1, an airborne hazard is present**.
C	Concentration of a specific airborne contaminant.
L	TWA, STEL, or ceiling for that substance, from Table 3.

Note:

- *When results from your exposure evaluation indicate an airborne hazard, follow requirements in WAC 296-841-20010 through 296-841-20020 of this chapter.*
- *When changes occur that increase the level of exposure to an airborne hazard, you may need to conduct a new exposure evaluation to make sure exposure controls and other protective measures are sufficient.*

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 14-07-086 (Order 13-08), § 296-841-20005, filed 03/18/14, effective 05/01/14. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 07-05-062, 07-06-005 (Order 06-38), § 296-841-20005, filed 02/20/07, effective 04/01/07. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 04-18-079 (Order 04-25), § 296-841-20005, filed 08/31/04, effective 11/01/04. Statutory Authority: Statutory Authority: RCW 49.17.010, .040, .050, and .060. 03-20-115 (Order 03-09), § 296-841-20005, filed 10/01/03, effective 01/01/04.]

WAC 296-841-20010 Exposure controls.

IMPORTANT:

- Respirators and other personal protective equipment **are not** exposure controls. Respirators may be used to protect employees while exposure controls are being installed or when it is not feasible to use exposure controls to remove or reduce the airborne hazard.

(1) Use feasible exposure controls to reduce employee exposure to one of the following:

- A level below the permissible exposure limit (PEL) in Table 3.
- A level that removes the airborne hazard, when no PEL is established.
- The lowest achievable level, when exposure cannot be reduced to below the PEL or the airborne hazard cannot be removed.

(2) Make sure exposure controls do not create or increase employee health hazards. For example, when ventilation systems are installed.

- Prevent contaminated exhaust air from either:
  - Reentering the building in harmful amounts
    OR
  - Exposing any employee to a health hazard.
- Temper make-up air, when necessary
- Prevent employee exposure to excessive air velocities.

(3) Use make-up air systems that will not interfere with the effectiveness of the exhaust air system.

- For example, make sure enough make-up air is provided to replace the amount of air exhausted.

WAC 296-841-20010 (Cont.)

Note:

- *Table 1 provides examples of possible exposure controls.*

Table 1 Examples of Possible Controls	
Preferred exposure controls include:	**For example:**
Using a different chemical this is also known as substitution)	• Choose a chemical with a lower evaporation rate or vapor pressure • Choose a chemical that is not hazardous
Changing a process to decrease emissions	• Use hand rolling or paint dipping instead of paint spraying • Bolt items instead of welding them
Separating employees from emissions areas and sources	• Use control rooms • Build an enclosure around process machinery or other emissions sources • Automate a process
Using **local** exhaust ventilation to remove emissions at or near the source	• Install exhaust hoods or slots to capture emissions • Use an exhausted enclosure (like a blasting cabinet or laboratory hood)
Other exposure controls include: Using **general** exhaust ventilation to dilute and remove emission in the work area *Note:* *This is not recommended for control of highly toxic airborne contaminants such as carcinogens, where low exposure can still prevent a health hazard*	**For example:** • Allow natural air movement to create an adequate airflow through an area • Use mechanical fans
Modifying work practices	• Change the position of the employee relative to the work so fumes, vapors, or smoke are not directed into the employee's face
Limiting the amount of time employees can spend in a contaminated area	• Establish a contaminant-free area for such tasks as prep work that do not need to be done in the exposure area
Implement an employee rotation schedule *Note:* *This control will increase the number of employees exposed to the airborne contaminant. Due to this risk, employee rotation is NOT recommended for highly toxic airborne contaminants such as carcinogens, where low exposures can still present a health hazard*	• Have employees alternate working in the exposure area so that each employee get less overall exposure

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 07-05-062, 07-06-005 (Order 06-38), § 296-841-20010, filed 02/20/07, effective 04/01/07. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 04-18-079 (Order 04-25), § 296-841-20010, filed 08/31/04, effective 11/01/04. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 03-20-115 (Order 03-09), § 296-841-20010, filed 10/01/03, effective 01/01/04.]

WAC 296-841-20015 Respirators.

Require employees to use respirators when airborne hazards have not been removed using feasible exposure controls. For example, use respirators at any of the following times:

- While exposure controls are being evaluated or put in place
- When the airborne hazard is not completely removed
- When exposure controls **are not** feasible.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 07-05-062, 07-06-005 (Order 06-38), § 296-841-20015, filed 02/20/07, effective 04/01/07. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 03-20-115 (Order 03-09), § 296-841-20015, filed 10/01/03, effective 01/01/04.]

WAC 296-841-20020 Notification.

Notify employees who are or may be exposed to airborne hazards, as specified in Table 2.

Note:

- *The notification may be provided either individually, to a group, or by posting of results in an appropriate location that is accessible to affected employees.*

Table 2
Notification Requirements

Notify employees of:	As follows:
Any exposure result above the PEL	Within 5 business days, after the employee's exposure result is known to the employer
The corrective action being taken to reduce employee exposure to or below the PEL **AND** The schedule for completion of the corrective action and any reasons why exposures cannot be lowered to below the PEL	Within 15 business days, after the employee's exposure result is known to the employer

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 07-05-062, 07-06-005 (Order 06-38), § 296-841-20020, filed 02/20/07, effective 04/01/07. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 04-18-079 (Order 04-25), § 296-841-20020, filed 08/31/04, effective 11/01/04. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 03-20-115 (Order 03-09), § 296-841-20020. Filed 10/01/03, effective 01/01/04.]

WAC 296-841-20025 Permissible exposure limits (PELs)

IMPORTANT:

The following information applies to Table 3, Permissible Exposure Limits (PELs) for Airborne Contaminants.

- Ppm refers to parts of vapor or gas per million parts of air by volume, at 25 degrees C and 760 mm Hg pressure.
- Mg/m^3 refers to milligrams of an airborne contaminant per cubic meter of air.
- F/cc refers to fibers per cubic centimeter of air.
- For a metal that is measured as the metal itself, only the CAS number for the metal is given. The CAS numbers for individual compounds of the metal are not provided. For more information about CAS registry numbers see the website: http://www.cas.org.
- Short-term exposure limits (STEL) pertain to 15-minute exposure periods, unless another time period is noted in Table 3.

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- An "X" in the "skin" column indicates the contaminant can be absorbed through the skin, either by airborne or direct contact.
  - Personal protective equipment (PPE) to prevent skin contact may be needed to minimize the risk for adverse health effects when employees are exposed to these chemicals.
  - Requirements for the use of gloves, coveralls, goggles, and other personal protective equipment can be found in WAC 296-800-160, Personal protective equipment (PPE).
- Nuisance dusts (also known as inert dusts) are included in the Table 3 listing, particulates not otherwise regulated (PNOR).
  - The PNOR listing in Table 3 also applies to other particulate airborne contaminants for which a specific PEL is NOT listed **unless** the airborne contaminant is found to require a lower limit.
- The respirable fraction of particulate airborne contaminant is measured by sampling with a size-selector having the following characteristics:

Mean aerodynamic diameter in micrometers	Percent passing the selector
1	97
2	91
3	74
4	50
5	30
6	17
7	9
8	5
10	1

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Table 3 "Permissible Exposure Limits (PELs) for Airborne Contaminants"

Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Abate (Temephos)	3383-96-8	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Acetaldehyde	75-07-0	100 ppm	150 ppm	----	----
Acetic acid	64-19-7	10 ppm	20 ppm	----	----
Acetic anhydride	108-24-7	----	----	5 ppm	----
Actinolite (asbestiform) (as asbestos) (see WAC 296-62-077 and chapter 296-65 WAC)	----	0.1 f/cc	1.0 f/cc (30 minutes)	----	----
Acetone	67-64-1	750 ppm	1,000 ppm	----	----
Acetonitrile	75-05-8	40 ppm	60 ppm	----	----
2-Acetylaminofluorene (see WAC 296-62-073)	53-96-3	----	----	----	----
Acetylene	74-86-2	Simple asphyxiant	----	----	----
Acetylene dichloride (1,2-Dichloroethylene)	540-59-0	200 ppm	250 ppm	----	----
Acetylene tetrabromide	79-27-6	1 ppm	3 ppm	----	----
Acetylsalicylic acid (Aspirin)	50-78-2	5 mg/m^3	10 mg/m^3	----	----
Acrolein	107-02-8	0.1 ppm	0.3 ppm	----	----
Acrylamide	79-06-1	0.03 mg/m^3	0.09 mg/m^3	----	X
Acrylic acid	79-10-7	10 ppm	20 ppm	----	X
Acrylonitrile (Vinyl cyanide) (see WAC 296-62-07336)	107-13-1	2 ppm	10 ppm	----	----
Aldrin	309-00-2	0.25 mg/m^3	0.75 mg/m^3	----	X
Allyl alcohol	107-18-6	2 ppm	4 ppm	----	X
Allyl chloride	107-05-1	1 ppm	2 ppm	----	----
Allyl glycidyl ether (AGE)	106-92-3	5 ppm	10 ppm	----	----
Allyl propyl disulfide	2179-59-1	2 ppm	3 ppm	----	----

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Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
alpha-Alumina (Aluminum oxide)	1344-28-1	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Aluminum (as Al)	7429-90-5	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Pyro powders	----	5 mg/m^3	10 mg/m^3	----	----
Welding fumes	----	5 mg/m^3	10 mg/m^3	----	----
Soluble salts	----	2 mg/m^3	4 mg/m^3	----	----
Alkyls (NOC)	----	2 mg/m^3	4 mg/m^3	----	----
Aluminum oxide (Alundum, Corundum)	7429-90-5	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
4-Aminodiphenyl (see WAC 296-62-073)	92-67-1	----	----	----	----
2-Aminoethanol (Ethanolamine)	141-43-5	3 ppm	6 ppm	----	----
2-Aminopyridine	504-29-0	0.5 ppm	1.5 ppm	----	----
Amitrole	61-82-5	0.2 mg/m^3	0.6 mg/m^3	----	----
Ammonia	7664-41-7	25 ppm	35 ppm	----	----
Ammonium chloride, fume	12125-02-9	10 mg/m^3	20 mg/m^3	----	----
Ammonium sulfamate (Ammate)	7773-06-0	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5.0 mg/m^3	10 mg/m^3	----	----
Amosite (as asbestos) (see WAC 296-62-077 and chapter 296-65 WAC)	----	0.1 f/cc	1.0 f/cc (30 minutes)	----	----
n-Amyl acetate	628-63-7	100 ppm	150 ppm	----	----
sec-Amyl acetate	626-38-0	125 ppm	156 ppm	----	----
Aniline and homologues	62-53-3	2 ppm	4 ppm	----	X
Anisidine (o, p-isomers)	29191-52-4	0.1 ppm	0.3 ppm	----	X

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Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Anthophyllite (asbestiform) (as asbestos) (see WAC 296-62-077 and chapter 296-65 WAC)					
Antimony and compounds (as Sb)	7440-36-0	0.5 mg/m^3	1.5 mg/m^3	----	----
ANTU (alpha Naphthyl thiourea)	86-88-4	0.3 mg/m^3	0.9 mg/m^3	----	----
Argon	7440-37-1	Simple asphyxiant	----	----	----
Arsenic, organic compounds (as As)	7440-38-2	0.2 mg/m^3	0.6 mg/m^3	----	----
Arsenic, inorganic compounds (as As) (when use **is** covered by chapter 296-848 WAC)	7440-38-2	0.01 mg/m^3	----	----	----
Arsenic, inorganic compounds (as As) (when use **is not** covered by chapter 296-848 WAC)	7440-38-2	0.2 mg/m^3	0.6 mg/m^3	----	----
Arsine	7784-42-1	0.05 ppm	0.15 ppm	----	----
Asbestos (see WAC 296-62-077) and chapter 296-65 WAC)	----	0.1 f/cc	1.0 f/cc (30 minutes)	----	----
Asphalt (Petroleum fumes)	8052-42-4	5 mg/m^3	10 mg/m^3	----	----
Atrazine	1912-24-9	5 mg/m^3	10 mg/m^3	----	----
Azinphos methyl (Guthion)	86-50-0	0.2 mg/m^3	0.6 mg/m^3	----	X
Azodrin (Monocrotophos)	6923-22-4	0.25 mg/m^3	0.75 mg/m^3	----	----
Barium, soluble compounds (as Ba)	7440-39-3	0.5 mg/m^3	1.5 mg/m^3	----	----
Barium sulfate	7727-43-7	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Baygon (Propoxur)	114-26-1	0.5 mg/m^3	1.5 mg/m^3	----	----
Benomyl	17804-35-2	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Benzene (see chapter 296-849 WAC)	71-43-2	1 ppm	5 ppm	----	----
Benzidine (see WAC 296-62-073)	92-87-5	----	----	----	----
p-Benzoquinone (Quinone)	106-51-4	0.1 ppm	0.3 ppm	----	----
Benzo(a) pyrene (Coal tar pitch volatiles)	65996-93-2	0.2 mg/m^3	0.6 mg/m^3	----	----
Benzoyl peroxide	94-36-0	5 mg/m^3	10 mg/m^3	----	----
Benzyl chloride	100-44-7	1ppm	3 ppm	----	----
Beryllium and beryllium compounds (as Be)	7440-41-7	0.002 mg/m^3	0.005 mg/m^3 (30 min.)	0.025 mg/m^3	----
Biphenyl (Diphenyl)	92-52-4	0.2 ppm	0.6 ppm	----	----
Bismuth telluride, undoped	1304-82-1	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Bismuth telluride, Se-doped	----	5 mg/m^3	10 mg/m^3	----	----
Borates, tetra, sodium salts	----	----	----	----	----
Anhydrous	1330-43-4	1 mg/m^3	3 mg/m^3	----	----
Decahydrate	1303-96-4	5 mg/m^3	10 mg/m^3	----	----
Pentahydrate	12179-04-3	1 mg/m^3	3 mg/m^3	----	----
Boron oxide	1303-86-2	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Boron tribromide	10294-33-4	----	----	1 ppm	----
Boron trifluoride	6737-07-2	----	----	1 ppm	----
Bromacil	314-40-9	1 ppm	3 ppm	----	----
Bromine	7726-95-6	0.1 ppm	0.3 ppm	----	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Bromine pentafluoride	7789-30-2	0.1 ppm	0.3 ppm	----	----
Bromochloromethane (Chlorobromom-thane)	74-97-5	200 ppm	250 ppm	----	----
Bromoform	15-25-2	0.5 ppm	1.5 ppm	----	X
Butadiene (1,3-butadiene) (see WAC 296-62-07460)	106-99-0	1 ppm	5 ppm	----	----
Butane	106-97-8	800 ppm	1,000 ppm	----	----
Butanethiol (Butyl mercaptan)	109-79-5	0.5 ppm	1.5 ppm	----	----
2-Butanone (Methyl ethyl ketone)	78-93-3	200 ppm	300 ppm	----	----
2-Butoxy ethanol (Butyl cellosolve)	111-76-2	25 ppm	38 ppm	----	X
n-Butyl acetate	123-86-4	150 ppm	200 ppm	----	----
sec-Butyl acetate	105-46-4	200 ppm	250 ppm	----	----
tert-Butyl acetate	540-88-5	200 ppm	250 ppm	----	----
Butyl acrylate	141-32-2	10 ppm	20 ppm	----	----
n-Butyl alcohol	71-36-3	----	----	50 ppm	X
sec-Butyl alcohol	78-92-2	100 ppm	150 ppm	----	----
tert-Butyl alcohol	75-65-0	100 ppm	150 ppm	----	----
Butylamine	109-73-9	----	----	5 ppm	X
Butyl cellosolve (2-Butoxy ethanol)	111-76-2	25 ppm	38 ppm	----	----
tert-Butyl chromate (as Cr) (see WAC 296-62-08003)	1189-85-1	0.005 mg/m^3	----	0.1 mg/m^3	X
n-Butyl glycidyl ether (BGE)	2426-08-6	25 ppm	38 ppm	----	----
n-Butyl lactate	138-22-7	5 ppm	10 ppm	---	----
Butyl mercaptan	109-79-5	0.5 ppm	1.5 ppm	----	----
o-sec-Butylphenol	89-72-5	5 ppm	10 ppm	----	X
p-tert-Butyl-toluene	98-51-1	10 ppm	20 ppm	----	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Cadmium oxide fume (as Cd) (see WAC 296-62-074 and 296-155-174)	1306-19-0	0.005 mg/m^3	----	----	----
Cadmium dust and salts (as Cd) (see WAC 296-62-074 and 296-155-174)	7440-43-9	0.005 mg/m^3	----	----	----
Calcium arsenate (see chapter 296-848 WAC)	----	0.01 mg/m^3	----	----	----
Calcium carbonate	1317-65-3	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Calcium cyanamide	156-62-7	0.5 mg/m^3	1.5 mg/m^3	----	----
Calcium hydroxide	1305-62-0	5 mg/m^3	10 mg/m^3	----	----
Calcium oxide	1305-78-8	2 mg/m^3	4 mg/m^3	----	----
Calcium silicate	1344-95-2	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Calcium sulfate	7778-18-9	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Camphor (synthetic)	76-22-2	2 mg/m^3	4 mg/m^3	----	----
Caprolactam	105-60-2	----	----	----	----
Dust	----	1 mg/m^3	3 mg/m^3	----	----
Vapor	----	5 ppm	10 ppm	----	----
Captafol (Difolatan)	2425-06-1	0.1 mg/m^3	0.3 mg/m^3	----	X
Captan	133-06-2	5 mg/m^3	10 mg/m^3	----	----
Carbaryl (Sevin)	63-25-2	5 mg/m^3	10 mg/m^3	----	----
Carbofuran (Furadon)	1563-66-2	0.1 mg/m^3	0.3 mg/m^3	----	----
Carbon black	1333-86-4	3.5 mg/m^3	7 mg/m^3	----	----
Carbon dioxide	124-38-9	5,000 ppm	30,000 ppm	----	----

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Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Carbon disulfide	75-15-0	4 ppm	12 ppm	----	X
Carbon monoxide	630-08-0	35 ppm	200 ppm (5 min.)	1,500 ppm	----
Carbon tetrabromide	558-13-4	0.1 ppm	0.3 ppm	----	----
Carbon tetrachloride (Tetrachloromethane)	56-23-5	2 ppm	4 ppm	----	X
Carbonyl chloride (Phosgene)	7803-51-2	0.1 ppm	0.3 ppm	----	----
Carbonyl fluoride	353-50-4	2 ppm	5 ppm	----	----
Catechol (Pyrocatechol)	120-80-9	5 ppm	10 ppm	----	X
Cellosolve acetate (2-Ethoxyethylacetate)	111-15-9	5 ppm	10 ppm	----	X
Cellulose (paper fiber)	9004-34-6	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Cesium hydroxide	21351-79-1	2 mg/m^3	4 mg/m^3	----	----
Chlordane	57-74-9	0.5 mg/m^3	1.5 mg/m^3	----	X
Chlorinated camphene (Toxaphen)	8001-35-2	0.5 mg/m^3	1 mg/m^3	----	X
Chlorinated diphenyl oxide	55720-99-5	0.5 mg/m^3	1.5 mg/m^3	----	----
Chlorine	7782-50-5	0.5 ppm	----	1 ppm	----
Chlorine dioxide	10049-04-4	0.1 ppm	0.3 ppm	----	----
Chlorine trifluoride	7790-91-2	----	----	0.1 ppm	----
Chloroacetaldehyde	107-20-0	----	----	1 ppm	----
a-Chloroacetophenone (Phenacyl chloride)	532-21-4	0.05 ppm	0.15 ppm	----	----
Chloroacetyl chloride	79-04-9	0.05 ppm	0.15 ppm	----	----
Chlorobenzene (Monochlorobenzene)	108-90-7	75 ppm	113 ppm	----	----
o-Chlorobenzylidene malononitrile (OCBM)	2698-41-1	----	----	0.05 ppm	X
Chlorobromomethane	74-97-5	200 ppm	250 ppm	----	----

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Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
2-Chloro-1, 3-butadiene (beta-Chloroprene)	126-99-8	10 ppm	20 ppm	----	X
Chlorodifluoromethane	75-45-6	1,000 ppm	1,250 ppm	----	----
Chlorodiphenyl (42% Chlorine) (PCB) (Polychlorobiphenyls)	53469-21-9	1 mg/m^3	3 mg/m^3	----	X
Chlorodiphenyl (54% Chlorine) (Polychlorobiphenyls (PCB))	11097-69-1	0.5 mg/m^3	1.5 mg/m^3	----	X
1-Chloro-2, 3-epoxypropane (Epichlorhydrin)	106-89-8	2 ppm	4 ppm	----	X
2-Chloroethanol (Ethylene chlorohydrin)	107-07-3	----	----	1 ppm	X
Chloroethylene (vinyl chloride) (See WAC 296-62-07329)	75-01-4	1 ppm	5 ppm	----	----
Chloroform (Trichloromethane)	67-66-3	2 ppm	4 ppm	----	----
1-Chloro-1-nitropropane	600-25-9	2 ppm	4 ppm	----	----
bis-Chloromethyl ether (see WAC 296-62-073)	542-88-1	----	----	----	----
Chloromethyl methyl ether (Methyl chloromethyl ether) (see WAC 296-62-073)	107-30-2	----	----	----	----
Chloropentafluoroethane	76-15-3	1,000 ppm	1,250 ppm	----	----
Chloropicrin (Nitrotrichloromethane)	76-06-2	0.1 ppm	0.3 ppm	----	----
beta-Chloroprene (2-Chloro- 1,3-butadiene)	126-99-8	10 ppm	20 ppm	----	X
o-Chlorostyrene	2039-87-4	50 ppm	75 ppm	----	----
o-Chlorotoluene	95-49-8	50 ppm	75 ppm	----	----
2-Chloro-6-trichloromethyl pyridine (Nitrapyrin)	1929-82-4	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Chlorpyrifos	2921-88-2	0.2 mg/m^3	0.6 mg/m^3	----	X

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Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Chromium					
Chromium metal or Chromium (II) compounds or Chromium (III) compounds	7440-47-3	0.5 mg/m^3	----	----	----
Chromium (VI) compounds (as Cr) when the compound **is** covered by WAC296-62-08003	Varies with compound	0.005 mg/m^3	----	----	----
Chromic acid and chromates (as Cr) (when the compound is **not** covered by WAC 296-62-08003)	Varies with compound	----	----	0.1 mg/m^3	----
Chromyl chloride (as Cr) (see WAC 296-62-08003)	14977-61-8	0.005 mg/m^3	----	----	----
Chrysene (Coal tar pitch volatiles)	65996-93-2	0.2 mg/m^3	0.6 mg/m^3	----	----
Chrysotile (as asbestos) (see WAC 296-62-077 and chapter 296-65 WAC)	----	0.1 f/cc	1.0 f/cc (30 minutes)	----	----
Clopidol	2971-90-6	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Coal dust (less than 5% SiO2)	----	----	----	----	----
Respirable fraction	----	2 mg/m^3	4 mg/m^3	----	----
Coal dust (greater than or equal to 5% SiO2)	----	----	----	----	----
Respirable fraction	----	0.1 mg/m^3	0.3 mg/m^3	----	----
Coal tar pitch volatiles (benzene soluble fraction)	65996-93-2	0.2 mg/m^3	0.6 mg/m^3	----	----
Acridine					
Anthracene					
Benzo (a) pyrene					
Chrysene					
Phenanthrene					
Pyrene					

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Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Cobalt, metal fume & dust (as Co)	7440-48-4	0.05 mg/m^3	0.15 mg/m^3	----	----
Cobalt carbonyl (as Co)	10210-68-1	0.1 mg/m^3	0.3 mg/m^3	----	----
Cobalt hydrocarbonyl (as Co)	16842-03-8	0.1 mg/m^3	0.3 mg/m^3	----	----
Coke oven emissions (see WAC 296-62-200)	----	0.15 mg/m^3	----	----	----
Copper (as Cu)	7440-50-8	----	----	----	----
Fume	----	0.1 mg/m^3	0.3 mg/m^3	----	----
Dusts and mists	----	1 mg/m^3	3 mg/m^3	----	----
Cotton dust (raw) (waste sorting, blending, cleaning, willowing and garetting) (see WAC 296-62-14533)	----	1 mg/m^3	----	----	----
Corundum (Aluminum oxide)	7429-90-5	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Crag herbicide (Sesone, Sodium-2, 4-dichloro-phenoxyethyl sulfate)	136-78-7	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Cresol (all isomers)	1319-77-3	5 ppm	10 ppm	----	X
Crocidolite (as asbestos) (see WAC 296-62-077 and chapter 296-65 WAC)	----	0.1 f/cc	1.0 f/cc (30 minutes)	----	----
Crotonaldehyde	123-73-9; 4170-30-3	2 ppm	4 ppm	----	----
Crufomate	299-86-5	5 mg/m^3	10 mg/m^3	----	----
Cumene	98-82-8	50 ppm	75 ppm	----	X
Cyanamide	420-04-2	2 mg/m^3	4 mg/m^3	----	----
Cyanide (as CN)	Varies with compound	5 mg/m^3	10 mg/m^3	----	X
Cyanogen	460-19-5	10 ppm	20 ppm	----	----
Cyanogen chloride	506-77-4	----	----	0.3 ppm	----

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Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Cyclohexane	110-82-7	300 ppm	375 ppm	----	----
Cyclohexanol	108-93-0	50 ppm	75 ppm	----	X
Cyclohexanone	108-94-1	25 ppm	38 ppm	----	X
Cyclohexene	110-83-8	300 ppm	375 ppm	----	----
Cyclohexylamine	108-91-8	10 ppm	20 ppm	----	----
Cyclonite (RDX)	121-82-4	1.5 mg/m^3	3.0 mg/m^3	----	X
Cyclopentadiene	542-92-7	75 ppm	113 ppm	----	----
Cyclopentane	287-92-3	600 ppm	750 ppm	----	----
Cyhexatin (Tricyclohexyltin hydroxide)	13121-70-5	5 mg/m^3	10 mg/m^3	----	----
2,4-D (Dichlorophenoxy-acetic acid)	94-75-7	10 mg/m^3	20 mg/m^3	----	----
DBCP (1,2-Dibromo-3-chloropropane) (see WAC 296-62-07342)	96-12-8	0.001 ppm	----	0.005 ppm	----
DDT (Dichlorodiphenyltri-chloroethane)	50-29-3	1 mg/m^3	3 mg/m^3	----	X
DDVP, (Dichlorvos)	62-73-7	0.1 ppm	0.3 ppm	----	X
Dasanit (Fensulfothion)	115-90-2	0.1 mg/m^3	0.3 mg/m^3	----	----
Decaborane	17702-41-9	0.05 ppm	0.15 ppm	----	X
Demeton	8065-48-3	0.01 ppm	0.03 ppm	----	X
Diacetone alcohol (4-hydroxy-4-methyl-2-pentanone)	123-42-2	50 ppm	75 ppm	----	----
1, 2-Diaminoethane (Ethylenediamine)	107-15-3	10 ppm	20 ppm	----	----
Diazinon	333-41-5	0.1 mg/m^3	0.3 mg/m^3	----	X
Diazomethane	334-88-3	0.2 ppm	0.6 ppm	----	----
Diborane	19287-45-7	0.1 ppm	0.3 ppm	----	----
Dibrom (see Naled)	300-76-5	3 mg/m^3	6 mg/m^3	----	X
1, 2-Dibromo-3-chloropropane (DBCP) (see WAC 296-62-07342)	96-12-8	0.001 ppm	----	0.005 ppm	----
2-N-Dibutylamino ethanol	102-81-8	2 ppm	4 ppm	----	X

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Dibutyl phosphate	107-66-4	1 ppm	2 ppm	----	----
Dibutyl phthalate	84-74-2	5 mg/m^3	10 mg/m^3	----	----
Dichloroacetylene	7572-29-4	----	-----	0.1 ppm	----
o-Dichlorobenzene	95-50-1	----	----	50 ppm	----
p-Dichlorobenzene	106-46-7	75 ppm	110 ppm	----	----
3, 3'-Dichlorobenzidine (see WAC 296-62-073)	91-94-1	----	----	----	----
Dichlorodiphenyltri-chloroethane (DDT)	50-29-3	1 mg/m^3	3 mg/m^3	----	X
Dichlorodifluoromethane	75-71-8	1,000 ppm	1,250 ppm	----	----
1, 3-Dichloro-5, 5-dimethyl hydantoin	118-52-5	0.2 mg/m^3	0.4 mg/m^3	----	----
1, 1-Dichloroethane (Ethylidine chloride)	75-34-3	100 ppm	150 ppm	----	----
1, 2-Dichloroethane (Ethylene dichloride)	107-06-2	1 ppm	2 ppm	----	----
1, 1-Dichloroethylene (Vinylidene chloride)	75-35-4	1 ppm	3 ppm	----	----
1, 2-Dichloroethylene (Acetylene dichloride)	540-59-0	200 ppm	250 ppm	----	----
Dichloroethyl ether	111-44-4	5 ppm	10 ppm	----	X
Dichlorofluoromethane	75-43-4	10 ppm	20 ppm	----	----
Dichloromethane (Methylene chloride) (see chapter 296-859 WAC)	75-09-2	25 ppm	125 ppm	----	----
1, 1-Dichloro-1-nitroethane	594-72-9	2 ppm	10 ppm	----	----
Dichlorophenoxyacetic acid (2, 4-D)	94-75-7	10 mg/m^3	20 mg/m^3	----	----
1, 2-Dichloropropane (Propylene dichloride)	78-87-5	75 ppm	110 ppm	----	----
Dichloropropene	542-75-6	1 ppm	3 ppm	----	X
2, 2-Dichloropropionic acid	75-99-0	1 ppm	3 ppm	----	----
Dichlorotetrafluoroethane	76-14-2	1,000 ppm	1,250 ppm	----	----
Dichlorvos (DDVP)	62-73-7	0.1 ppm	0.3 ppm	----	X
Dicrotophos	141-66-2	0.25 mg/m^3	0.75 mg/m^3	----	X

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Dicyclopentadiene	77-73-6	5 ppm	10 ppm	----	----
Dicyclopentadienyl iron	102-54-5	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Dieldrin	60-57-1	0.25 mg/m^3	0.75 mg/m^3	----	X
Diethanolamine	111-42-2	3 ppm	6 ppm	----	----
Diethylamine	109-89-7	10 ppm	25 ppm	----	----
2-Diethylaminoethanol	100-37-8	10 ppm	20 ppm	----	X
Diethylene triamine	111-40-0	1 ppm	3 ppm	----	X
Diethyl ether (Ethyl ether)	60-29-7	400 ppm	500 ppm	----	----
Diethyl ketone	96-22-0	200 ppm	250 ppm	----	----
Diethyl phthalate	84-66-2	5 mg/m^3	10 mg/m^3	----	----
Difluorodibromomethane	75-61-6	100 ppm	150 ppm	----	----
Difolatan (Captafol)	2425-06-1	0.1 mg/m^3	0.3 mg/m^3	----	X
Diglycidyl ether (DGE)	2238-07-5	0.1 ppm	0.3 ppm	----	----
Dihydroxybenzene (Hydroquinone)	123-31-9	2 mg/m^3	4 mg/m^3	----	----
Diisobutyl ketone (2, 6-Dimethylheptanone)	108-83-8	25 ppm	38 ppm	----	----
Diisopropylamine	108-18-9	5 ppm	10 ppm	----	X
Dimethoxymethane (Methylal)	109-87-5	1,000 ppm	1,250 ppm	----	----
Dimethyl acetamide	127-19-5	10 ppm	20 ppm	----	X
Dimethylamine	124-40-3	10 ppm	20 ppm	----	----
4-Dimethylaminoazo benzene (see WAC 296-62-073)	60-11-7	----	----	----	----
Dimethylaminobenzene (Xylidene)	1300-73-8	2 ppm	4 ppm	----	X
Dimethylaniline (N, N-Dimethylaniline)	121-69-7	5 ppm	10 ppm	----	X
Dimethylbenzene (Xylene)	1300-73-8	100 ppm	150 ppm	----	----
Dimethyl-1, 2-dibromo-2, 2-dichloroethyl phosphate (Naled)	300-76-5	3 mg/m^3	6 mg/m^3	----	X

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Dimethylformamide	68-12-2	10 ppm	20 ppm	----	X
2, 6-Dimethylheptanone (Diisobutyl ketone)	108-83-8	25 ppm	38 ppm	----	----
1, 1-Dimethylhydrazine	57-14-7	0.5 ppm	1.5 ppm	----	X
Dimethyl phthalate	131-11-3	5 mg/m^3	10 mg/m^3	----	----
Dimethyl sulfate	77-78-1	0.1 ppm	0.3 ppm	----	X
Dinitolmide (3, 5-Dinitro-o-toluamide)	148-01-6	5 mg/m^3	10 mg/m^3	----	----
Dinitrobenzene (all isomers - alpha, meta and para)	528-29-0; 99-65-0; 100-25-4	0.15 ppm	0.45 ppm	----	X
Dinitro-o-cresol	534-52-1	0.2 mg/m^3	0.6 mg/m^3	----	X
3, 5-Dinitro-o-toluamide (Dinitolmide)	148-01-6	5 mg/m^3	10 mg/m^3	----	----
Dinitrotoluene	25321-14-6	1.5 mg/m^3	3 mg/m^3	----	X
Dioxane (Diethylene dioxide)	123-91-1	25 ppm	38 ppm	----	X
Dioxathion	78-34-2	0.2 mg/m^3	0.6 mg/m^3	----	X
Diphenyl (Biphenyl)	92-52-4	0.2 ppm	0.6 ppm	----	----
Diphenylamine	122-39-4	10 mg/m^3	20 mg/m^3	----	----
Diphenylmethane diisocyanate (Methylene bisphenylisocyanate (MDI))	101-68-8	----	----	0.02 ppm	----
Dipropylene glycol methyl ether	34590-94-8	100 ppm	150 ppm	----	X
Dipropyl ketone	123-19-3	50 ppm	75 ppm	----	----
Diquat	85-00-7	0.5 mg/m^3	1.5 mg/m^3	----	----
Di-sec, Octyl phthalate (Di-2-ethylhexylphthalate)	117-81-7	5 mg/m^3	10 mg/m^3	----	----
Disulfram	97-77-8	2 mg/m^3	4 mg/m^3	----	----
Disulfoton	298-04-4	0.1 mg/m^3	0.3 mg/m^3	----	X
2, 6-Di-tert-butyl-p-cresol	128-37-0	10 mg/m^3	20 mg/m^3	----	----
Diuron	330-54-1	10 mg/m^3	20 mg/m^3	----	----
Divinyl benzene	1321-74-0	10 ppm	20 ppm	----	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Emery	12415-34-8	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Endosulfan (Thiodan)	115-29-7	0.1 mg/m^3	0.3 mg/m^3	----	X
Endrin	72-20-8	0.1 mg/m^3	0.3 mg/m^3	----	X
Epichlorhydrin (1-Chloro-2, 3-epoxypropane)	106-89-8	2 ppm	4 ppm	----	X
EPN	2104-64-5	0.5 mg/m^3	1.5 mg/m^3	----	X
1, 2-Epoxypropane (Propylene oxide)	75-56-9	20 ppm	30 ppm	----	----
2, 3-Epoxy-1-propanol (Glycidol)	556-52-5	25 ppm	38 ppm	----	----
Ethane	----	Simple asphyxiant	----	----	----
Ethanethiol (Ethyl mercaptan)	75-08-1	0.5 ppm	1.5 ppm	----	----
Ethanol (Ethyl alcohol)	64-17-5	1,000 ppm	1,250 ppm	----	----
Ethanolamine (2-Aminoethanol)	141-43-5	3 ppm	6 ppm	----	----
Ethion	563-12-2	0.4 mg/m^3	1.2 mg/m^3	----	X
2-Ethoxyethanol (Glycol monoethyl ether)	110-80-5	5 ppm	10 ppm	----	X
2-Ethoxyethyl acetate (Cellosolve acetate)	111-15-9	5 ppm	10 ppm	----	X
Ethyl acetate	141-78-6	400 ppm	500 ppm	----	----
Ethyl acrylate	140-88-5	5 ppm	25 ppm	----	X
Ethyl alcohol (ethanol)	64-17-5	1,000 ppm	1,250 ppm	----	----
Ethylamine	75-04-07	10 ppm	20 ppm	----	----
Ethyl amyl ketone (5-Methyl-3-hepatone)	541-85-5	25 ppm	38 ppm	----	----
Ethyl benzene	100-41-4	100 ppm	125 ppm	----	----
Ethyl bromide	74-96-4	200 ppm	250 ppm	----	----
Ethyl butyl ketone (3-Heptanone)	106-35-4	50 ppm	75 ppm	----	----
Ethyl chloride	75-00-3	1,000 ppm	1,250 ppm	----	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Ethylene	74-85-1	Simple asphyxiant	----	----	----
Ethylene chlorohydrin (2-Chloroethanol)	107-07-3	----	----	1 ppm	X
Ethylenediamine (1,2-Diaminoethane)	107-15-3	10 ppm	20 ppm	----	X
Ethylene dibromide	106-93-4	0.1 ppm	0.5 ppm	----	----
Ethylene dichloride (1,2-Dichloroethane)	107-06-2	1 ppm	2 ppm	----	----
Ethylene glycol	107-21-1	----	----	50 ppm	----
Ethylene glycol dinitrate	628-96-6	----	0.1 mg/m^3	----	X
Ethylene glycol monomethyl ether acetate (Methyl cellosolve acetate)	----	5 ppm	10 ppm	----	X
Ethyleneimine (see WAC 296-62-073)	151-56-4	----	----	----	X
Ethylene oxide (see chapter 296-855 WAC)	75-21-8	1 ppm	5 ppm	----	----
Ethyl ether (Diethyl ether)	60-29-7	400 ppm	500 ppm	----	----
Ethyl formate	109-94-4	100 ppm	125 ppm	----	----
Ethylidine chloride (1, 1-Dichloroethane)	107-06-2	1 ppm	2 ppm	----	----
Ethylidene norbornene	16219-75-3	----	----	5.0 ppm	----
Ethyl mercaptan (Ethanethiol)	75-08-1	0.5 ppm	1.5 ppm	----	----
n-Ethylmorpholine	100-74-3	5 ppm	10 ppm	----	X
Ethyl sec-amyl ketone (5-methyl-3-heptanone)	541-85-5	25 ppm	38 ppm	----	----
Ethyl silicate	78-10-4	10 ppm	20 ppm	----	----
Fenamiphos	22224-92-6	0.1 mg/m^3	0.3 mg/m^3	----	X
Fensulfothion (Dasanit)	115-90-2	0.1 mg/m^3	0.3 mg/m^3	----	----
Fenthion	55-38-9	0.2 mg/m^3	0.6 mg/m^3	----	X

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Ferbam	----	----	----	----	----
Total particulate	14484-64-1	10 mg/m^3	20 mg/m^3	----	----
Ferrovanadium dust	12604-58-9	1 mg/m^3	3 mg/m^3	----	----
Fluorides (as F)	Varies with compound	2.5 mg/m^3	5 mg/m^3	----	----
Fluorine	7782-41-4	0.1 ppm	0.3 ppm	----	----
Fluorotrichloromethane (see Trichlorofluoro methane)	75-69-4	----	----	1,000 ppm	----
Fonofos	944-22-9	0.1 mg/m^3	0.3 mg/m^3	----	X
Formaldehyde (see chapter 296-856 WAC)	50-00-0	0.75 ppm	2 ppm	----	----
Formamide	75-12-7	20 ppm	30 ppm	----	----
Formic acid	64-18-6	5 ppm	10 ppm	----	----
Furadon (carbofuran)	1563-66-2	0.1 mg/m^3	0.3 mg/m^3	----	----
Furfural	98-01-1	2 ppm	4 ppm	----	X
Furfuryl alcohol	98-00-0	10 ppm	15 ppm	----	X
Gasoline	8006-61-9	300 ppm	500 ppm	----	----
Germanium tetrahydride	7782-65-2	0.2 ppm	0.6 ppm	----	----
Glass, fibrous or dust	----	10 mg/m^3	20 mg/m^3	----	----
Glutaraldehyde	111-30-8	----	----	0.2 ppm	----
Glycerin mist	56-81-5	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Glycidol (2, 3-Epoxy-1-propanol)	556-52-5	25 ppm	38 ppm	----	----
Glycol monoethyl ether (2-Ethoxyethanol)	110-80-5	5 ppm	10 ppm	----	X
Grain dust (oat, wheat, barley)	----	10 mg/m^3	20 mg/m^3	----	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Graphite, natural	7782-42-5	----	----	----	----
Respirable particulate	----	2.5 mg/m^3	5 mg/m^3	----	----
Graphite, synthetic	----	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Guthion (Azinphosmethyl)	86-50-0	0.2 mg/m^3	0.6 mg/m^3	----	X
Gypsum	13397-24-5	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Hafnium	7440-58-6	0.5 mg/m^3	1.5 mg/m^3	----	----
Helium	----	Simple asphyxiant	----	----	----
Heptachlor	76-44-8	0.5 mg/m^3	1.5 mg/m^3	----	X
Heptane (n-heptane)	142-82-5	400 ppm	500 ppm	----	----
2-Heptanone (Methyl n-amyl ketone)	110-43-0	50 ppm	75 ppm	----	----
3-Heptanone (Ethyl butyl ketone)	106-35-4	50 ppm	75 ppm	----	----
Hexachlorobutadiene	87-68-3	0.02 ppm	0.06 ppm	----	X
Hexachlorocyclopentadiene	77-47-4	0.01 ppm	0.03 ppm	----	----
Hexachloroethane	67-72-1	1 ppm	3 ppm	----	X
Hexachloronaphthalene	1335-87-1	0.2 mg/m^3	0.6 mg/m^3	----	X
Hexafluoroacetone	684-16-2	0.1 ppm	0.3 ppm	----	X
Hexane	----	----	----	----	----
n-hexane	110-54-3	50 ppm	75 ppm	----	----
other isomers	Varies with compound	500 ppm	1,000 ppm	----	----
2-Hexanone (Methyl-n-butyl ketone)	591-78-6	5 ppm	10 ppm	----	----
Hexone (Methyl isobutyl ketone)	108-10-1	50 ppm	75 ppm	----	----
Sec-Hexyl acetate	108-84-9	50 ppm	75 ppm	----	----
Hexylene glycol	107-41-5	----	----	25 ppm	----
Hydrazine	302-01-2	0.1 ppm	0.3 ppm	----	X

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Hydrogen	----	Simple asphyxiant	----	----	----
Hydrogenated terphenyls	61788-32-7	0.5 ppm	1.5 ppm	----	----
Hydrogen bromide	10035-10-6	----	----	3.0 ppm	----
Hydrogen chloride	7647-01-0	----	----	5.0 ppm	----
Hydrogen cyanide	74-90-8	----	4.7 ppm	----	X
Hydrogen fluoride	7664-39-3	----	----	3 ppm	----
Hydrogen peroxide	7722-84-1	1 ppm	3 ppm	----	----
Hydrogen selenide (as Se)	7783-07-5	0.05 ppm	0.15 ppm	----	----
Hydrogen sulfide	7783-06-4	10 ppm	15 ppm	----	----
Hydroquinone (Dihydroxybenzene)	123-31-9	2 mg/m^3	4 mg/m^3	----	----
4-Hydroxy-4-methyl-2-pentanone (Diacetone alcohol)	123-42-2	50 ppm	75 ppm	----	----
2-Hydroxypropyl acrylate	99-61-1	0.5 ppm	1.5 ppm	----	X
Indene	95-13-6	10 ppm	20 ppm	----	----
Indium and compounds (as In)	7440-74-6	0.1 mg/m^3	0.3 mg/m^3	----	----
Iodine	7553-56-2	----	----	0.1 ppm	----
Iodoform	75-47-8	0.6 ppm	1.8 ppm	----	----
Iron oxide dust and fume (as Fe)	1309-37-1	----	----	----	----
Total particulate	----	5 mg/m^3	10 mg/m^3	----	----
Iron pentacarbonyl (as Fe)	13463-40-6	0.1 ppm	0.2 ppm	----	----
Iron salts, soluble (as Fe)	Varies with compound	1 mg/m^3	3 mg/m^3	----	----
Isoamyl acetate	123-92-2	100 ppm	150 ppm	----	----
Isoamyl alcohol (primary and secondary)	123-51-3	100 ppm	125 ppm	----	----
Isobutyl acetate	110-19-0	150 ppm	188 ppm	----	----
Isobutyl alcohol	78-83-1	50 ppm	75 ppm	----	----
Isooctyl alcohol	26952-21-6	50 ppm	75 ppm	----	X
Isophorone	78-59-1	4 ppm	----	5 ppm	----
Isophorone diisocyanate	4098-71-9	0.005 ppm	0.02 ppm	----	X

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Isopropyl acetate	108-21-4	250 ppm	310 ppm	----	----
Isopropyl alcohol	67-63-0	400 ppm	500 ppm	----	----
Isopropylamine	75-31-0	5 ppm	10 ppm	----	----
N-Isopropylaniline	768-52-5	2 ppm	4 ppm	----	X
Isopropyl ether	108-20-3	250 ppm	313 ppm	----	----
Isopropyl glycidyl ether (IGE)	4016-14-2	50 ppm	75 ppm	-----	----
Kaolin	----	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Ketene	463-51-4	0.5 mg/m^3	1.5 mg/m^3	----	----
Lannate (Methomyl)	16752-77-5	2.5 mg/m^3	5 mg/m^3	----	----
Lead, inorganic (as Pb) (see WAC 296-62-07521 and 296-155-176)	7439-92-1	0.05 mg/m^3	----	----	----
Lead arsenate (as Pb) (see WAC 296-62-07521, 296-155-176, and chapter 296-848 WAC)	3687-31-8	0.05 mg/m^3	----	----	----
Lead chromate (as Pb) (see WAC 296-62-08003, 296-62-07521, and 296-155-176)	7758-97-6	0.05 mg/m^3	----	----	----
Limestone	1317-65-3	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Lindane	58-89-9	0.5 mg/m^3	1.5 mg/m^3	----	X
Lithium hydride	7580-67-8	0.025 mg/m^3	0.075 mg/m^3	----	----
L.P.G. (liquified petroleum gas)	68476-85-7	1,000 ppm	1,250 ppm	----	----
Magnesite	546-93-0	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA8	STEL	Ceiling	Skin
Magnesium oxide fume	1309-48-4	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Malathion	121-75-5	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	X
Maleic anhydride	108-31-6	0.25 ppm	0.75 ppm	----	----
Manganese and compounds (as Mn)	7439-96-5	----	----	5 mg/m^3	----
Manganese cyclopentadienyl tricarbonyl (as Mn)	12079-65-1	0.1 mg/m^3	0.3 mg/m^3	----	X
Manganese tetroxide and fume (as Mn)	7439-96-5	1 mg/m^3	3 mg/m^3	----	----
Marble	1317-65-3	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
MBOCA (4, 4'-Methylene bis (2-chloro-aniline)) (see WAC 296-62-073)	101-14-4	----	----	----	X
MDA (4, 4-Methylene dianiline) (see WAC 296-62-076 and 296-155-173)	101-77-9	0.01 ppm	0.1 ppm	----	X
MDI (Methylene bisphenyl isocyanate) (Diphenylmethane diisocyanate)	101-68-8	----	----	0.02 ppm	----
MEK (Methyl ethyl ketone) (2-Butanone)	78-93-3	200 ppm	300 ppm	----	----
MEKP (Methyl ethyl ketone peroxide)	1338-23-4	----	----	0.2 ppm	----
Mercury (as Hg)	7439-97-6	----	----	----	----
Aryl and inorganic	----	0.1 mg/m^3	0.3 mg/m^3	----	X
Organo-alkyl compounds	----	0.01 mg/m^3	0.03 mg/m^3	----	X
Vapor	----	0.05 mg/m^3	0.15 mg/m^3	----	X

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Mesityl oxide	141-79-7	15 ppm	25 ppm	----	----
Methacrylic acid	79-41-4	20 ppm	30 ppm	----	X
Methane	----	Simple asphyxiant	----	----	----
Methanethiol (Methyl mercaptan)	74-93-1	0.5 ppm	1.5 ppm	----	----
Methanol (Methyl alcohol)	67-56-1	200 ppm	250 ppm	----	X
Methomyl (lannate)	16752-77-5	2.5 mg/m^3	5 mg/m^3	----	----
Methoxychlor	72-43-5	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
2-Methoxyethanol (Methyl cellosolve)	109-86-4	5 ppm	10 ppm	----	X
2-Methoxyethyl acetate (Methyl cellosolve acetate)	110-49-6	5 ppm	10 ppm	----	X
4-Methoxyphenol	150-76-5	5 mg/m^3	10 mg/m^3	----	----
Methyl acetate	79-20-9	200 ppm	250 ppm	----	----
Methyl acetylene (propyne)	74-99-7	1,000 ppm	1,250 ppm	----	----
Methyl acetylene-propadiene mixture (MAPP)	----	1,000 ppm	1,250 ppm	----	----
Methyl acrylate	96-33-3	10 ppm	20 ppm	----	X
Methylacrylonitrile	126-98-7	1 ppm	3 ppm	----	X
Methylal (Dimethoxy-methane)	109-87-5	1,000 ppm	1,250 ppm	----	----
Methyl alcohol (methanol)	67-56-1	200 ppm	250 ppm	----	X
Methylamine	74-89-5	10 ppm	20 ppm	----	----
Methyl amyl alcohol (Methyl isobutyl carbinol)	108-11-2	25 ppm	40 ppm	----	X
Methyl n-amyl ketone (2-Heptanone)	110-43-0	50 ppm	75 ppm	----	----
N-Methyl aniline (Monomethyl aniline)	100-61-8	0.5 ppm	1.5 ppm	----	X
Methyl bromide	74-83-9	5 ppm	10 ppm	----	X
Methyl-n-butyl ketone (2-Hexanone)	591-78-6	5 ppm	10 ppm	----	----
Methyl cellosolve (2-Methoxyethanol)	109-86-4	5 ppm	10 ppm	----	X

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA8	STEL	Ceiling	Skin
Methyl cellosolve acetate (2-Methoxyethyl acetate)	110-49-6	5 ppm	10 ppm	----	X
Methyl chloride	74-87-3	50 ppm	100 ppm	----	----
Methyl chloroform (1, 1, 1-trichlorethane)	71-55-6	350 ppm	450 ppm	----	----
Methyl chloromethyl ether (chloromethyl methyl ether) (see WAC 296-62-073)	107-30-2	----	----	----	----
Methyl 2-cyanoacrylate	137-05-3	2 ppm	4 ppm	----	----
Methylcyclohexane	108-87-2	400 ppm	500 ppm	----	----
Methylcyclohexanol	25639-42-3	50 ppm	75 ppm	----	----
Methylcyclohexanone	583-60-8	50 ppm	75 ppm	----	X
Methylcyclopentadienyl manganese tricarbonyl (as Mn)	12108-13-3	0.2 mg/m^3	0.6 mg/m^3	----	X
Methyl demeton	8022-00-2	0.5 mg/m^3	1.5 mg/m^3	----	X
Methylene bisphenyl isocyanate (MDI) (Diphenylmethane diisocyanate)	101-68-8	----	----	0.02 ppm	----
4,4'-Methylene bis (2-chloro-aniline) (MBOCA) (see WAC 296-62-073)	101-14-4	----	----	----	X
Methylene bis (4-cyclohexy-lisocyanate)	5124-30-1	----	----	0.01 ppm	----
Methylene chloride (Dichloromethane) (see WAC 296-62-07470)	75-09-2	25 ppm	125 ppm	----	----
4, 4-Methylene dianiline (MDA) (see WAC 296-62-076 and 296-155-173)	101-77-9	0.01 ppm	0.1 ppm	----	X
Methyl ethyl ketone (MEK) (2-Butanone)	78-93-3	200 ppm	300 ppm	----	----
Methyl ethyl ketone peroxide (MEKP)	1338-23-4	----	----	0.2 ppm	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA8	STEL	Ceiling	Skin
Methyl formate	107-31-3	100 ppm	150 ppm	----	----
5-Methyl-3-heptanone (Ethyl amyl ketone)	541-85-5	25 ppm	38 ppm	----	----
Methyl hydrazine (Monomethyl hydrazine)	60-34-4	----	----	0.2 ppm	X
Methyl iodide	74-88-4	2 ppm	4 ppm	----	X
Methyl isoamyl ketone	110-12-3	50 ppm	75 ppm	----	----
Methyl isobutyl carbinol (Methyl amyl alcohol)	108-11-2	25 ppm	40 ppm	----	X
Methyl isobutyl ketone (Hexone)	108-10-1	50 ppm	75 ppm	----	----
Methyl isocyanate	624-83-9	0.02 ppm	0.06 ppm	----	X
Methyl isopropyl ketone	563-80-4	200 ppm	250 ppm	----	----
Methyl mercaptan (Methanethiol)	74-93-1	0.5 ppm	1.5 ppm	----	----
Methyl methacrylate	80-62-6	100 ppm	150 ppm	----	----
Methyl parathion	298-00-0	0.2 mg/m^3	0.6 mg/m^3	----	X
Methyl propyl ketone (2-Pentanone)	107-87-9	200 ppm	250 ppm	----	----
Methyl silicate	684-84-5	1 ppm	3 ppm	----	----
alpha-Methyl styrene	98-83-9	50 ppm	100 ppm	----	----
Mevinphos (Phosdrin)	7786-34-7	0.01 ppm	0.03 ppm	----	X
Metribuzin	21087-64-9	5 mg/m^3	10 mg/m^3	----	----
Mica (Silicates) Respirable fraction	12001-26-2	3 mg/m^3	6 mg/m^3	----	----
Molybdenum (as Mo)	7439-98-7	----	----	----	----
Soluble compounds	----	5 mg/m^3	10 mg/m^3	----	----
Insoluble compounds	----	10 mg/m^3	20 mg/m^3	----	----
Monochlorobenzene (Chlorobenzene)	108-90-7	75 ppm	113 ppm	----	----
Monocrotophos (Azodrin)	6923-22-4	0.25 mg/m^3	0.75 mg/m^3	----	----
Monomethyl aniline (N-Methyl aniline)	100-61-8	0.5 ppm	1.5 ppm	----	X
Monomethyl hydrazine	----	----	----	0.2 ppm	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA8	STEL	Ceiling	Skin
Morpholine	110-91-8	20 ppm	30 ppm	----	X
Naled (Dibrom)	300-76-5	3 mg/m^3	6 mg/m^3	----	X
Naphtha	8030-30-6	100 ppm	150 ppm	----	X
Naphthalene	91-20-3	10 ppm	15 ppm	----	----
alpha-Naphthylamine (see WAC 296-62-073)	134-32-7	----	----	----	----
Beta-Naphthylamine (see WAC 296-62-073)	91-59-8	----	----	----	----
Neon	7440-01-9	Simple asphyxiant	----	----	----
Nickel carbonyl (as Ni)	13463-39-3	0.001 ppm	0.003 ppm	----	----
Nickel (as Ni)	7440-02-0	----	----	----	----
Metal and insoluble compounds	----	1 mg/m^3	3 mg/m^3	----	----
Soluble compounds	----	0.1 mg/m^3	0.3 mg/m^3	----	----
Nicotine	54-11-5	0.5 mg/m^3	1.5 mg/m^3	----	X
Nitrapyrin (2-Chloro-6 trichloromethyl pyridine)	1929-82-4	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Nitric acid	7697-37-2	2 ppm	4 ppm	----	----
Nitric oxide	10102-43-9	25 ppm	38 ppm	----	----
p-Nitroaniline	100-01-6	3 mg/m^3	6 mg/m^3	----	X
Nitrobenzene	98-95-3	1 ppm	3 ppm	----	X
4-Nitrobiphenyl (see WAC 296-62-073)	92-93-3	----	----	----	----
p-Nitrochlorobenzene	100-00-5	0.5 mg/m^3	1.5 mg/m^3	----	X
4-Nitrodiphenyl (see WAC 296-62-073)	----	----	----	----	----
Nitroethane	79-24-3	100 ppm	150 ppm	----	----
Nitrogen	7727-37-9	Simple asphyxiant	----	----	----
Nitrogen dioxide	10102-44-0	----	1 ppm	----	----
Nitrogen oxide (Nitrous oxide)	10024-97-2	50 ppm	75 ppm	----	----
Nitrogen trifluoride	7783-54-2	10 ppm	20 ppm	----	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Nitroglycerin	55-63-0	----	0.1 mg/m^3	----	X
Nitromethane	75-52-5	100 ppm	150 ppm	----	----
1-Nitropropane	108-03-2	25 ppm	38 ppm	----	----
2-Nitropropane	79-46-9	10 ppm	20 ppm	----	----
N-Nitrosodimethylamine (see WAC 296-62-073)	62-75-9	----	----	----	----
Nitrotoluene	----	----	----	----	----
o-isomer	88-72-2	2 ppm	4 ppm	----	X
m-isomer	98-08-2	2 ppm	4 ppm	----	X
p-isomer	99-99-0	2 ppm	4 ppm	----	X
Nitrotrichloromethane (Chloropicrin)	76-06-2	0.1 ppm	0.3 ppm	----	----
Nitrous oxide (Nitrogen oxide)	10024-97-2	50 ppm	75 ppm	----	----
Nonane	111-84-2	200 ppm	250 ppm	----	----
Nuisance dusts (see particulates not otherwise regulated)	----	----	----	----	----
Octachloronaphthalene	2234-13-1	0.1 mg/m^3	0.3 mg/m^3	----	X
Octane	111-65-9	300 ppm	375 ppm	----	----
Oil mist mineral (particulate)	8012-95-1	5 mg/m^3	10 mg/m^3	----	----
Osmium tetroxide (as Os)	20816-12-0	0.0002 ppm	0.0006 ppm	----	----
Oxalic acid	144-62-7	1 mg/m^3	2 mg/m^3	----	----
Oxygen (see requirements in other chapters such as: Chapter 296-809 WAC, Confined spaces, chapter 296-843 WAC, Hazardous waste operations, chapter 296-824 WAC, Emergency response, WAC 296-62-100, Oxygen deficient atmospheres	----	----	----	----	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Oxygen difluoride	7783-41-7	----	----	0.05 ppm	----
Ozone	10028-15-6	0.1 ppm	0.3 ppm	----	----
Paper fiber (Cellulose)	9004-34-6	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Paraffin wax fume	8002-74-2	2 mg/m^3	4 mg/m^3	----	----
Paraquat	----	----	----	----	----
Respirable fraction	4685-14-7 1910-42-5 2074-50-2	0.1 mg/m^3	0.3 mg/m^3	----	X
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Parathion	56-38-2	0.1 mg/m^3	0.3 mg/m^3	----	X
Particulate polycyclic aromatic hydrocarbons (see coal tar pitch volatiles)	----	----	----	----	----
Particulates not otherwise regulated	----	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Pentaborane	19624-22-7	0.005 ppm	0.015 ppm	----	----
Pentachloronaphthalene	1321-64-8	0.5 mg/m^3	1.5 mg/m^3	----	X
Pentachlorophenol	87-86-5	0.5 mg/m^3	1.5 mg/m^3	----	X
Pentaerythritol	115-77-5	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Pentane	109-66-0	600 ppm	750 ppm	----	----
2-Pentanone (methyl propyl ketone)	107-87-9	200 ppm	250 ppm	----	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA8	STEL	Ceiling	Skin
Perchloroethylene (tetrachloroethylene)	127-18-4	25 ppm	38 ppm	----	----
Perchloromethyl mercaptan	594-42-3	0.1 ppm	0.3 ppm	----	----
Perchloryl fluoride	7616-94-6	3 ppm	6 ppm	----	----
Perlite	----	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Petroleum distillates (Naptha, rubber solvent)	----	100 ppm	150 ppm	----	----
Phenacyl chloride (a-Chloroaceto-phenone)	532-21-4	0.05 ppm	0.15 ppm	----	----
Phenol	108-95-2	5 ppm	10 ppm	----	X
Phenothiazine	92-84-2	5 mg/m^3	10 mg/m^3	----	X
p-Phenylene diamine	106-50-3	0.1 mg/m^3	0.3 mg/m^3	----	X
Phenyl ether (vapor)	101-84-8	1 ppm	3 ppm	----	----
Phenyl ether-diphenyl mixture (vapor)	----	1 ppm	3 ppm	----	----
Phenylethylene (Styrene)	100-42-5	50 ppm	100 ppm	----	----
Phenyl glycidyl ether (PGE)	122-60-1	1 ppm	3 ppm	----	----
Phenylhydrazine	100-63-0	5 ppm	10 ppm	----	X
Phenyl mercaptan	108-98-5	0.5 ppm	1.5 ppm	----	----
Phenylphosphine	638-21-1	----	----	0.05 ppm	----
Phorate	298-02-2	0.05 mg/m^3	0.2 mg/m^3	----	X
Phosdrin (Mevinphos)	7786-34-7	0.01 ppm	0.03 ppm	----	X
Phosgene (carbonyl chloride)	75-44-5	0.1 ppm	0.3 ppm	----	----
Phosphine	7803-51-2	0.3 ppm	1 ppm	----	----
Phosphoric acid	7664-38-2	1 mg/m^3	3 mg/m^3	----	----
Phosphorus (yellow)	7723-14-0	0.1 mg/m^3	0.3 mg/m^3	----	----
Phosphorous oxychloride	10025-87-3	0.1 ppm	0.3 ppm	----	----
Phosphorus pentachloride	10026-13-8	0.1 ppm	0.3 ppm	----	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA8	STEL	Ceiling	Skin
Phosphorus pentasulfide	1314-80-3	1 mg/m^3	3 mg/m^3	----	----
Phosphorus trichloride	12-2-19	0.2 ppm	0.5 ppm	----	----
Phthalic anhydride	85-44-9	1 ppm	3 ppm	----	----
m-Phthalodinitrile	626-17-5	5 mg/m^3	10 mg/m^3	----	----
Picloram	1918-02-1	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Picric acid (2, 4, 6-Trinitrophenol)	88-89-1	0.1 mg/m^3	0.3 mg/m^3	----	X
Pindone (2-Pivalyl-1, 3-indandione, Pival)	83-26-1	0.1 mg/m^3	0.3 mg/m^3	----	----
Piperazine dihydrochloride	142-64-3	5 mg/m^3	10 mg/m^3	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Platinum (as Pt)	7440-06-4	----	----	----	----
Metal	----	1 mg/m^3	3 mg/m^3	----	----
Soluble salts	----	0.002 mg/m^3	0.006 mg/m^3	----	----
Polychlorobiphenyls (Chlorodiphenyls)	----	----	----	----	----
42% Chlorine (PCB)	53469-21-9	1 mg/m^3	3 mg/m^3	----	X
54% Chlorine (PCB)	11097-69-1	0.5 mg/m^3	1.5 mg/m^3	----	X
Portland cement	65997-15-1	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Potassium hydroxide	1310-58-3	----	----	2 mg/m^3	----
Propane	74-98-6	1,000 ppm	1,250 ppm	----	----
Propargyl alcohol	107-19-7	1 ppm	3 ppm	----	X
beta-Propiolactone (see WAC 296-62-073)	57-57-8	----	----	----	----
Propionic acid	79-09-4	10 ppm	20 ppm	----	----
Propoxur (Baygon)	114-26-1	0.5 mg/m^3	1.5 mg/m^3	----	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
n-Propyl acetate	109-60-4	200 ppm	250 ppm	----	----
n-Propyl alcohol	71-23-8	200 ppm	250 ppm	----	X
n-Propyl nitrate	627-13-4	25 ppm	40 ppm	----	----
Propylene	----	Simple asphyxiant	----	----	----
Propylene dichloride (1, 2-Dichloropropane)	78-87-5	75 ppm	110 ppm	----	----
Propylene glycol dinitrate	6423-43-4	0.05 ppm	0.15 ppm	----	X
Propylene glycol monomethyl ether	107-98-2	100 ppm	150 ppm	----	----
Propylene imine	75-55-8	2 ppm	4 ppm	----	X
Pyrocatachol (Catechol)	120-80-9	5 ppm	10 ppm	----	X
Quinone (p-Benzoquinone)	106-51-4	0.1 ppm	0.3 ppm	----	----
RDX (Cyclonite)	----	1.5 mg/m^3	3 mg/m^3	----	X
Resorcinol	108-46-3	10 ppm	20 ppm	----	----
Rhodium (as Rh)	7440-16-6	----	----	----	----
Insoluble compounds, metal fumes and dusts	----	0.1 mg/m^3	0.3 mg/m^3	----	----
Soluble compounds, salts	----	0.001 mg/m^3	0.003 mg/m^3	----	----
Ronnel	299-84-3	10 mg/m^3	20 mg/m^3	----	----
Rosin core solder, pyrolysis products (as formaldehyde)	8050-09-7	0.1 mg/m^3	0.3 mg/m^3	----	----
Rotenone	83-79-4	5 mg/m^3	10 mg/m^3	----	----
Rouge	----	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Rubber solvent (naphtha)	8030-30-6	100 ppm	150 ppm	----	----
Selenium compounds (as Se)	7782-49-2	0.2 mg/m^3	0.6 mg/m^3	----	----
Selenium hexafluoride (as Se)	7783-79-1	0.05 ppm	0.15 ppm	----	----
Sesone (Crag herbicide)	136-78-7	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA8	STEL	Ceiling	Skin
Sevin (Carbaryl)	63-25-2	5 mg/m^3	10 mg/m^3	----	----
Silane (see Silicon tetrahydride)	7803-62-5	5 ppm	10 ppm	----	----
Silica, amorphous, precipitated and gel	112926-00-8	6 mg/m^3	12 mg/m^3	----	----
Silica, amorphous, diatomaceous earth, containing less than 1% crystalline silica	61790-53-2	----	----	----	----
Total particulate	----	6 mg/m^3	12 mg/m^3	----	----
Respirable fraction	----	3 mg/m^3	6 mg/m^3	----	----
Silica, crystalline cristobalite	----	----	----	----	----
Respirable fraction	14464-46-1	0.05 mg/m^3	0.15 mg/m3	----	----
Silica, crystalline quartz	----	----	----	----	----
Respirable fraction	14808-60-7	0.1 mg/m^3	0.3 mg/m^3	----	----
Silica, crystalline tripoli (as quartz)	----	----	----	----	----
Respirable fraction	1317-95-9	0.1 mg/m^3	0.3 mg/m^3	----	----
Silica, crystalline tridymite	----	----	----	----	----
Respirable fraction	15468-32-3	0.05 mg/m^3	0.15 mg/m^3	----	----
Silica, fused	----	----	----	----	----
Respirable fraction	60676-86-0	0.1 mg/m^3	0.3 mg/m^3	----	----
Silicates (less than 1% crystalline silica)	----	----	----	----	----
Mica	----	----	----	----	----
Respirable fraction	12001-26-2	3 mg/m^3	6 mg/m^3	----	----
Soapstone	----	----	----	----	----
Total particulate	----	6 mg/m^3	12 mg/m^3	----	----
Respirable fraction	----	3 mg/m^3	6 mg/m^3	----	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA8	STEL	Ceiling	Skin
Talc (containing asbestos) (as asbestos) (see WAC 296-62-07705 and chapter 296-65 WAC)	----	0.1 f/cc	1.0 f/cc (30 minutes)	----	----
Talc (containing no asbestos)	----	----	----	----	----
Respirable fraction	14807-96-6	2 mg/m^3	4 mg/m^3	----	----
Tremolite (asbestiform) (see WAC 296-62-07705 and chapter 296-65 WAC)	----	0.1 f/cc	1.0 f/cc (30 minutes)	----	----
Silicon	7440-21-3	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Silicon carbide	409-21-2	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Silicon tetrahydride (Silane)	7803-62-5	5 ppm	10 ppm	----	----
Silver, metal dust and soluble compounds (as Ag)	7440-22-4	0.01 mg/m^3	0.03 mg/m^3	----	----
Soapstone	----	----	----	----	----
Total particulate	----	6 mg/m^3	12 mg/m^3	----	----
Respirable fraction	----	3 mg/m^3	6 mg/m^3	----	----
Sodium azide (as HN3 or NaN3)	26628-22-8	----	----	0.1 ppm	X
Sodium bisulfite	7631-90-5	5 mg/m^3	10 mg/m^3	----	----
Sodium-2, 4-dichloro-Phenoxyethyl sulfate (Crag herbicide)	136-78-7	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Sodium fluoroacetate	62-74-8	0.05 mg/m^3	0.15 mg/m^3	----	X
Sodium hydroxide	1310-73-2	----	----	2 mg/m^3	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA8	STEL	Ceiling	Skin
Sodium metabisulfite	7681-57-4	5 mg/m^3	10 mg/m^3	----	----
Starch	9005-25-8	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Stibine	7803-52-3	0.1 ppm	0.3 ppm	----	----
Stoddard solvent	8052-41-3	100 ppm	150 ppm	----	----
Strychnine	57-24-9	0.15 mg/m^3	0.45 mg/m^3	----	----
Styrene (Phenylethylene, Vinyl benzene)	100-42-5	50 ppm	100 ppm	----	----
Subtilisins	9014-01-1	----	0.00006 mg/m^3 (60 min.)	----	----
Sucrose	57-50-1	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Sulfotep (TEDP)	3689-24-5	0.2 mg/m^3	0.6 mg/m^3	----	X
Sulfur dioxide	7446-09-5	2 ppm	5 ppm	----	----
Sulfur hexafluoride	2551-62-4	1,000 ppm	1,250 ppm	----	----
Sulfuric acid	7664-93-9	1 mg/m^3	3 mg/m^3	----	----
Sulfur monochloride	10025-67-9	----	----	1 ppm	----
Sulfur pentafluoride	5714-22-1	----	----	0.01 ppm	----
Sulfur tetrafluoride	7783-60-0	----	----	0.1 ppm	----
Sulfuryl fluoride	2699-79-8	5 ppm	10 ppm	----	----
Sulprofos	35400-43-2	1 mg/m^3	3 mg/m^3	----	----
Systox (Demeton)	8065-48-3	0.01 ppm	0.03 ppm	----	X
2, 4, 5-tri-chlorophenoxyacetic acid	93-76-5	10 mg/m^3	20 mg/m^3	----	----
Talc (containing asbestos) (as asbestos) (see WAC 296-62-07705 and chapter 296-65 WAC)	----	01. f/cc	1.0 f/cc (30 minutes)	----	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Talc (containing no asbestos)	----	----	----	----	----
Respirable fraction	14807-96-6	2 mg/m^3	4 mg/m^3	----	----
Tantalum	----	----	----	----	----
Metal and oxide dusts	7440-25-7	5 mg/m^3	10 mg/m^3	----	----
TDI (Toluene-2, 4-diisocyanate)	584-84-9	0.005 ppm	0.02 ppm	----	----
TEDP (Sulfotep)	3689-24-5	0.2 mg/m^3	0.6 mg/m^3	----	X
Tellurium and compounds (as Te)	13494-80-9	0.1 mg/m^3	0.3 mg/m^3	----	----
Tellurium hexafluoride (as Te)	7783-80-4	0.02 ppm	0.06 ppm	----	----
Temephos (Abate)	3383-96-8	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
TEPP	107-49-3	0.004 ppm	0.012 ppm	----	X
Terphenyls	26140-60-3	----	----	0.5 ppm	----
1, 1, 1, 2-Tetrachloro-2, 2-difluoroethane	76-11-0	500 ppm	625 ppm	----	----
1, 1, 2, 2-Tetrachloro-1, 2-difluoroethane	76-12-0	500 ppm	625 ppm	----	----
1, 1, 2, 2-Tetrachloroethane	79-34-5	1 ppm	3 ppm	----	X
Tetrachloroethylene (Perchloroethylene)	127-18-4	25 ppm	38 ppm	----	----
Tetrachloromethane (Carbon tetrachloride)	56-23-5	2 ppm	4 ppm	----	X
Tetrachloronaphthalene	1335-88-2	2 mg/m^3	4 mg/m^3	----	X
Tetraethyl lead (as Pb)	78-00-2	0.075 mg/m^3	0.225 mg/m^3	----	X
Tetrahydrofuran	109-99-9	200 ppm	250 ppm	----	----
Tetramethyl lead (as Pb)	75-74-1	0.075 mg/m^3	0.225 mg/m^3	----	X
Tetramethyl succinonitrile	3333-52-6	0.5 ppm	1.5 ppm	----	X
Tetranitromethane	509-14-8	1 ppm	3 ppm	----	----
Tetrasodium pyrophosphate	7722-88-5	5 mg/m^3	10 mg/m^3	----	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA_8	STEL	Ceiling	Skin
Tetryl (2, 4, 6-trinitrophenyl-methylnitramine)	479-45-8	1.5 mg/m^3	3 mg/m^3	----	X
Thallium (soluble compounds) (as Tl)	7440-28-0	0.1 mg/m^3	0.3 mg/m^3	----	X
4, 4-Thiobis (6-tert-butyl-m-cresol)	96-69-5	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Thiodan (Endosulfan)	115-29-7	0.1 mg/m^3	0.3 mg/m^3	----	X
Thioglycolic acid	68-11-1	1 ppm	3 ppm	-----	X
Thionyl chloride	7719-09-7	----	----	1 ppm	----
Thiram (see WAC 296-62-07519)	137-26-8	5 mg/m^3	10 mg/m^3	----	----
Tin (as Sn)	----	----	----	----	----
Inorganic compounds	7440-31-5	2 mg/m^3	4 mg/m^3	----	----
Tin (as Sn)	----	----	----	----	----
Organic compounds	7440-31-5	0.1 mg/m^3	0.3 mg/m^3	----	X
Tin oxide (as Sn)	21651-19-4	2 mg/m^3	4 mg/m^3	----	----
Titanium dioxide	13463-67-7	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
TNT (2, 4, 6-Trinitrotoluene)	118-96-7	0.5 mg/m^3	1.5 mg/m^3	----	X
Toluene	108-88-3	100 ppm	150 ppm	----	----
Toluene-2, 4-diisocyanate (TDI)	584-84-9	0.005 ppm	0.02 ppm	-----	----
m-Toluidine	108-44-1	2 ppm	4 ppm	----	X
o-Toluidine	95-53-4	2 ppm	4 ppm	----	X
p-Toluidine	106-49-0	2.0 ppm	4 ppm	----	X
Toxaphene (Chlorinated camphene)	8001-35-2	0.5 mg/m^3	1 mg/m^3	----	X

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA8	STEL	Ceiling	Skin
Tremolite (asbestiform) (as asbestos) (see WAC 296-62-07705 and chapter 296-65 WAC)	----	0.1 f/cc	1.0 f/cc (30 minutes)	----	----
Tributyl phosphate	126-73-8	0.2 ppm	0.6 ppm	----	----
Trichloroacetic acid	76-03-9	1 ppm	3 ppm	----	----
1, 2, 4-Trichlorobenzene	120-82-1	----	----	5 ppm	----
1, 1, 1-Trichloroethane (Methyl chloroform)	71-55-6	350 ppm	450 ppm	----	----
1, 1, 2-Trichloroethane	79-00-5	10 ppm	20 ppm	----	----
Trichloroethylene	79-01-6	50 ppm	200 ppm	----	----
Trichlorofluoromethane (Fluorotrichloromethane)	75-69-4	----	----	1,000 ppm	----
Trichloromethane (Chloroform)	67-66-3	2 ppm	4 ppm	----	----
Trichloronaphthalene	1321-65-9	5 mg/m^3	10 mg/m^3	----	X
1, 2, 3-Trichloropropane	96-18-4	10 ppm	20 ppm	----	X
1, 1, 2-Trichloro-1, 2, 2-trifluoroethane	76-13-1	1,000 ppm	1,250 ppm	----	----
Tricyclohexyltin hydroxide (Cyhexatin)	13121-70-5	5 mg/m^3	10 mg/m^3	----	----
Triethylamine	121-44-8	10 ppm	15 ppm	----	----
Trifluorobromomethane	75-63-8	1,000 ppm	1,250 ppm	----	----
Trimellitic anhydride	552-30-7	0.005 ppm	0.015 ppm	----	----
Trimethylamine	75-50-3	10 ppm	15 ppm	----	----
Trimethyl benzene	25551-13-7	25 ppm	38 ppm	----	----
Trimethyl phosphite	121-45-9	2 ppm	4 ppm	----	----
2, 4, 6-Trinitrophenol (Picric acid)	88-89-1	0.1 mg/m^3	0.3 mg/m^3	----	X
2, 4, 6-Trinitrophenyl-methylnitramine (Tetryl)	479-45-8	1.5 mg/m^3	3 mg/m^3	-----	X
2, 4, 6-Trinitrotoluene (TNT)	118-96-7	0.5 mg/m^3	1.5 mg/m^3	----	X
Triorthocresyl phosphate	78-30-8	0.1 mg/m^3	0.3 mg/m^3	----	X
Triphenyl amine	603-34-9	5 mg/m^3	10 mg/m^3	----	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA8	STEL	Ceiling	Skin
Triphenyl phosphate	115-86-6	3 mg/m^3	6 mg/m^3	----	----
Tungsten (as W)	7440-33-7	----	----	----	----
Soluble compounds	----	1 mg/m^3	3 mg/m^3	----	----
Insoluble compounds	----	5 mg/m^3	10 mg/m^3	----	----
Turpentine	8006-64-2	100 ppm	150 ppm	----	----
Uranium (as U)	7440-61-1	----	----	----	----
Soluble compounds	----	0.05 mg/m^3	0.15 mg/m^3	----	----
Insoluble compounds	----	0.2 mg/m^3	0.6 mg/m^3	----	----
n-Valeraldehyde	110-62-3	50 ppm	75 ppm	----	----
Vanadium (as V2O5)	----	----	----	----	----
Respirable fraction	1314-62-1	0.05 mg/m^3	0.15 mg/m^3	----	----
Vegetable oil mist	----	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Vinyl acetate	108-05-1	10 ppm	20 ppm	----	----
Vinyl benzene (Styrene)	100-42-5	50 ppm	100 ppm	----	----
Vinyl bromide	593-60-2	5 ppm	10 ppm	----	----
Vinyl chloride (Chloroethylene) (see WAC 296-62-07329)	75-01-4	1 ppm	5 ppm	----	----
Vinyl cyanide (Acrylonitrile) (see WAC 296-62-07336)	107-13-1	2 ppm	10 ppm	----	----
Vinyl cyclohexene dioxide	106-87-6	10 ppm	20 ppm	----	X
Vinyl toluene	25013-15-4	50 ppm	75 ppm	----	----
Vinylidene chloride (1, 1-Dichloroethylene)	75-35-4	1 ppm	3 ppm	----	----
VM & P Naphtha	8032-32-4	300 ppm	400 ppm	----	----
Warfarin	81-81-2	0.1 mg/m^3	0.3 mg/m^3	----	----
Welding fumes (total particulate)	----	5 mg/m^3	10 mg/m^3	----	----

WAC 296-841-20025 (Cont.)

Airborne contaminant	CAS	TWA8	STEL	Ceiling	Skin
Wood dust	----	----	----	----	----
Nonallergenic; (All woods except allergenics)	----	5 mg/m^3	10 mg/m^3	----	----
Allergenics (e.g. cedar, mahogany and teak)	----	2.5 mg/m^3	5 mg/m^3	----	----
Xylenes (ortho, meta, and para isomers) (Dimethylbenzene)	1330-20-7	100 ppm	150 ppm	----	----
m-Xylene alpha, alpha-diamine	1477-55-0	----	----	0.1 mg/m^3	X
Xylidine (Dimethylaminobenzene)	1300-73-8	2 ppm	4 ppm	----	X
Yttrium	7440-65-5	1 mg/m^3	3 mg/m^3	----	----
Zinc chloride fume	7646-85-7	1 mg/m^3	2 mg/m^3	----	----
Zinc chromate (as Cr) (see WAC 296-62-08003)	Varies with compound	0.005 mg/m^3	----	0.1 mg/m^3	----
Zinc oxide	1314-13-2	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m	----	----
Zinc oxide fume	1314-13-2	5 mg/g^3	10 mg/m^3	----	----
Zinc stearate	557-05-1	----	----	----	----
Total particulate	----	10 mg/m^3	20 mg/m^3	----	----
Respirable fraction	----	5 mg/m^3	10 mg/m^3	----	----
Zirconium compounds (as Zr)	7440-67-2	5 mg/m^3	10 mg/m^3	----	----

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 07-05-062, 07-06-005 (Order 06-38), § 296-20025, filed 02/20/07, effective 04/01/07. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 04-18-079 (Order 04-25), § 296-841-20025, filed 08/31/04, effective 11/01/04]

WAC 296-841-300 Definitions.

Breathing zone - The space around and in front of an employee's nose and mouth, forming a hemisphere with a 6 to 9 inch radius.

Ceiling limit – See permissible exposure limits (PELs).

Dust - - Solid particles suspended in air. Dusts are generated by handling, drilling, crushing, grinding, rapid impact, detonation, or decrepitation of organic or inorganic materials such as rock, ore, metal, coal, wood, grain, etc.

Exposed or exposure - The contact an employee has with a toxic substance, harmful physical agent or oxygen deficient condition, whether or not protection is provide by respirators or other personal protective equipment (PPE) Exposure can occur through various routes of entry, such as inhalation, ingestion, skin contact, or skin absorption.

Fume - Solid particles suspended in air, generated by condensation from the gaseous state, generally after volatilization from molten metals, etc.

Gas - A normally formless fluid which can be changed to the liquid or solid state by the effect of increased pressure or decreased temperature or both.

General exhaust ventilation - The general movement of air out of an area or permit-required confined space by mechanical or natural means.

Immediately dangerous to life or health (IDLH) - An atmosphere condition that would:

- Cause and immediate threat to life
  or
- Interfere with an employee's ability to escape

Mist - Liquid droplets suspended in air, generated by condensation from the gaseous to the liquid state or by breaking up a liquid into a dispersed state, such as by splashing, foaming, spraying or atomizing.

Nuisance dust or inert dust - Dust that, when inhaled, have little adverse effect on the lungs **and** do not produce significant organic disease or toxic effect when exposures are kept under reasonable control.

The biological reaction to these dusts in lung tissue has the following characteristics:

- The architecture of the air spaces remains intact
- Scar tissue (collagen) is not formed to a significant extent
- The tissue reaction is potentially reversible

Oxygen deficient - An atmosphere with an oxygen content below 19.5% by volume.

Permissible exposure limits (PEL) - The amount of an airborne chemical, toxic substance, or other harmful agent that must not be exceeded during any part of the workday.

An airborne chemical or toxic substance can have 3 PEL values:

- **TWA_8.** This is an 8-hour, time-weighted average limit
- Short-term exposure limit (STEL). This is typically a 15-minute, time-weighted average limit.
- Ceiling limit (C). This is an instantaneous limit.

Short-term exposure limit (STEL) - See permissible exposure limits (PELs).

Temper - To condition air for a specific work environment by changing its temperature or moisture content.

Time weighted average (TWA_8) – See permissible exposure limits (PELs).

WAC 296-841-800 (Cont.)

Toxic substance - Any chemical substance or biological agent, such as bacteria, virus, and fungus, which is any of the following:

- Listed in the latest edition of the National Institute for Occupational Safety and Health (NIOSH) Registry of Toxic Effects of Chemical Substances (RTECS)
- Shows positive evidence of an acute or chronic health hazard in testing conducted by, or known to, the employer.
- The subject of a safety data sheet kept by or known to the employer showing the material may pose a hazard to human health.

Vapor - The gaseous form of a substance that is normally in the solid or liquid state.

Ventilation – Providing, circulating or exhausting air into or out of an area of space.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 14-07-086 (Order 13-08), § 296-841-300, filed 03/18/14, effective 05/01/14. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 07-05-062, 07-06-005 (Order 06-38), § 296-841-800, filed 02/20/07, effective 04/01/07. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 04-18-079 (Order 04-25), § 296-841-300, filed 08/31/04, effective 11/01/04. Statutory Authority: RCW 49.17.010, .040, .050, and .060. 03-20-115 (Order 03-09), § 296-841-300, filed 10/01/03, effective 01/01/04.]

C: General Safety Information

Prudent Practices in the Laboratory NRC 1995 is used to cite policy references by state and federal agencies responsible for laboratory safety. Many of these general hygiene practices are typically unspecified in laws and regulations. Therefore, the following information has been provided to assist in the development of your Chemical Hygiene Plan.

1. GENERAL HYGIENE PRACTICES

a. Ingestion

Laboratory workers must be protected from inadvertent ingestion of hazardous materials. Food and beverages are not permitted to be stored or consumed in any laboratory where there is a potential of contamination with chemical, radioactive, or biological hazardous materials. After handling hazardous materials, protective clothing and gloves should be removed, and any potentially contaminated body surface (such as hands) should be thoroughly washed prior to consumption of food or beverages. Application of cosmetics, such as hand lotion, etc., are also strongly discouraged.

Glassware or utensils that have been used for laboratory operations shall not be used to prepare or consume food or beverages.

Laboratory refrigerators and cold or heated rooms shall not be used for food or beverage storage.

b. Mouth Suction

Mouth suction must never be used to pipette chemicals or to start a siphon. Use a pipette bulb, aspirator bulb, or another source of vacuum for procedures requiring suction of materials.

c. Smoking

Smoking is prohibited in all campus laboratories. After handling hazardous materials, hands and face should be washed prior to smoking in an approved area.

d. Eye Protection

Laboratory Workers must be protected from hazardous materials. Eyes require protection from chemicals in all forms. In addition other potential hazards include impact of shattered glass or other projectiles, which may be generated during the handling of glassware or through grinding, burnishing or cutting procedures used in processing laboratory materials or other tasks.

i. Goggles or face shields designed to protect the eyes and/or face from chemical splash shall be used whenever there is risk of splash or release of caustic or corrosive materials. Proper eye/face protection must also be used whenever a liquid containing toxic materials which can be absorbed through body surfaces is used (the eye is especially sensitive to absorption).

ii. Goggles, glasses or face shields designed to protect the eyes and/or face from impact from grinding, welding or potential failure of glassware and other anticipated projectiles shall be used whenever a risk of such damage is present in a laboratory.

iii. Contact lenses use must be evaluated in relation to the hazard and at a minimum chemical splash goggles worn in all circumstances to protect the eyes. The Laboratory supervisor and/or PI should be informed of contact lens use.

e. Skin Exposure

Laboratory workers must be protected from skin exposure to hazardous materials and from sharp utensils, glassware, and other mechanical or equipment hazards. At a minimum laboratory coats or aprons shall be worn when handling hazardous materials. Laboratory coats shall be buttoned to minimize chemical exposure to skin and/or clothing.

f. Feet

Proper foot covering must always be worn in laboratories. Closed toed shoes are required to minimize the exposure of skin to possible hazardous materials in the laboratory or work are. If heavy items or glassware is handled, the employee should have foot covering designed to prevent damage (e.g. rubber, steel toed etc).

g. Hands

Gloves should be worn by laboratory employees to protect hands. The appropriate glove for the task must be chosen by referring to the manufacturers glove guide.

Double-layering of gloves (one kind of glove worn over another) should be considered when mixtures of hazardous chemicals are handled, or when highly hazardous materials are handled. Double-layering of gloves should also be considered when hazards associated with both chemical toxicity and sharp or abrasive equipment are present. The inner glove is designed to protect against chemical contact with the skin and the outer glove is a sturdy glove designed to resist puncture and abrasion.

The following guidelines apply to the selection and use of protective gloves:

i. Refer to the manufacturers guidelines in order to chose a glove made of a material known to be resistant to the substances in use. Wearing the wrong type of glove can be more hazardous than wearing no gloves at all, because if a chemical seeps through, the glove can hold it in prolonged contact with the wearer's hand.

ii. Inspect gloves for small holes or tears before use.

iii. Wash gloves appropriately before removing them. (Note: some gloves, e.g., leather and polyvinyl alcohol, are water-permeable.)

iv. In order to prevent the unintentional spread of hazardous substances, remove gloves before handling objects such as doorknobs, telephones, pens, computer keyboards, etc.

v. Replace gloves periodically, depending on the frequency of use and their permeation and degradation characteristics relative to the substances handled. (See Appendix F - for links to various manufacturers Degradation Charts)

h. Jewelry and loose clothing

Jewelry may interfere with proper glove use and should not be worn with gloves. Necklaces, neckties, scarfs, bracelets, and other loose items may be damaged by

chemicals, or may be caught in laboratory equipment, and therefore should not be worn in laboratories.

i. Hair

Long hair should be tied back or secured when working in a laboratory to reduce the risk of it becoming caught in laboratory equipment or being contaminated by chemicals.

2. CHEMICAL HAZARDS

Chemicals used in laboratories have a variety of hazards associated with them. Some chemicals present a high degree of toxicity, or present a danger to laboratory workers because they are explosive, highly flammable, or corrosive to tissue.

a. Reactive/Explosive

Unstable chemicals such as those classified as Class A Explosives (e.g., picric acid), highly reactive (e.g., strong reducing agents [sodium metal]) or oxidizing agents (e.g., perchloric acid), or chemicals which, over time, form explosive peroxides, must be inventoried. Class A Explosives are stabilized by the addition of water and become unstable when dehydration occurs. Dehydration or exposure to reducing agents may concentrate the material allowing it to become sensitive to heat and impact.

When new chemical stocks are received by the laboratory, they should be dated and periodically inspected at intervals no greater than 6 months to insure storage compatibility and the integrity of the chemical substance.

If during periodic inspection, any contamination of the chemical is noted, if it has become discolored or other physical characteristics have changed, do not move the material, and contact EHS immediately at 372-7163.

b. Oxidizers

Mixing a strong oxidizing agents with moderate (flammable liquids) or strong (alkali metal or hydride) reducing agents can cause a fire or explosion.

Mixing a strong reducing agent with a moderate (water, air) or strong (oxo-compound) oxidizing agent may produce the same effect.

Therefore, these types of chemicals should never be stored together and chemical stocks should be inspected and inventoried at least annually to insure proper segregation.

Very strong (Class IV) oxidizers (e.g., 73% perchloric acid) are typically stabilized by water and may become unstable with age or with contamination by reducing agents. Class IV oxidizers which have become unstable may detonate without warning. If such chemicals are found to be discolored, or the physical characteristics have changed, do not move the material and contact EH&S immediately at 372-7163.

c. Peroxides

Chemicals which spontaneously form peroxides (with or without the presence of air) should be inspected at least every six months. Ethers (including dioxane and tetrahydrofuran) spontaneously form peroxides, even without the presence of air.

Exposure to air accelerates peroxide formation in ethers. Peroxide residues from oxidized ether are violently explosive.

In addition to ether, peroxides may form in olefins and in aromatic and saturated hydrocarbons, although generally more slowly than in ethers.

All chemicals in which peroxides form should be stored, handled, and utilized according to the manufacturer's instructions.

The expiration date should be clearly marked on the container prior to first opening.

Chemicals that form peroxides on aging should only be purchased in quantities that can be used within the shelf life, and not kept beyond that shelf life.

If you discover containers of ether or other peroxidizable chemicals to be more than one year old, do not move the material, and contact EH&S immediately at 372-7163.

d. Flammables

Highly flammable materials that are used in laboratory processes in volumes greater than one liter require certain additional safety practices. Many Flammable solvents also are toxic. Minimum training of laboratory workers should include what to do in case of fire, how to recognize toxic effects, and the emergency procedures for the chemicals used.

If large quantities of highly flammable materials are used, laboratory employees must never work alone with them.

In laboratories in which large quantities of highly flammable materials are used, appropriate fire suppression devices of sufficient number and quantity must be present. Consult with Environmental Health Services Department (372-7163) for information if questions arise.

e. Corrosives

Corrosive materials such as concentrated acids and bases can cause serious injury or death even in very small amounts. Additional hazards may be present for strong acids and salts containing fluorine. Organic compounds, like phenol, are not only highly toxic, but corrosive as well.

A thorough hazard analysis including PPE selection and certification is required for all chemicals to ensure that the appropriate PPE is worn. Employees must be fully trained prior to working with any laboratory chemicals.

f. Toxic Chemicals

Highly toxic chemical substances (such as cyanide, phenol, and compounds containing fluorine) must be recognized by all laboratory personnel who may come into contact with them. Specific emergency procedures for treatment of exposed laboratory workers and training in those procedures is required for all personnel.

3. CHEMICAL HAZARD LISTS

a. Acutely Hazardous Chemicals

Certain chemicals are regulated under hazardous waste rules at the time they are discarded. Washington Dangerous Waste Regulations (WAC 173-303) limit the amount of hazardous chemical waste which can be stored in the laboratory in which they are generated. The Washington Department of Ecology (DOE) places "dangerous wastes" into two categories; dangerous waste and acutely hazardous waste. Containers of

dangerous waste can be stored in quantities up to 55 gallons. Acutely hazardous waste can only be stored in a quantity up to one quart before it must be removed, within three days, to a properly designed waste accumulation storage area or permitted facility. See S70.40 for a specific list of these chemicals.

b. Potentially Explosive Chemicals

Some chemical and reagent combinations have the potential for producing a violent explosion when subject to shock or friction. The following tables list some common laboratory reagents that can produce explosions when they are brought together or that generate reaction products which can explode without any apparent external initiating action.

Shock Sensitive Compounds:
Acetylenic Compounds, especially polyacetylenes, haloacetylenes, and heavy metal salts of acetylenes (copper, silver, and mercury salts are particularly sensitive).
Acyl nitrates.
Alkyl Nitrates, particularly polyol nitrates such as nitrocellulose and nitroglycerine.
Alkyl and Acyl Nitrites.
Alkyl Perchlorates.
Ammine metal oxosalts: metal compounds with coordinated ammonia, hydrazine, or similar nitrogenous donors and ionic perchlorate, nitrate, permanganate, or other oxidizing group.
Azides, including metal, nonmetal, and organic azides.
Chlorite salts of metals, such as AgClO2 and Hg (ClO2)2.
Diazo compounds such as CH2N2.
Diazonium salts, when dry.
Fulminates (silver fulminate, AgCNO, can form in the reaction mixture from Tollens' test for aldehydes if it is allowed to stand for some time; this can be prevented by adding dilute nitric acid to the test mixture as soon as the test has been completed).
Hydrogen peroxide becomes increasingly treacherous as the concentration rises above 30%, forming explosive mixtures with organic materials and decomposing violently in the presence of traces of transition metals.
N-Halogen compounds such as difluoroamino compounds and halogen Azides.
N-Nitro compounds such as N-nitromethylamine, nitrourea, nitroguanidine, and nitric amide.
Oxo salts of nitrogenous bases: perchlorates, dichromates, nitrates, iodates, chlorites, chlorates, and permanganates of ammonia, amines, hydroxylamine, guanidine, etc.
Perchlorate salts. Most metal, nonmetal, and amine perchlorates can be detonated and may undergo violent reaction in contact with combustible materials.
Peroxides and hydroperoxides, organic.
Peroxides (solid) that crystallize from or are left from evaporation of Peroxidizable solvents.
Peroxides, transition-metal salts.
Picrates, especially salts of transition and heavy metals, such as Ni, Pb, Hg, Cu, and Zn; picric acid is explosive but is less sensitive to shock or friction than its metal salts and is relatively safe as a water-wet paste.
Polynitroalkyl compounds, such as tetranitromethane and dinitroacetonitrile.
Polynitroaromatic compounds, especially polynitro hydrocarbons, phenols, and amines.

Potentially Explosive Combinations Of Some Common Reagents
Acetone + chloroform in the presence of base
Acetylene + copper, silver, mercury, or their salts
Ammonia (including aqueous solutions) + Cl_2, Br_2, I_2
Carbon disulfide + sodium azide,
Chlorine + an alcohol.
Chloroform or carbon tetrachloride + powdered Al or Mg,
Decolorizing carbon + an oxidizing agent.
Diethyl ether + chlorine (including chlorine atmosphere).
Dimethyl sulfoxide + an acyl halide, $SOCl_2$, or $POCl_3$.
Dimethyl sulfoxide + CrO_3.
Ethanol + calcium hypochlorite.
Ethanol + silver nitrate.
Nitric acid + acetic anhydride or acetic acid.
Picric acid + a heavy-metal salt, such as Pb, Hg, or Ag.
Silver oxide + ammonia + ethanol.
Sodium + a chlorinated hydrocarbon.
Sodium hypochlorite + an amine.

Peroxidizable Chemicals

Ethers - Straight-chain and cyclic ethers readily form peroxides.

- isopropyl ether
- ethyl ether
- furan
- tetrahydrofuran
- p-dioxane

Unsaturated Compounds - Relatively low molecular weight compounds containing carbon-carbon double and triple bonds often have a propensity to form explosive peroxides. These include:

- cyclopentene
- cyclohexene
- dicyclopentadiene
- divinyl acetylene

Note: Some halogenated-substituted alkenes will form peroxides. Some, such as trichloroethylene, pose no significant danger. Others produce an extreme peroxide hazard, such as:

- 1,1-dichloroethylene

Note: Styrene, acrylates, and methacrylates form peroxides which do not pose an explosive hazard, but may initiate rapid and violent polymerization of the chemical.

Other Organic Compounds - Several organic compounds form explosive peroxides. Among these are:

- decahydronaphthalene
- tetrahydronaphthalene
- methylcyclohexane

Inorganic Compounds - The following metals will form dangerous peroxides and/or super-oxides over time:

- metallic potassium
- metallic rubidium
- metallic cesium
- potassium amide
- sodium amide
- metal amides
- metal alkoxides

Polymerizable Chemicals

Chemicals listed in this table may polymerize without initiation (unless an inhibitor is present), in contact with a contaminant, or in contact with a specific chemical listed. These chemicals should not be combined with each other in an individual waste container. The information in the following table is from the Handbook of Reactive Chemical Hazards..

Chemicals Which Will Polymerize…	**When mixed with…*** **(* indicates compounds that will polymerize by themselves)**
1,2-Di(3-buten-1ynyl)cyclobutane	*
1,3,5-Triethynylbenzene	*
1,3-Butadyne	Arsenic pentafluoride
1,4-Dicyano-2-butene	*
1-Buten-3-one	*
2,2,3,3-Tetrafluoropropanol	Potassium Hydroxide
2,3-Epoxypropionaldehyde oxime	*
2,4-Hexadienal	*
2-Buten-1-yl benzenesulfonate	*
2-Chloro-1,3-butadiene	*
2-Chloroethylamine	*
2-Chloroethylammonium chloride	Alkali
2-Cyanoethanol	Acids or Bases
2-Methylaziridine	Acids
2-Nitropropene	*
2-Propen-1-ol	Sulfuric Acid
3-Aminopripiononitrile	*
3-Methyl-2-penten-4-yn-1-ol	*
3-Propynethiol	*
3-Propynol	Mercury (II) sulfate
4-Hydroxy-*trans*-cinnamic acid	*
6-Fulvenoselone	*
Acetaldehyde	Sulfuric acid
Acetaldehyde	*
Acrylamide	*
Acrylic acid	*
Acrylic acid	Initiator
Acrylonitrile	*
Acrylonitrile	Benzyltrimethylammonium hydroxide
Acrylonitrile	Initiators
Acrylonitrile	Silver nitrate
Allyl 4-Toluenesulfonate	*
Aluminum chloride	Alkenes
Aluminum chloride	Nitrobenzene
Aziridine	*
Chloroacetone	Contaminants
Chloroethylene	*
Chloropeoxytrifluoromethane	Tetrafluoroethylene
Cyanamide	Water
Cyanogen Fluoride	Hydrogen fluoride
Cyclopentadiene	*

Polymerizable Chemicals

Chemicals listed in this table may polymerize without initiation (unless an inhibitor is present), in contact with a contaminant, or in contact with a specific chemical listed. These chemicals should not be combined with each other in an individual waste container. The information in the following table is from the Handbook of Reactive Chemical Hazards..

Chemicals Which Will Polymerize…	**When mixed with…*** **(* indicates compounds that will polymerize by themselves)**
Cyclopentadiene	Potassium hydroxide
Diallyl phosphate	*
Diallyl sulfate	*
Diisocyanatomethane	Dimethylformamide
Diketene	*
Ethyl acrylate	*
Ethylene oxide	Ammonia
Ethylene oxide	Contaminants
Formaldehyde	*
Furfuryl alcohol	Acids
Glyconitrile	*
Hydrogen cyanide	*
Methacrylic acid	*
Methyl acrylate	*
Methyl methacrylate	Propionaldhyde
Methyl Trichloroacetate	Trimethylamine
Methyl vinyl ether	Acids
N-Hydroxymethacrylamide	*
Octakis(F_3phosphine)dirhodium	Acetylenic esters
Propene	Lithium nitrate, Sulfur dioxide
Propionaldehyde	*
Propylene oxide	Sodium hydroxide
Styrene	Air, Polymerizing styrene
Styrene	Butyllithium
Styrene	Dibenzoyl peroxide
Styrene	Initiators
Tetrafluoroethylene	*
Tetrafluoroethylene	Iodine pentafluoride
Thiocyanogen	*
Triboron pentafluoride	*
Vinyl acetate	*
Vinylpyridine	*

4. INCOMPATIBLE CHEMICALS

In order to safely manage chemicals in a laboratory (or non-laboratory) setting, it is important to consider chemical reactions which may result from mixing together of chemical species. Mixing of chemicals may occur during a designed process, or it may occur inadvertently (e.g., mixing waste chemicals in a waste container, incompatible storage of chemicals). Three things should be considered in reference to chemical compatibility:

a. Chemical Knowledge

Know the properties of the chemicals used. The chemical incompatibilities discussed below are by no means exhaustive. As a result, it is crucial for laboratory personnel to thoroughly research the properties of the chemicals used. Safety Data Sheets (SDSs) all have sections on chemical incompatibility, and while the quality of SDSs varies from one manufacturer to another; they should serve as a primary resource for information on avoiding contact with incompatible compounds. A more detailed reference is the Handbook of Reactive Chemical Hazards.

b. Waste Mixing

Avoid mixing incompatible waste materials. Use separate waste containers for each generated waste stream. Contact EH&S at 372-7163 for assistance with determining how to store waste.

c. Storage

Store incompatible chemicals separately. Storage of chemicals in alphabetical order on shelves often results in incompatible chemicals being stored together. For example, an alphabetical arrangement could result in hydrogen peroxide (a strong oxidizer) being stored next to a hydrazine (a strong reducer). If the shelf was jarred and these chemical containers broke together, a violent reaction may occur.

d. Chemical Classes

Storage of chemicals by class rather than alphabetically ensures that individual chemicals receive the proper storage measures warranted by their reactivity. Incompatibilities between classes can be anticipated and protected against. Alphabetizing within a group is then acceptable. An added benefit to this type of storage is that knowledge of chemical reactivity is transmitted to users of chemicals, who observe the proper storage practices.

i. Acids: Segregate acids from active metals such as sodium, potassium, magnesium, etc. Segregate oxidizing acids from organic acids, flammable solvents, and combustible materials. Some strong oxidizing acids, such as perchloric acid, should be stored separate from any other chemical and double containerized in compatible containers. Segregate acids from chemicals which could generate toxic or flammable gases upon contact, such as sodium cyanide, iron sulfide, calcium carbide, etc. Acids should be segregated from bases.

ii. Bases: Segregate bases from acids, metals, explosives, organic peroxides, and easily ignitable materials.

iii. Flammables: Store in approved safety cans or vented cabinets. Segregate from oxidizing acids and oxidizers. Keep away from any source of ignition: heat, sparks, or open flames.

iv. Oxidizers: Store in a cool, dry place. Keep away from combustible and flammable materials. Keep away from reducing agents such as zinc, alkali metals, and formic acid. Do not store oxidizers in or on wooden or metal shelves or cabinets (coating the shelf or cabinet surface with epoxy or other material which does not react with oxidizers is suggested). Some strong oxidizers will react violently on contact with other strong oxidizers. If this is the case, separate storage of these materials is advisable. Double-containerizing the individual containers to preclude inadvertent contact may be helpful.

v. Cyanides: Segregate from acids and oxidizers.

vi. Water Reactive Chemicals: Store in a cool, dry place away from any water source. Have a Class D fire extinguisher available in case of fire.

vii. Pyrophoric Substances: Store in a cool, dry place making provisions for an airtight seal.

viii. Light Sensitive Chemicals: Store in amber bottles in a cool, dry, dark place.

ix. Peroxidizable Chemicals: Store in airtight containers in a dark, cool, dry space. Label containers with receiving, opening, and disposal dates.

x. Toxic Chemicals: Store according to the nature of the chemical, using appropriate security where necessary.

e. Incompatible Storage Chart

The following chart lists some specific guidelines for the storage of hazardous chemical substances. These charts are not all inclusive and for any specific questions regarding chemical storage contact EH&S, 372-7163.

INCOMPATIBLE STORAGE CHART	
Chemical	**Is Incompatible With**
Acetic Acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Acids; mineral, nonoxidizing (hydrochloric, hydrobromic, phosphoric, sulfuric)	Water, bases, ethylene, strong oxidizers
Acids; mineral, oxidizing [nitric,perchloric, chromic (Chromium trioxide)] (STORE IN GLASS OR OTHER INERT BOTTLES) (DO NOT USE CORKS OR RUBBER STOPPERS)	Bases, organics, combustibles
Acids; organic (Acetic, benzoic, caprylic, chloracetic, formic,fumaric, maleic, oxalic, phthalic, propionic)	Sulfuric acid, nitric acid, peroxides, chromic acid, acetaldehyde, ethylenediamine, hydroxides, water, permanganates, hypochlorites
Alkali and Alkaline Earth metals (such as powdered aluminum or magnesium, calcium, lithium, sodium, potassium)	Water, oxidizers, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens
Alcohols, Glycols (Allyl alcohol, methanol, ethanol, butanol, pentanol, 2-chloroethanol, benzyl alcohol, ethylene glycol, propylene glycol)	Water and sulfuric acid mixture, hypochlorites, isocyanates, acetaldehyde, ethanolamine, oxidizers
Aldehydes (Formaldehyde, glutaraldehyde)	Strong acids, strong bases, strong oxidizers, phenols, urea
Ammonia, anhydrous	Mercury (in manometers, for example), chlorine, calcium, hypochlorite, iodine, bromine, hydrofluoric acid, oxidizers
Ammonia nitrate	Acids, metal powders, flammable liquids, chlorates, nitrates, sulfur, finely divided organic or combustible materials, reducing agents
Amides (Formamide, dimethylaminobenzaldehyde)	Strong oxidizers, halogenated compounds, esp. CCl_4
Amines (Pyridine, benzylamine, naphthylamine, aniline)	Acetic acid, acetic anhydride, chlorosulfonic acid, nitric acid, hydrochloric acid, sulfuric acid, acrolein, acrylonitrile, hydrofluoric acid, vinyl acetate, oxidizers in general
Aninline	Nitric acid, hydrogen peroxide, other oxidizers
Azo compounds, Diazo compounds, and Hydrazine (Hydrazine, diazomethane, diazoaminobenzene, azobenzene)	Hydrogen peroxide, nitric acid, porous materials, oxidizers, strong acids,metal oxides
Bromine	Ammonia, acetylene, butadiene, butane, methane, propane, (or other petroleum gases), hydrogen, sodium carbide, turpentine, benzene, finely divided metals
Carbon, activated	Calcium hypochlorite, all oxidizing agents
Caustics (Sodium hydroxide, potassium hydroxide, ammonium hydroxide, ammonia, barium oxide, calcium oxide, lithium hydroxide, sodium carbonate)	Acid, water, acetic anhydride, acetaldehyde, acrolein, acrylonitrile, propane, tetrahydrofuran, trichloroethylene, organic halogens, tin, nitro compounds
Chlorates	Ammonium salts, acids, powdered metals, sulfur,

INCOMPATIBLE STORAGE CHART	
Chemical	**Is Incompatible With**
	finely divided organic or combustible materials
Chromic acid	Acetic acid, naphthalene, camphor, glycerin, turpentine, alcohol, flammable liquids
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane, (or other petroleum gases), hydrogen, sodium carbide, turpentine, benzene, finely divided metals
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen peroxide, nitric acid, sodium peroxide, the halogens
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acids, organic or inorganic, reducing agents
Cyanides (Sodium, potassium, hydrogen)	Acids and acid salts, nitrates, chlorates, other oxidizers
Esters (Dibutyl phthalate, ethyl acetate, methyl methacrylate)	Oxidizing materials, nitrate, strong acids, strong bases, peroxides
Ethers (Isopropyl ether, 1,4-dioxane, tetrahydrofuran)	Strong acids, liquid oxygen or air, oxidizers
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, the halogens
Fluorides (Potassium fluoride, sodium fluoride, hydrofluoric acid)	Acids; best to isolate
Fluorine	Isolate from everything
Hydrocarbons (Butane, propane, benzene, gasoline, turpentine, etc.)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide, other oxidizers
Hydrocyanic acid	Nitric acid, alkali
Hydrofluoric acid, anhydrous	Ammonia, aqueous or anhydrous
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, flammable liquids, combustible materials
Hydrogen sulfide	Fuming nitric acid, oxidizing gases
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Isocyanates (Methyl isocyanate, toluene diisocyanate) (STORE UNDER NITROGEN OR DRY AIR)	WATER, alkali, amines, iron, copper, tin, strong oxidizers
Ketones (Acetone, diethyl ketone, butanone, methyl ethyl ketone)	Strong oxidizers, nitric acid, hypochlorites, nitric acid-hydrogen peroxide mixture
Mercaptans and organic sulfides (Carbon disulfide)	Oxidizing agents, chlorine, azides, ethylenediamine, fluorine, permanganates, potassium, zinc, calcium hypochlorite, and organic amines
Mercury	Acetylene, fulminic acid, ammonia
Nitric acid, concentrated	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases
Oxalic acid	Silver, mercury
Perchloric acid STORE SEPARATELY. USE IN A SEPARATE AREA SPECIFICALLY DESIGNED FOR PERCHLORIC USE. (including fume hood with	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood

INCOMPATIBLE STORAGE CHART	
Chemical	**Is Incompatible With**
washdown system)	
Potassium	Carbon tetrachloride, carbon dioxide, water, oxidizers
Potassium chlorate	Sulfuric and other acids, other oxidizers
Potassium perchlorate	Sulfuric and other acids, other oxidizers(See also Chlorates)
Potassium permanganate	Glycerin, ethylene glycol, benzaldehyde, sulfuric acid, reducing agents such as organicliquids, etc.
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds
Sodium	Carbon tetrachloride, carbon dioxide, water, oxidizers
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural, other reducing agents
Sulfuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate (or compounds with similar light metals, such as sodium, lithium)

5. WASTE DISPOSAL

Chemical waste disposal laws are very complex and are inclusive of the majority of chemicals used in the laboratory. Improper storage and disposal of hazardous chemical wastes presents a direct liability to any person directly involved in storage and disposal. This liability is associated with imprisonment and/or large monetary fines. Supervisors and administrative officials share in that liability. See WSU Safety Policies and Procedures Manual, Section 5.66 for information about proper chemical waste management procedures.

In general, it is against the law to:

a. Dilute a hazardous chemical waste substance in order to reduce its concentration below regulated limits,

b. Dump a hazardous chemical waste substance down a drain or into the environment,

c. Dispose of a hazardous chemical waste in a waste basket, dumpster or landfill.

Consult with EH&S at 372-7163 regarding any questions about hazardous chemical waste disposal.

6. CHEMICAL SPILL MANAGEMENT

A chemical spill or uncontrolled release represents the single greatest potential for employee overexposure to a hazardous chemical. Employees expected to clean up spills of hazardous chemicals must be trained for the specific hazardous materials they will be cleaning up.

For clean up of large spills contact EH&S at 372-7163 during normal working hours or 372-7234 after normal working hours. Contact EH&S at 372-7163 for further information regarding chemical spill clean up.

D: Respiratory Protection

Information about respiratory protection can be found on the Environmental Health & Safety respiratory protection webpage and the Safety Policies and Procedures Manual Section S3.24 on respiratory protection.

E: WSU Hazardous Waste Management Guidelines

Information about chemical waste management can be found on the Environmental Health & Safety website.

Washington State University Tri-Cities Hazardous Waste Management Plan (HWMP)

1.0 INTRODUCTION

This document describes hazardous waste management requirements and procedures for Washington State University, Tri-Cities (WSUTC). Proper waste management provides opportunities for:

- Reduction in disposal costs
- Good stewardship of the environment and WSU facilities
- Enhanced safety of employees, students, volunteers and visitors
- Reduction of the university's exposure to liability and regulatory citations and fines.

This plan applies to all activities performed by building/grounds maintenance, academic and research laboratories, and other university offices conducting activities which are regulated by the Washington State Department of Ecology Dangerous Waste Regulations, Washington Administrative Code (WAC) 173-303.

2.0 PROGRAM BASICS

Measures to reduce and prevent creation of dangerous wastes will be outlined in this document[1].

Once dangerous wastes are generated, there are specific legal requirements for how they must be managed. State and federal regulations describe requirements for all of the following waste-related activities:

- Accumulation
- Labeling and Signage
- Recordkeeping
- Accumulation area inspections
- Treatment
- Transportation of Wastes
- Authorized Disposal Methods
- Training

All of these will be discussed in more detail in the following pages.

WSU Tri-Cities Environmental Health & Safety (EH&S) department provides staff to ensure the proper handling, accumulation, and disposal of dangerous wastes.

[1] Please note that while Washington State generally uses the term "Dangerous Waste", the term "Hazardous Waste" may be used interchangeably.

3.0 POLLUTION PREVENTION

WSUTC is committed to eliminating and reducing waste generation and associated hazards. In order to accomplish this, generators must consult with EH&S before initiating any process which will create dangerous waste. When waste generation cannot be eliminated, disposal methods and costs can be discussed.

The following are additional measures to reduce waste generation:

1. Accepting donated chemicals from outside of WSU is generally not allowed. EH&S must be consulted prior to accepting any such donations.

2. Prior to transfer of chemicals between WSUTC departments, EH&S must be notified, and both departments' chemical inventory and Safety Data Sheet (SDS) files must be updated.

3. Obtain the smallest volume of chemical required to meet the needs of your project. This will ensure that unused products do not accumulate and become large quantities of waste.

4. If you require only a small quantity of a chemical, contact EH&S to determine if it may be available from another user on campus prior to ordering new product.

5. If you are working with pesticides, contact EH&S prior to any ordering, efforts can be made to ship unused materials back to the vendors as well as ship only the amount needed for the study.

Spill prevention and minimization efforts must be implemented to reduce the potential for generation of more waste. This includes the use of secondary containment for chemical accumulation areas, transporting materials, and dispensing chemicals. Having spill supplies on hand will help minimize the spread of contamination.

Standard operating procedures (SOP's) must consider methods of waste minimization. It may be possible to reduce waste generation by substituting products and materials, using microscale procedures, re-using or recycling chemicals from other experiments. Contact EH&S to explore using another department's excess chemical stocks. New SOPs must identify waste reduction alternatives when the process is being planned.

4.0 DANGEROUS WASTE ACCUMULATION PROCEDURES

Satellite Accumulation Areas (SAAs) and larger Central Accumulation Areas (CAAs) are both used for management of dangerous wastes on campus. SAAs are located in the immediate vicinity of the location where wastes are generated (typically, in the same room), and must be secure. Once certain thresholds are met (detailed below) containers must be transferred from the SAA to the Central Accumulation Area for disposal. Both types of accumulation areas have specific requirements, which must be met.

4.1. Satellite Accumulation Areas (SAAs)

SAAs can be located anywhere on campus, and can be a room, part of a room, a cabinet, fume hood, or other location which is "at or near the point of generation." These areas must be under the control of the person generating the waste(s). SAAs must meet the following requirements:

- SAAs must be secured when the area is not occupied and should be identified with the sign: "Satellite Accumulation Area".
- Containers located in an SAA must:
    - Be compatible with the waste material, in good condition, and clean both inside and outside.
    - Have a secure lid that cannot be dislodged during accumulation and transport[2]. Ground glass, cork or rubber stoppers; Parafilm, foil; or snap cap lids cannot be used to seal waste containers.
    - Be kept closed except when adding waste. Containers receiving waste from instruments such as GCs and HPLCs must have a line running through a cap or secure stopper.
    - Be clearly labeled <u>when waste is *first* placed in them</u>. (See Section 4.0 for further details.)
- Date and report the waste to WSUTC EH&S for collection (see Section 5.0) when:
    - Containers are full (leave an air space of at least 10% of the container volume)
    - Waste accumulation ends (the end of an experiment or class)
    - A total volume of 55 gallons of waste (or 1 quart of Acutely Hazardous Waste) is accumulated
- Once reported, wastes are to be removed from the SAA within 3 working days.

4.2 Central Accumulation Areas

The Bioproducts, Sciences, and Engineering Laboratory (BSEL), Collaboration Hall (TCOL), and Wine Science Center (WSC) buildings have Central Accumulation Areas managed by EH&S (BSEL 151A, TCOL 116A, and WSC130). Wastes from SAAs are consolidated in these areas for further management prior to disposal.

Requirements for Central Accumulation Areas include:

- The area is locked when not in use, and there is limited key access. Wastes are stored by hazard classification(s), and are properly segregated.
- The area is posted and identified as "Dangerous Waste Storage - Authorized Personnel Only." Emergency contacts and phone numbers are posted by the entry door. Only authorized and trained personnel are allowed to work in this accumulation area.
- Wastes must be properly labeled (see section 5.1) and inventoried
- When wastes are present in the CAA, weekly inspections are required to be conducted and documented.
- See Section 7.0 for more detailed Central Accumulation Area procedures.

[2] On rare occasions, it may be necessary to leave waste bottles loosely capped in order to prevent pressure from building up in the container. Such wastes must be clearly labeled and placed in a fume hood, where they cannot be disturbed, until it is safe to securely close them.

5.0. LABELING OF DANGEROUS WASTE

5.1 Dangerous Waste Labeling

Labeling is a critical part of proper waste management. All wastes must be clearly labeled to identify their contents and associated hazards. Every container will be handled by several people, inside and outside of the university, before its final disposal. In order to ensure the safety of personnel at each step in the disposal process, containers must be labeled completely and accurately.

Proper labeling of waste containers includes ALL of the following:

- The words "Hazardous Waste" or "Dangerous Waste". (These are interchangeable)
- The waste generator's name and phone number
- A unique ID number, which cannot be duplicated (this is not required during accumulation, but must be transferred from the online Chemical Collection Request once the waste is submitted for collection)
- Identification of ALL waste constituents (including water), and their approximate percentages, which total 100%[3]. Full chemical names must be used, formulas or abbreviations are not acceptable
- The hazard(s) associated with the waste (flammable, toxic, corrosive, etc.) determined by the Safety Data Sheet (SDS) or by knowledge and testing
- The date the container was filled, or the date on which it was declared waste

Additional label requirements:

- Writing must be legible. Print clearly or type labels.
- All of the information above must be clearly visible.
- Use permanent ink.
- For containers with a volume of 1 gallon or larger, the words "Hazardous Waste" or "Dangerous Waste" and the hazard(s) associated with the waste must be in letters at least ½" tall.
- If you have an unknown, and don't know what the waste consists of, write in "Unknown (solid, liquid, or gas)" and describe it as best you can such as, "brown thick liquid". Also provide information on where it was found, in order to determine what type of material it may be

In addition to the label information, each container must comply with the following:

- All information on any existing labels on the container must be completely marked out or the labels removed to prevent any confusion.
- The outside of the bottle where the label will be affixed must be cleaned to ensure the label will stay attached, and placed where it will be easily visible.
- When the container is too small to affix this label, the container is placed in a clear plastic bag, sealed, and the label is placed on the outside of the plastic bag.
- If there are several or many small vials containing the same waste material, the vials are placed in a sealed outer container such as a bag or box, and the label is affixed on the outside. Indicate on the label that there are small vials of waste inside.
- If it is expected the label may be subjected to spills from filling the container, seal over the waste label with clear packaging tape after the label has been completed to protect the label ink from running, and becoming illegible.
- **Polychlorinated Biphenyl (PCB) wastes,** such as old fluorescent light fixture ballasts, must have the date the material was taken out of service (out of service date) written on the outside of the container. (See specific procedure in Section 22.1)

[3] A range of percentage values is allowable, but must be as narrow as possible and must account for 100% of the waste.

Labels meeting the above requirements will be automatically created when generators use the online Chemical Collection Request (Section 6.1). WSUTC EH&S will provide an electronic label for printing, but will not provide physical labels.

5.2 Universal Waste Labeling

Ecology designates certain wastes as "Universal Wastes." **Spent batteries** (including lead-acid, alkaline, lithium, nickel-cadmium, nickel metal halide, mercury containing batteries), **lamps** (including fluorescent, compact fluorescent, high pressure sodium, metal halide, and mercury vapor lamps), and **mercury containing equipment** all fall into the category of Universal Wastes.

These wastes must be labeled "Universal Waste," and must identify the type of universal waste, hazards, an accumulation start date, and (for lamps) the number of individual lamps in the package.

WSUTC uses "Big Green Box" for disposal of batteries. Pre-labeled disposal boxes are located in the shipping center (Floyd 127) and in the Wine Science Center break room (room 229). Lithium batteries, such as those from laptops, and 9V batteries must have the metal contact points covered by non-conductive tape before being placed in the box. EH&S monitors and ships this box when it becomes full, or when its disposal date approaches.

Similarly, lamps and bulbs are collected in pre-labeled boxes by Facilities Maintenance, and are regularly transferred to EH&S for shipment

Mercury-containing equipment, when encountered, must be reported to EH&S using the procedures for disposal of Dangerous Waste (Section 6.0).

6.0 DISPOSAL OF DANGEROUS WASTE

Most wastes generated at WSU Tri-Cities are containerized and shipped to disposal facilities around the country. A few waste streams can be discharged to the drain, or can be treated before discharge. WSUTC EH&S will review the wastes being generated to determine whether any are eligible for treatment or discharge.

6.1 Disposal – Chemical Collection Requests (CCRs)

Dangerous wastes must be reported to EH&S for collection and disposal when:

- A waste container is full (allow headspace of at least 10% of the container volume).
- It is determined that no more waste will be added to the container.
- It is determined a chemical will no longer be used.
- An unknown chemical is discovered. Unknowns must be reported immediately to WSUTC EH&S.
- When the SAA waste quantity limits are reached:
  - ≥2.2 lb of an Acutely Hazardous Waste is accumulated[4]
  - ≥55-gallons (total) of hazardous waste is accumulated.

Reporting of wastes ready for collection is done exclusively via an online form, the Chemical Collection Request. It is located on the WSUTC EH&S website at http://tricities.wsu.edu/safety, or can be reached directly at http://customforms.tricity.wsu.edu/collectionrequest.

Upon completing and submitting an online CCR, the system will provide a completed label, which can be printed and applied to the waste container(s). Note that these labels can be scaled down for smaller bottles. If the bottle already has a compliant label, simply transfer the CCR number to the label. Note that this number is *required* for disposal – it provides a unique and traceable container identification.

Completed CCRs are delivered to WSUTC EH&S electronically, and scheduled for collection. The electronic file then provides the complete inventory of wastes located in the Central Accumulation Area

How to fill out the Chemical Collection Request form:

GENERATOR

Full Name:	Enter the first and last name of the person responsible for the waste. This must be the person who physically generates the waste and is able to answer questions about it, not the PI or supervisor.
E-mail:	E-mail address of the person named above
Phone:	Phone number of the person named above

LOCATION OF WASTE

Building:	Select the campus building in which the waste is located (Tri-Cities only)
Room:	Enter the room number where the waste is located

WASTE DESCRIPTION

Constituents:	Enter each waste component on a separate line. All compounds in the waste must be identified (including water). If the waste contains more than 10 constituents, contact WSUTC EH&S.
Percentage:	For each constituent, enter its percentage of the total waste. Percentages must total 100%
Hazards:	Identify the hazards associated with the waste, based on your knowledge, testing, or information from the manufacturer's label or SDS. Check all that apply.

[4] "Acutely hazardous waste" means dangerous waste sources F020, F021, F022, F023, F026, or F027, and discarded chemical products that are identified with a dangerous waste number beginning with a "P".

Physical State:	Indicate whether the waste is solid, liquid, or gas.

CONTAINER DESCRIPTION

Number of Containers:	Record the number of containers of this waste. Containers with the same waste, which are the same type and size, can be combined on a single CCR number. Containers of varying type and size must be reported separately.
Size:	Record the container size – numbers only. For example, for a 4-liter bottle, simply enter 4
Units:	Select the appropriate unit of measure for the container size.

ADDITIONAL INFORMATION

Use this field to record any other information regarding the waste, such as a precise location in a room, its pH, access limitations, etc.

For generators who have a large number of wastes to collect, contact WSUTC EH&S for assistance. Large numbers of containers can be reported using an Excel spreadsheet, rather than multiple form submittals.

6.2 Requesting Disposal by Discharge to Sanitary Sewer and Storm Water System

WSU Tri-Cities holds an Industrial Wastewater Discharge Permit from the City of Richland, and any discharge must meet the conditions set by that permit. Discharge of any material other than soap & water is prohibited unless approved by WSUTC EH&S.

Discharge approval can be obtained by submitting the "WSU Tri-Cities Discharge Approval Form". EH&S will review each form for compliance with permit limits and will approve or deny them on a case-by-case basis. Approvals will be issued in writing, and must be maintained at the point of discharge. Approvals are specifically and exclusively applicable to the exact material described in the approval. Any changes to that material will require a new approval before discharging may occur. Unauthorized discharges could result in penalties, and may impact operations and research. . If any unauthorized discharges to are observed, call immediately 509-372-7234. WSUTC EH&S personnel will investigate, remediate, and report the discharge to the Department of Ecology as necessary.

Discharges to WSUTC stormwater systems are prohibited, and are regulated under the WSU Tri-Cities Stormwater Management Plan, and stormwater permit issued by the Department of Ecology. Any suspected discharges to stormwater drains on campus must be reported to 509-372-7234 immediately. Such discharges may be considered criminal violations.

6.3 Wastewater Treatment

Sometimes a waste material can be "pre-treated" by certain methods that will render the waste acceptable for sewer drain discharge. Only specific methods are allowed by Ecology under the "Treatment by Generator" (TBG) Rule, and must be preapproved by WSUTC EH&S. Some common methods allowed include: elementary neutralization; filtration; carbon adsorption; separation; solidification/stabilization; and evaporation (water only).

Detailed records of any TBG activity are required. A Waste Treatment Log is required to be maintained at the location of treatment activities. This log is to be provided to WSUTC EH&S each calendar year for inclusion in the campus' Annual Dangerous Waste Report

Contact WSUTC EH&S if you have wastes which may be subject to treatment.

7.0 COLLECTION OF DANGEROUS WASTES FOR TRANSFER TO THE CENTRAL ACCUMULATION AREA

Collection and consolidation of waste containers in the central area is completed by EH&S. In order for the collection to be efficient, it is important for the generator to coordinate with EH&S in advance, and be thorough in meeting all labeling and reporting requirements.

Upon receipt of a Chemical Collection Request (CCR) EH&S will contact the generator if information is unclear. If the information is complete, the container(s) will be collected and transferred to the Central Accumulation Area within 3 days.

- When collecting/handling waste, at the minimum, the following personal protective equipment (PPE) must be used: Safety eye wear, disposable nitrile gloves and a lab coat. Depending on specific conditions, other PPE may be required.
- Each container must be assessed before transporting to the Central Accumulation Area, for each of the following: integrity, compatibility with the waste, proper labeling, secure lids, outside contamination, and reasonable headspace. Containers that do not meet any one of these requirements will not be collected. Notify the generator of any deficiencies so that they can be corrected.
- Secondary containment or other transfer devices are required for all chemical transport and incompatibles need to be separated.
- When using the elevator, do not allow other personnel into the car. Ask them to wait until you have exited.
- At the Central Accumulation Area, the weight of each container is recorded, its destination indicated (bulk drum, lab pack, neutralization, etc.). Place containers in appropriate cabinets based on their hazard classification. Solids are placed on the upper shelves and liquids below where possible.
- All containers in cabinets should be placed so that their labels are readable upon opening the cabinet doors.
- Maintain an inventory by placing the completed list of CCRs in a binder located in the accumulation area. Be sure to completely cross out any containers which were not collected due to container and/or labeling issues.

8.0 CENTRAL ACCUMULATION AREA PROCEDURES

Operation and management of the Central Accumulation Area is the responsibility of WSUTC EH&S. Access to this area is limited to authorized and trained individuals. Waste materials can only be received by WSUTC EH&S, and cannot be accepted into the CAA unless they meet all of the labeling requirements in Section 5.0, and have been added to the CAA inventory.

Upon being accepted into the CAA, the date of collection and weight of each waste must be recorded on the CAA inventory sheet. A disposal option must also be recorded. Typical disposal options include:

- ORG: Bulk Organic wastes – liquids with a significant organic component, such as alcohols and laboratory solvents. High and low pH solutions are generally allowable, but may require revision of waste profiles for acceptance. Wastes containing heavy metals or D-listed solvents should not be added to the ORG stream until evaluated against the waste profile and determined to be acceptable. These wastes are typically sent for incineration.
- AQ: Bulk Aqueous wastes – liquids with little organic component (less than approximately 5% total). Typically consists of various mixtures of toxic salts. High and low pH solutions are allowable. Wastes containing heavy metals or D-listed compounds must be evaluated against the waste profile before being added to the AQ stream. These wastes may be sent for incineration or wastewater treatment, depending on their precise contents.
- LP: Lab Pack wastes – Wastes which are not eligible for disposal in a bulk drum, due to their characteristics. All waste solids will be lab packed. Liquid wastes may also be lab packed if they are strong oxidizers, if they are reactive, particularly toxic, or if they contain heavy metals or other compounds which prevent them from being placed in a bulk waste stream. Common examples of materials which will be lab packed include hydrogen peroxide solutions, mercury wastes, and solid salts.
- TRT: Treatment – clean acid and base wastes mixed with water and no other constituents can be neutralized and discharged to sewer. Chemical names and quantities of materials neutralized must be recorded, with the date of discharge and the final pH of the waste. Additionally, chemicals being neutralized must be reviewed prior to discharge to ensure that reaction products do not produce toxic criteria wastes ineligible for discharge.

Approximately 80% of WSUTC wastes are placed in the bulk waste streams (ORG and AQ). These options require less time to prepare waste shipments, and have lower disposal costs, so they are typically the preferred disposal option. However, all wastes must be carefully reviewed prior to being assigned to one of these alternatives in order to ensure that they will not violate the waste profiles established with our disposal contractor, and (more importantly) to ensure that they will not react with other wastes and create unsafe conditions on campus or in another waste handling facility.

8.1 ACCUMULATION TIME LIMITS

There are regulatory time limits on accumulating hazardous waste; therefore it is important to track waste accumulation times. WSUTC typically qualifies as a Medium Quantity Generator (MQG), and has a 180-day limit on accumulation of wastes. The Wine Science Center is typically a Small Quantity Generator (SQG), which has no accumulation time limit. However, a single container of Acutely Hazardous Waste can turn either facility into a Large Quantity Generator, with a 90-day accumulation time limit.

When the first waste container is placed in the CAA, determine the required shipment date by adding 180 days (or 90 days for acutely hazardous wastes) to the date on the container label. Post this date in a conspicuous location in the CAA.

Universal wastes must be shipped for disposal within one year of accumulation. This date must be marked on each container of Universal Waste.

When PCB wastes greater than 50 ppm are collected, they must be shipped off-site within one year from the "Out of Service" Date.

8.2 CENTRAL ACCUMULATION AREA WEEKLY INSPECTIONS

WSUTC EH&S conducts weekly inspections for the Central Accumulation Areas when hazardous wastes are present using the "Weekly Inspection Checklist" form found in Appendix A. The inspection forms are maintained in a binder in a conspicuous location in the central area.

- If there is a discrepancy during an inspection EH&S will correct the issue, or arrange for its correction, immediately. When the discrepancy has been resolved, the date and corrective action will be noted on the original copy of the inspection form and initialed by EH&S.
- The inspection sheets must be retained for 3 years.

9.0 HAZARDOUS WASTE SHIPMENT PROCEDURE

WSUTC EH&S monitors the accumulation dates and shipment deadlines.

- Approximately six weeks prior to a waste shipment deadline for the central area, WSUTC EH&S makes shipment arrangements with the appropriate waste disposal contractor. Alternatively, based on waste volume, shipments may be arranged on a regular cycle of 3-4 months.
- EH&S may, at their discretion, notify generators of the scheduled shipment and request that they submit any wastes for collection.
- EH&S collects all wastes submitted for disposal at least two days prior to the shipment date. No wastes shall be collected from SAAs for two days prior to the shipment. This restriction may be waived at the discretion of EH&S, once shipment preparation is complete.
- EH&S provides disposal contractors access to the central area, showing them the location of all wastes going out for disposal, and familiarizing them with the location of the nearest phone, emergency shower and eye wash unit, and fire extinguisher, as well as exit routes. A briefing of the 911 dialing instructions and other emergency numbers on the Hazardous Waste Emergency Contact sign is done.
- EH&S ensure the **disposal contractor**:
  - Reviews all waste ready for disposal.
  - Only packages containers that have a WSU CCR number on them. If no CCR number is present, the contractor is to bring this to the attention of WSUTC EH&S, who will provide further instruction
  - The contractor writes the WSU CCR number for ***every*** lab pack container on the contractor's drum inventory sheets. Each individual bulk drum and lab pack must have an inventory sheet clearly indicating what containers were placed inside.
- Once all waste has been packed, EH&S inspects the waste storage cabinets and area to make sure all wastes have been packaged and no spills occurred
- EH&S inspects each drum and lab pack container, verifying labeling of containers and placarding of the transport vehicle, reviews manifests for accuracy, and signs the paperwork before the contractor leaves and the paperwork is distributed.
- WSUTC EH&S staff are the only personnel authorized to sign the manifest, other shipping papers and the time and materials sheet.
- The waste shipment's original manifest, Land Disposal Restrictions (LDRs), contractor's Time and Materials sheet, and drum inventory lists, and the CAA inventory list, are placed in a file dated for the shipment and placed in the location's central hazardous waste file.
- If any containers have remained in the CAA after shipment, the accumulation time limit must be re-calculated based on the date of the oldest container. The CAA inventory must be updated to reflect any containers left behind.

- Note the date of the shipment on the Weekly Inspection Log. If all wastes were removed from the CAA, indicate this on the log.
- The original manifest signed by the final receiving facility, must be received by WSUTC EH&S within 45 days of the shipment. Place this into the shipment file. If it has not been received within 45 days, WSUTC EH&S must contact the disposal contractor to obtain a copy ASAP. If a copy is not received, this must be reported as a violation.

10.0 HAZARDOUS WASTE RECORDKEEPING

There are specific documentation requirements for hazardous waste shipment and disposal that must be closely adhered to.

The hazardous waste files for the main campus are located in WSUTC EH&S office, BSEL 129. For the Wine Science Center, they are located in the Central Accumulation Area in room 130

The central files must contain the following for wastes shipped off site for disposal:

- Manifest paperwork for each waste shipment, the signed returned manifest, certificates of disposal (CD), and the inventory of materials shipped.
- Annual Dangerous Waste reports submitted to Ecology.
- Exception reports, if any.
- Analytical data/testing for any waste that has been required.
- Current CAA inventory
- Central Accumulation Area inspection records
- Waste treatment records (neutralization logs)

Hazardous waste manifest and shipment records must, by law, be retained on site for a minimum of 5 years.

WSUTC EH&S audits the central files annually for completeness.

11.0 WASTE DESIGNATION

The Department of Ecology regulates all hazardous wastes in Washington State. In addition to the listed and characteristic wastes defined by the U.S. Environmental Protection Agency (USEPA), this includes Washington State "Criteria" wastes are defined by WAC 173-303. All wastes must be designated, meaning that they must be evaluated to determine whether they meet the definition of "hazardous" under federal and state regulations.

When planning projects or experiments, generators must determine whether hazardous waste will be generated, and ensure that it is collected, identified, and disposed of in a proper manner. All generators must attend Hazardous Waste Generator training prior to receiving keys for laboratory access or working on waste-generating processes. This training includes additional information regarding proper waste designation. Generators can also contact EH&S for assistance with waste designation.

In order to determine whether wastes are hazardous EH&S will require the following information:

- All constituents of the material, and their approximate concentrations, If a trade name such as Wonderclean is being disposed, the actual chemical names of the ingredients can be obtained from the container label or Safety Data Sheet
- The physical state of the waste material.
- If the material is unused product (primarily applicable to research chemicals and pesticides)
- The volume of waste, the container size and type
- Waste generation rate and if it is constant, periodic, batch or continuous.
- If it is corrosive, the pH is helpful.
- Safety Data Sheet for the chemical(s)

It is best to have this done prior to generating the waste so that proper containerization, storage, and possible alternate chemicals, methods, or treatment options can be discussed.

12.0 TRAINING

Performing different tasks/responsibilities related to hazardous waste management requires varying forms of training.

Waste Generator: All personnel working in the labs need to take and pass the hazardous waste generator training *annually*. This training includes: basic waste designation, container selection and labeling, satellite accumulation requirements, personal protective equipment, procedures for waste reporting, and emergency procedures.

WSUTC EH&S (Emergency Coordinator): All EH&S employees are appropriately trained for waste handling duties relevant to their position. These include: waste designation, container selection and labeling, waste collection procedures, chemical hazards and incompatibilities, requirements for Satellite Accumulation Areas and Central Accumulation Areas, waste reporting and collection procedures, record keeping requirements, Hazard Communications, personal protective equipment, container management procedures, emergency procedures in the event of a fire, explosion, spill or other release, WSU hazardous waste procedures, and pertinent U.S. Department of Transportation regulations.

13.0 SPECIFIC PROCEDURES

13.1 FLUORESCENT LIGHT BALLAST DISPOSAL

Fluorescent Light Ballast Disposal Procedure 2017

This procedure is to ensure fluorescent light ballasts are properly processed for disposal on the WSU Tri-Cities campus. This will cover how to package, label, document, store, and safely handle the ballasts. PCB containing materials are regulated by both the EPA and Washington Department of Ecology.

Ecology regulates PCBs at lower levels than EPA, so labels on individual ballasts that indicate they contain no PCBs may still be regulated in the State of Washington. Following these procedures is necessary to be in compliance with requirements.

The following guidance was developed by WSU Pullman, using data from sampling conducted there:

- Light ballasts that are marked "PCB-free" or "No PCBs" do not contain regulated concentrations of PCBs, and may be recycled.
- Ballasts marked "Non-PCB" may contain regulated concentrations of PCBs and must be managed as hazardous in accordance with the procedure below.

Facilities Personnel

Removing Ballasts:

1. As soon as they are removed from service, mark ballasts with the date removed from service and place them into the designated drums located in East building maintenance shop or in the Central Accumulation Area located in BSEL room 151. **Be sure the lid of the drum is back on after placing the ballasts in the drum**. Labeling is provided by WSUTC EH&S on the drum in the BSEL accumulation area. If ballasts are stored elsewhere, contact WSUTC EH&S.
2. The out-of-service date of the first ballast must also be written on the drum.
3. If the drum becomes full, or when it approaches 1 year from the oldest out-of-service date, notify WSUTC EH&S immediately.
4. If a ballast is observed to be leaking, or has signs of previous leaking such as a stain, do not handle it until you have proper protection and supplies to handle it. Wear nitrile gloves to handle the ballast. After removal, place it in a clear plastic bag and seal the bag tightly. Use a paper towel or rag to wipe up any oil on the fixture or elsewhere. Place the gloves and rags into another clear plastic bag and seal. Notify WSUTC EH&S of the leaking ballast.

WSUTC EH&S Personnel

1. Provide an open-top drum for accumulation of light ballasts. The drum must be labeled as follows:
    a. End of Service label on the side of the drum showing out to the front.
    b. "Keep Lid Closed" label must be on top of the lid.
    c. Hazardous Waste Label affixed to the side of the drum.
2. When full, complete an Online Chemical Collection Request form for the drum, and attach it to the top of the drum.
    a. Assign a unique inventory number.
    b. Enter the date the container was filled.
3. When contacted by Facilities that ballasts are being placed in the drum for the first time
    a. Ensure the "Out of Service Date" was properly placed on that label. If not contact Facilities to obtain the date and place it on the label.

b. Check to make sure lid is closed and no leaking ballasts are present.

c. Place a date 9 months out from the "Out of Service" date on the Shipment Date Compliance Sign posted on a storage cabinet, and note for PCB disposal.

4. When contacted by facilities that the drum is full, that day:

    a. Complete the CCR and Hazardous Waste Label with the "Container Filled Date" and seal drum.

    b. Start a new drum if not already done.

5. When contacted by Facilities that a leaky ballast has been deposited in storage, that day:

    a. Label the bagged ballast(s) and any cleanup materials with a hazardous waste label, and complete an entry on the CCR attached to the top of the ballast drum.

    b. Place the ballast(s) in the appropriate storage cabinet.

6. Inspect the drum during weekly inspections to ensure everything is in compliance. Start a new drum when the existing one is near full.

13.2 USED BATTERY DISPOSAL AND RECYCLING

WSUTC uses "Big Green Box" for disposal of batteries. Pre-labeled disposal boxes are located in the shipping center (Floyd 127) and in the Wine Science Center break room (room 229).

The disposal box is pre-labeled with all required information, and must be marked with the date the first battery is placed inside. The box must be closed and shipped for disposal within 1 calendar year of this date. EH&S monitors and ships this box when it becomes full, or when its disposal date approaches.

The following restrictions must be observed:

- If a battery is contaminated on the outside, place it in a small plastic bag before placing into the collection container. If there is already a bag with contaminated batteries in the collection container, add it to that bag.
- Lithium batteries, such as those from laptops, and 9V batteries must have the metal contact points covered by non-conductive tape before being placed in the box. Similarly, lithium "button" batteries must be wrapped in non-conductive tape before being placed in the box.
- Large wet-cell batteries (typically lead-acid or gel cell batteries) cannot be placed in the box. Report these batteries on a Chemical Collection Request. EH&S will collect and manage them as Universal Waste through a disposal contractor.

13.3 MANAGEMENT OF PEROXIDE FORMING COMPOUNDS

Some solvents can form dangerous levels of peroxides during storage, through a process called autoxidation. This can occur upon exposure to air, heat, light, or simply with passage of time. Elevated concentrations of peroxides may become sensitive to heat, friction, or shock and become explosive. The danger is increased when a peroxide forming chemical is concentrated by distillation or evaporation.

Due to the risk of explosion, disposal contractors will not accept peroxide-forming compounds outside of their shelf life, unless they are stabilized. Stabilization of old, out-of-date compounds is very expensive, and must be avoided.

In order to prevent accumulation of peroxide-forming compounds, the following purchasing practices must be implemented:

- Purchase only what will be used completely before the end of the storage time limit for that category of material. (See the table below of peroxide forming risk and retention time)
- Purchase factory-inhibited materials whenever possible. In many cases, manufacturers add stabilizers or inhibitors that slow peroxide formation within the solvent's shelf-life.
- Tracking and storage of containers to ensure safety:
    - When purchasing a peroxide forming chemical, inform WSUTC EH&S of the purchase. EH&S will then label the container and add it to a tracking database.
    - When the container is first opened, write the "Date Opened" on the container.
    - Use the oldest stock on the shelf first until it is all used up. Rotate stock to prevent stock exceeding its disposal date.
    - Store peroxide-forming materials in the original manufacturer's container when possible. If it is necessary to use a different container, use one that is opaque and does not have a glass stopper or metal lid. These materials must be stored in tightly closed containers to eliminate evaporation and decrease contact with air.
    - Store material in a safe environment away from heat, light, and ignition sources. Containers must be protected from physical damage.
    - Periodically review the inventory to ensure material is used up or disposed of in the required time limit.
    - When a container becomes empty, notify WSUTC EH&S
- Notify EH&S of any material which is approaching its shelf life. This will allow time to either dispose of the material prior to its expiration, or add inhibitor to the compound if it will still be used. Failing to monitor this may require that the container be stabilized prior to disposal, at a significant cost.

Proper handling of peroxide forming materials:

- Do not allow containers to evaporate to dryness. Rinse empty containers with water, label as "Empty" and dispose of in the trash with the lid removed.
- Peroxide-forming materials must not be opened after the manufacturer's expiration date or after the storage time limit has been reached (see chart). These materials must be disposed of as dangerous waste. Contact WSUTC EH&S for assistance.
- If a viscous liquid or crystalline solid is observed in the material or around the cap, do not open, do not touch the container lid, or attempt to move the container. If already open, do not reseal. Immediately call WSUTC EH&S for assistance. Place a warning sign near the container (do not touch container) describing the potential explosion hazard, and include the date and contact person.
- Do NOT distill peroxide-forming chemicals. This removes any peroxide inhibitors.

- Any container discovered that has been stored past its storage time limit must be reported to WSUTC EH&S immediately. WSUTC EH&S will make arrangements for the container to be evaluated, tested, stabilized, and certified for peroxide levels by an approved contractor.

Organic Peroxide Forming Compound Storage Time and Disposal

Peroxide-forming compounds are typically classified into three categories on the basis of peroxide formation susceptibility.

Group I materials are the most hazardous, and can spontaneously form peroxides in storage, even without concentration. These materials typically have a shelf life of no more than 3 months, meaning that they must be stabilized, inhibited, or consumed within 3 months of purchase. Some examples of Group I materials are:

Chemical	Synonyms
Isopropyl ether	Disopropyl ether, Disopropyl oxide
Potassium metal	Potassium
Vinylidene chloride	1.1-dichloroethylene, 1.1-dichloroethene

Group II materials typically form peroxides on concentration, as the solvent evaporates (including distillation). This can occur as the material is consumed, and a small amount is left in a large container. These materials, when inhibited, have a shelf life of 1 year. Uninhibited, they have a shelf life of 3 months. Examples include:

Chemical	Synonyms
p-dioxane	1.4-dioxane, diethylene-dioxide
Ethyl ether	Ether, diethyl ether, ethoxyethane
Tetrahydrofuran	Butylene oxide, diethyleneoxide
Cyclohexene	1.2.3.4-tetrahydrobenzene

Group III materials may autopolymerize as a result of peroxide formation. Shelf life of these materials is the same as Group II. Examples include:

Chemical	Synonyms
1.3-butadiene	Vinylethylene, divinyl
Vinyl acetate	
Vinyl chloride	Chloroethylene, ethylene monochloride

These lists are not exhaustive. Check the Safety Data Sheet (SDS) of your chemical to determine if it forms peroxides. If so, there will be a warning under the heading Precautionary Labeling or Fire and Explosion Hazard Data on the SDS (section 2- Hazards Identification).

If a substance does not appear on the lists and the SDS does not indicate that it is a peroxide former, but you suspect that it is a peroxide former, evaluate the molecular structure of the chemical for peroxide forming functional groups and the chemical families of common peroxide formers below:

Organic Materials	Inorganic materials
Acetals Ethers Olefins with allylic hydrogens, chloro- and fluoroolefines, terpenes Dienes, vinyl acetylenes Aldehydes Ureas, amides, lactams Vinyl monomers including vinyl halides, acrylates, methacrylates, and vinyl esters	Alkali metals, particularly potassium Alkali metal alkoxides and amides Organometallics

13.4 FACILITIES OPERATIONS/MAINTENANCE WASTES

Maintenance activities such as vehicle and equipment repair, painting, pesticide applications, construction projects may create hazardous wastes regulated by the State of Washington which need to be handled as described in this procedure. Never dispose of shop fluids in storm drains, septic tanks, dry wells, dumpsters, or sewer.

Recyclable materials:

When feasible, recycling materials in lieu of disposal, is a more cost effective and environmental friendly option for handling spent materials. Contact WSUTC EH&S with any questions regarding a waste material and the options for disposal. If a local source for recycling or disposal is used, contact WSUTC EH&S prior to using that source. All disposal and recycling sources must be approved by WSUTC EH&S.

Recyclable materials must be stored separately from hazardous wastes. Label the area: "Used Shop Materials for Recycle." Note, the word "waste" is not used in the labeling of recyclable materials. Recyclable shop fluid accumulation areas need to be inside the shop and in control of the generator. Fluids that become contaminated with chlorinated products, solvents, and metal working fluids must be treated as hazardous waste. Only trained and authorized staff place fluids into recycle/waste containers.

Recycling records are maintained with the hazardous waste files (file all bills of lading). Provide copies to WSUTC EH&S.

Light ballasts from fluorescent light fixtures require disposal as a hazardous waste. Specific procedures for processing and accumulation of these materials for disposal are covered in Section 22.1 Fluorescent Light Ballast Disposal Procedure.

The following materials need to be collected for recycle, special handling, or hazardous waste disposal. For more information, refer to the Ecology "Guide for Automotive Shops" which is posted on the Ecology website.

SPENT MATERIAL	ACTION	LABEL	WASTE DESIGNATION
Lead-acid batteries	Recycle with vendor or other vendor	"Spent Batteries for Recycle Caution Corrosive"	Recycle or hazardous waste if can't recycle
Batteries other than lead acid	Recycle through vendor or dispose as hazardous waste	Use Universal Waste label	Universal waste
Oil filters	Drain filters for 24 hours & recycle	"Used Oil Filters for Recycle"	Recycle or local landfill (approval needed)
Transmission filters	Drain filters for 24 hours & recycle	"Used Transmission Filters for Recycle"	Recycle or local landfill (approval needed)
Fuel filters	Manage as hazardous waste	Use hazardous waste label	Hazardous waste
Vehicle oil	Recycle with approved local vendor if they contain no chlorinated products or solvents	"Used Oil for Recycle Caution Combustible"	Recycle or hazardous waste-designation depends on generator procedures
Transmission oil, gear oil, hydraulic fluid, differential fluid	Recycle with used oil if they contain no synthetic or chlorinated products or solvents	See used oil	See used oil
Brake & Power Steering Fluid	Dispose of through hazardous waste vendor	Use hazardous waste label	Hazardous waste
Antifreeze	Recycle through approved local vendor	"Spent Antifreeze for Recycle Caution Toxic"	Recycle or hazardous waste-designation depends on generator procedures
Parts cleaner	Research solvent alternatives OR dispose of through hazardous waste vendor or recycle through supplier	Depends on product	Non-hazardous waste, reduced hazardous waste or hazardous waste depending on product selected & generator procedures
Carb cleaner	Dispose of via hazardous waste vendor	Use hazardous waste label	Hazardous Waste
Shop Towels/Wipers	Dependent on generator treatment of towels-read DOE literature concerning shop towels in appendix B	Dispose of in UL flammable can in shop/Label: "Contaminated Shop Towels Combustible"	Launder, landfill or hazardous waste-designation depends on generator procedures
Solvents/Paint Thinners	Dispose of through hazardous waste vendor	Use hazardous waste label	Hazardous waste
Aerosol cans (empty or containing paint)	Dispose of through hazardous waste vendor	Use hazardous waste label	Hazardous waste

Metals	Local recycling vendor	Store under cover/Label area "Metals for Recycle"	Recycle
Spent tires	Landfill or find local recycler	Store under cover	Recycle or Landfill
Oil Water Separator sludge	Pump sludge via local approved vendor	NA	Non-hazardous or hazardous waste designation depends on generator procedures
Shop floor wash water	Seek permission from WSUTC EH&S to put down drain	NA	Non-hazardous or hazardous waste designation depends on generator procedures
Floor Sweep (spill clean-up)	Dependent on product & spill	Dependent on spill	Hazardous waste
Fluorescent lights & other mercury containing equipment	Recycle through hazardous waste vendor or local recycler or check with local landfill	Use Universal waste label	Universal waste
PCB containing equipment including transformers	Dispose of through hazardous waste vendor or vendor designated by WSUTC EH&S	"Caution PCB Containing Equipment Toxic"	Hazardous waste (TSCA rules apply)
Paint	Recycle or dispose of via hazardous waste vendor	"Paint for Recycle" or use hazardous waste label	Recycle or hazardous waste
Pesticides	Dispose of through vendor who sold product, WSDA event, or hazardous waste vendor	Use hazardous waste label	Hazardous waste

13.5 COMPUTER AND ELECTRONIC WASTE

Lead and precious metals in computers preclude discarding of monitors, printers, and electronic devices with circuit boards into landfills. This equipment is to be surplused via WSU Pullman or other vendors approved by WSUTC EH&S for proper disposal through a licensed waste/recycle vendor.

13.6 PESTICIDES

Unused pesticides for research or classroom use that are provided to WSU by manufacturers, distributors, or field representatives need to be returned to suppliers when projects are finished. This practice not only saves the University money and storage room, but also prevents unnecessary waste generation. A written agreement with the supplier must be obtained before receiving the material that commits the supplier to take back the unused material. Before accepting any pesticides work out return logistics. If a company representative wants to leave a sample, ensure the rep will take back any excess sample before accepting it.

Control pesticide inventory by only receiving the amount needed for the season, request suppliers repackage pesticides accordingly. Arrange for suppliers to send additional small amounts of product, if the initial estimates prove inadequate.

Mailing/shipping Pesticides: Mail back pesticides in the same shipping containers they were sent in (requires the containers be saved). If pesticide is mailed, have the company confirm and/or provide the necessary shipping labels, hazard labels, bill of lading, and packaging. DO NOT mail improperly packaged or labeled pesticides as there are large monetary fines possible when hazardous materials are not packaged per DOT shipping regulations; contact WSUTC EH&S for assistance.

14.0 HAZARDOUS WASTE SECURITY

14.1 Hazardous Waste Central Accumulation Area Security

The Central Accumulation Areas in BSEL 151A, Collaboration Hall 116A, and Wine Science 130 are kept locked at all times. Keys are issued only to authorized personnel. Trash is emptied by WSUTC EH&S.

14.2 Hazardous Waste Shipment Security

The University contracts with the State of Washington's Hazardous Waste Vendor for hazardous waste disposal. This vendor is selected by the State after a rigorous investigation and selection process. By law, the vendor is required to develop a security plan to help ensure safe shipment of its various clients' waste.

To help ensure safe shipments of University waste WSUTC EH&S inspects the integrity of the containers and lids, supervises waste packaging prior to shipment, confirms identity of contractor personnel, monitors loading of waste into contractor vehicles and DOT signage on the vehicle. WSUTC EH&S obtains certificates of disposal (CDs) on all hazardous waste shipments. The majority of wastes are incinerated.

15.0 EMERGENCY PROCEDURES

15.1 Summon Help

Call 911 for any emergency which involves a threat to life or health. Otherwise call 372-7234. Other emergency contact numbers are listed on the Hazardous Waste Contingency Numbers sheet posted by the phone.

15.2 Fire

Both Central Accumulation Areas are equipped with automatic sprinkler systems, and fire extinguishers are located outside their doors. Fire alarm pull stations are located in the southwest entryway to BSEL, and near the south doorway of the Wine Science Center.

15.3 Chemical Exposures

There is an emergency eyewash and shower located inside each Central Accumulation Area. Flush eyes and/or body for a minimum of 15 minutes. The nationwide poison control number is 800-222-1222.

15.4 Chemical Spills

In the event of a chemical spill, call WSUTC Emergency number 509-372-7234. If a spill is in the BSEL building, also call the PNNL Dispatcher number 375-2400 to inform their personnel of the incident. If the spill requires evacuation of the building, follow emergency procedures in WSUTC Comprehensive Emergency Management Plan.

An Environmental Spill Response Contractor is available for 24- hour spill response in the event this type of response is warranted. Contact Scott Tomren (Emergency Coordinator) 509-372-7234; or EH&S Pullman 509-335-3041.

Releases to the environment must be reported immediately to the following outside agencies:

- Washington Emergency Management Division: 1-800-258-5990 -OR- 1-800-OILS-911
- Ecology Central Regional Office: Central Regional Office - 1-509-575-2490
- National Response Center: 1-800-424-8802

The Central Accumulation Areas are designed with sumps to catch any spilled materials. There are no floor drains in the building.

Chemical spill clean-up equipment and supplies are located in the Central Accumulation Areas.

Only WSUTC EH&S personnel are authorized to clean up spills in the Central Accumulation Areas. People untrained to respond to chemical spills must not attempt to clean up the spill. Close the door and get experienced help on the way.

Complete a Spill Cleanup Report when event is completed, and file the report in WSUTC Hazardous Waste records files located in the Central Accumulation Area. (See report form Section 20.10)

16.0 FORMS AND SIGNS

16.1 CONTINGENCY NUMBERS PHONE SHEET

HAZARDOUS WASTE EMERGENCY NUMBERS

FOR ANY INCIDENT INVOLVING HAZARDOUS MATERIALS, INCLUDING FIRE, EXPLOSION, OR SPILLS, CALL:

SINGLE POINT OF CONTACT (24 Hour):
509-372-7234

EMERGENCY COORDINATOR (Scott Tomren):
24 Hour: 509-372-7234
Business Hours: 509-372-7163

CAMPUS SECURITY (To help secure scene):
509-372-7698
(during campus operating hours only)

FOR EXTERNAL EMERGENCY RESPONSE (FIRE, MEDICAL EMERGENCIES, CRIME):

FIRE	
AMBULANCE	911
POLICE	
FIRE/POLICE NON-EMERGENCY	628-0333

NOTE: THIS FACILITY HAS A FIRE DETECTION SYSTEM WITH ACTIVE MONITORING. RICHLAND FIRE DEPARTMENT WILL BE NOTIFIED DIRECTLY IF A FIRE IS DETECTED.

APPENDIX A - CHEMICAL SPILL CLEANUP REPORT FORM

Chemical Spill Report & Accident Investigation

Date:		Time:	
Building/Room:		Location:	
Reporting Party:		Investigator:	
Description of Event:			
Narrative of Response:			
Date of Report		Completed By:	

Follow-up:	
Recommendations:	
Corrective Actions:	

APPENDIX B - WSUTC DISCHARGE APPROVAL FORM

Sewer discharge approval requests can be made online at https://wsu.co1.qualtrics.com/jfe/form/SV_8AhCPnWVqkrwGA5, or by submitting the form on the following page

WSU Tri-Cities Discharge Approval Application

V 2.0, 3-28-13

Submitted By:			
Building & Room:		Location of Drain:	

Description of waste being discharged:			
Description of process generating waste :			
Quantity of waste to discharge:		Frequency of discharge:	

List all constituents of the waste to be discharged, and their percentages (Total must be 100% - attach additional page if necessary)

Constituents	Estimated Percentage
Water	

Does the waste contain undissolved solids? Yes ☐ No ☐

If yes, describe: _____

Does the waste contain any biological material? Yes ☐ No ☐

If yes, describe: _____

Does the waste contain any radioactive material? Yes ☐ No ☐

If yes, describe: _____

Does the waste contain any dye(s)? Yes ☐ No ☐

Does the waste contain any of the materials listed in Table 1 (on page 2)? Yes ☐ No ☐

If yes, describe: _____

Temperature (range): _____ pH or pH range: _____

BOD (range): _____

Hazard(s): ☐ Flammable ☐ Corrosive ☐ Toxic ☐ Other: _____

Answer all questions above as completely as possible. Attach additional pages as necessary. Contact EH&S at 2-7163 for assistance.

Send completed forms to EH&S for processing. E-mail stomren@tricity.wsu.edu or deliver through campus mail.

WSU Tri-Cities Discharge Approval Application Instructions

V 1.0, 3-28-13

1. **Submitted by**: Enter the name of the person submitting the application. This should be the person primarily responsible for the generation/disposal of the waste.
2. **Building & Room**: Enter the building name and room number where the waste is generated and disposed.
3. **Location of Drain**: Describe the drain where the waste will be discharged (for example, sink at north end of center lab bench).

4. **Description of Waste**: Provide a complete description of the waste to be discharged, including expected products of any chemical or biological reactions associated with the process.
5. **Description of Process Generating Waste**: a short description of the procedure/equipment which produces the waste.
6. **Quantity of Waste to Discharge**: Approximate volume of waste to be discharged at one time.
7. **Frequency of discharge**: How often the volume from #6 will be discharged.
8. **List all constituents of the waste**: Identify all components of the waste (including water), and provide an estimated percentage of each of the identified components. Identify any constituents/reaction products which are expected but may not be quantified. Any of these constituents should also be included in the "Description of Waste", above.
9. **Does the waste contain undissolved solids**: Indicate whether solids are present in the waste, including any precipitate, sediment, plant material, etc.
10. **Does the waste contain biological material**: Indicate whether the waste includes any living material, including enzymes, proteins, bacteria, viruses, fungi, plant, animal, or human blood/tissue.
11. **Does the waste contain radioactive material**: Indicate whether the waste includes any radioactive isotopes above natural background levels
12. **Does the waste contain dye(s)**: Indicate whether any stains or dyes have been added to impart color to the waste.
13. **Does the waste contain any of the materials listed in Table 1:** Refer to Table 1 below, and indicate if any of these compounds are present in the waste to be discharged.
14. **Temperature and pH**: Indicate the approximate temperature and pH of the waste at the point of generation.
15. **Hazard(s)**: Indicate the primary hazard(s) of the waste at the point of generation. Flammable wastes include anything with closed cup flashpoint below 140 degrees F. Corrosive wastes include anything with a pH of 2 or less, or 12.5 or greater. Toxic wastes include anything with toxicities exceeding those in Table 2, below.

Table 1	
Arsenic	Molybdenum
Cadmium	Nickel
Chromium	Selenium
Copper	Silver
Lead	Zinc
Mercury	

Table 2	
Oral Rat LD_{50}	5,000 mg/kg or less
Dermal Rabbit LD_{50}	20,000 mg/kg or less
Inhalation Rat LC_{50} (1 hour or more)	200 mg/kg or less
Fish LC_{50} (24 hour or more)	100 mg/kg or less

APPENDIX C - LABELS

DANGEROUS WASTE

Hazard(s)
(check all that apply):

☐ Flammable

☐ Toxic

☐ Corrosive

☐ Other(describe):

CCR#: _____

Date Filled: _____

Generator: _____

Phone: _____

Constituent(s)	%

https://tricities.wsu.edu/documents/2019/01/dangerous-waste-label.pdf

For containers of 1 gallon total volume or more:

https://tricities.wsu.edu/documents/2019/01/dangerous-waste-label-for-containers-over-1-gallon.pdf

F: Glove Information and Links to Manufacturers Compatibility Charts

1. GLOVE USE IN LABORATORIES

a. No glove may be used as protection from all chemicals. A glove may protect against a specific chemical, but it may not protect the wearer from another. If a glove protects the wearer, it will not protect the wearer forever, as the glove material will deteriorate.

b. Different glove materials offer different kinds of protection. Determining what you need protection from (e.g. sharp edges, acids, pesticides, solvents) and the length of your exposure (e.g. splash only, 15 minutes to conduct an experiment, or complete submersion to wash a mechanical part) will allow you to determine which glove is the best for the task you are performing.

c. Factors to consider when choosing gloves:

   i. Chemical to be used: Consult the compatibility charts to ensure that the gloves will protect you.

   ii. Dexterity needed: The thicker the glove, typically the better the chemical protection, as the glove will be more resistant to physical damage, like tears and cracks, but it will harder be to handle and feel the work.

   iii. Extent of the protection required: Determine if a wrist length glove provides adequate protection, or will a glove that extends further up the arm be required.

   iv. Type of work to be done: gloves are specific to the task. Ensure the correct glove is chosen to avoid injuries. Examples: A nylon cryogenic glove will be damaged if a hot item is handled, where as a "hot mitt" will not protect the wearer when liquid nitrogen is used, as it may be too porous.

d. Examples of different types of gloves and their possible applications:

   i. Natural Rubber (latex) is inherently elastic and resilient, plus resists acids, alkalis, salts, and ketones. Natural rubber gloves are suited for food processing, electronics assembly, and laboratory chemical handling.

   ii. Neoprene a synthetic rubber developed as an oil-resistant substitute for natural rubber. It also resists a broad range of chemicals. Neoprene gloves are used in petrochemical, degreasing and refining applications, and when handling acids, caustics, and chemical washing.

   iii. Nitrile a synthetic rubber with superior puncture and abrasion resistance in addition to chemical protection. Nitrile gloves are suited for stripping and degreasing, as well as acid etching and chemical washing.

   iv. Polyvinyl chloride or vinyl (PVC) is a plastic material that resists acids and alcohols, but not petroleum products. Vinyl gloves are used for intricate assembly work, food processing, laboratory, research, and pharmaceutical menu.

   v. Viton a specialty fluoroelastomer which has excellent resistance to oils, fuels, lubricants, most mineral acids, hydraulic fluids, and aliphatic and aeromatic hydrocarbons.

vi. Chlorinated polyethylene (CPE) has increased resistance to oil, ozone, heat, and chemicals. It also provides low permeability to gases.

vii. Kevlar is resistance to cutting and punctures from sharp materials such as cage wires or sheet metal edges. It does not provide chemical resistance by itself.

e. Rules for glove use in the labs:

i. Wear the correct gloves when needed.

ii. Wear gloves no longer than 2 hours.

iii. Wash hands once gloves have been removed.

iv. Disposable gloves must be discarded once removed. Do not save for future use.

v. Dispose of gloves into the proper container (biologically contaminated gloves go into a red biohazard bag while chemically contaminated gloves may not).

vi. Non-disposable/reusable gloves must be washed and dried, as needed, and then inspected for tears and holes prior to reuse.

vii. Remove gloves before touching personal items, such as phones, computers, pens and one's skin.

viii. Do not wear gloves out of the lab. If gloves are needed to transport anything, wear one glove to handle the transported item. The free hand is then used to touch door knobs, elevator buttons, etc. If you are wearing gloves to "protect your sample from you" and are in the hall, no one else understands this and will be concerned about the items you have contaminated with those gloves.

ix. If for any reason a glove fails, and chemicals come into contact with skin, consider it an exposure and seek medical attention.

2. GLOVE COMPATIBILITY CHARTS

The following are links to various glove suppliers. Available on each site are the glove compatibility or chemical resistance charts. It is important to note that all chemicals will not be listed on these charts nor may two similar gloves supplied by two separate manufacturers provide the same level of protection to a specific chemical. Therefore, it is necessary to consult the manufacturer's specific compatibility chart for the brand of gloves being used.

Understanding terms used in glove compatibility charts:

a. Breakthrough time: Time it takes for the chemical to travel through the glove material. This is only recorded at the detectable level on the inside surface of the glove.

b. Permeation Rate: Time it takes for the chemical to pass through the glove once breakthrough has occurred. This involves the absorption of the chemical into the glove material, migration of the chemical through the material, and then deabsorption once it is inside the glove.

c. Degradation rating: This is the physical change that will happen to the glove material as it is affected by the chemical. This includes, but is not limited to swelling, shrinking, hardening, cracking, etc. of the glove material.

d. Compatibility charts rating systems will vary by the manufacturer's design of their chart. Many use a color code, where red = bad, yellow = not recommended, green = good, or some such variation. A letter code may be used, such as E + excellent, G = Good, P = poor, NR = Not Recommended.

If you have any questions regarding glove selection or glove use contact EH&S at 372-7163 for further information.

Chemguide

www.chemrest.com

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf

http://www.vwrsp.com/programs/safety/images/disposable_gloves.pdf

http://www.microflex.com/Products/~/media/Files/Literature/Domestic%20Reference%20Materials/DOM_Reference_Chemical%20Resistance.ashx

http://www.polyco.co.uk/downloads/chemical_resistance_guide.pdf

http://www.guardian-mfg.com/

G: Laboratory Safety References

Materials for the Development of the Chemical Hygiene Plan:

American Chemical Society, *Safety in Academic Chemistry Laboratories*, 4th edition, 1985.

Fawcett, H.H. and W.S. Wood, *Safety and Accident Prevention in Chemical Operations*, 2nd edition, Wiley-Interscience, New York, 1982.

Flury, Patricia A., *Environmental Health and Safety in the Hospital Laboratory*, Charles C. Thomas Publisher, Springfield, IL, 1978.

Green, Michael E. and Amos Turk, *Safety in Working With Chemicals*, MacMillan Publishing Co., NY, 1978.

Kaufman, James A., *Laboratory Safety Guidelines,* Dow Chemical Co., Box 1713, Midland, MI 48640, 1977.

National Institute of Health, *NIH Guidelines for the Laboratory Use of Chemical Carcinogens*, NIH Pub. No. 81-2385, Government Printing Office, Washington, DC 20402, 1981.

National Research Council, *Prudent Practices for Disposal of Chemicals from Laboratories*, National Academy Press, Washington, DC, 1995.

National Research Council, *Prudent Practices for Handling Hazardous Chemicals in Laboratories*, National Academy Press, Washington, DC, 2010.

Renfrew, Malcom, ed., *Safety in the Chemical Laboratory*, J. Chem. Ed., Vol. IV, American Chemical Society, Easlon, PA, 1981.

Steere, Norman V., *Handbook of Laboratory Safety*, The Chemical Rubber Company, Cleveland, OH, 1971.

Steere, Norman V., ed., *Safety in the Chemical Laboratory*, J. Chem. Ed., American Chemical Society, Easlon, PA, 18042, Vol. I, 1967; Vol. II, 1971; Vol. III, 1974.

Young, Jay A., ed., *Improving Safety in the Chemical Laboratory*, John Wiley & Sons, Inc., New York, 1987.

HAZARDOUS SUBSTANCES INFORMATION:

American Conference of Governmental Industrial Hygienists, *Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes*, PO Box 1937 Cincinnati, OH 45201 (latest Edition).

Best Company, *Best Safety Directory*, Vols. I and II, Oldwick, NJ, 1981.

Bretherick, L., *Hazards in the Chemical Laboratory*, 3rd edition, Royal Society of Chemistry, London, 1979.

Code of Federal Regulations, 29CFR part 1910 subpart Z., U.S. Govt. Printing Office, Washington, DC 20402 (latest edition).

IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man, World Health Organization Publications Center, 49 Sheridan Avenue, Albany, New York 12210 (latest edition).

IARC Scientific Publications Series, Oxford University Press, New York (latest edition).

The Merck Index: An Encyclopedia of Chemicals and Drugs, Merck and Company Inc., Rahway, NJ, 1976 (or latest edition).

National Toxicology Program, U.S. Department of Health and Human Services, *Annual Report on Carcinogens*, Public Health Service, U.S. Govt. Printing Office, Washington, DC, (latest edition).

NIOSH/OSHA Pocket Guide to Chemical Hazards, NIOSH Pub. No. 85-114, U.S. Govt. Printing Office, Washington, DC, 1985 (or latest edition).

Occupational Health Guidelines, NIOSH Pub. No. 81-123, U.S. Govt. Printing Office, Washington, DC, 1981.

Patty, F. A., *Industrial Hygiene and Toxicology*, John Wiles & Sons, Inc., New York, NY, (five volumes).

Proctor, N., James P. Hughes, and Michael L. Fischman, *Chemical Hazards of the Workplace*, J.B. Lippincott Co., New York, 2nd Edition, 1988.

Registry of Toxic Effects of Chemical Substances, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Revised Annually, for sale from Superintendent of Documents U.S. Govt. Printing Office, Washington, DC 20402.

Sax, N.I., *Dangerous Properties of Industrial Materials*, 5th Edition, Van Nostrand Reinhold, NY, 1979.

Shepard, Thomas H., *Catalog of Teratogenic Agents*, 6th Edition, Johns Hopkins University Press, Baltimore, 1989.

Sittig, Marshall, *Handbook of Toxic and Hazardous Chemicals*, Noyes Publications, Park Ridge, NJ, 1981.

INFORMATION ON VENTILATION:

American Conference of Governmental Industrial Hygienists, *Industrial Ventilation*, 16th Edition, Lansing, MI, 1980.

American National Standards Institute Inc., *American National Standards Fundamentals Governing the Design and Operation of Local Exhaust Systems*, ANSI Z 9.2-1979, American National Standards Institute, NY, 1979.

Imad, A. P. and C. L. Watson, "Ventilation Index: An Easy Way to Decide About Hazardous Liquids", *Professional Safety*, pp. 15-18. April 1980.

National Fire Protection Association, *Fire Protection for Laboratories Using Chemicals*, NFPA-45, 1982.

National Fire Protection Association, *Safety Standard for Laboratories in Health Related Institutions*, NFPA-56c, 1980.

Fire Protection Guide on Hazardous Materials, 7th Edition, National Fire Protection Association, Batterymarch Park, Quincy, MA 02269, 1978.

Scientific Apparatus Makers Association (SAMA), *Standards for Laboratory Fume Hoods*, SAMA LF7, 1101 16th Street, NW., Washington, DC 20036, 1980.

INFORMATION ON AVAILABILITY OF REFERENCED MATERIAL:

American National Standards Institute (ANSI), 1430 Broadway, New York, NY 10018.

American Society for Testing and Materials (ASTM), 1926 Race Street, Philadelphia, PA 19103.

H: Infectious and Biohazardous Waste Disposal

Information about biohazardous waste disposal can be found in the Safety Policies and Procedures Manual section S4.24.

I: Sharps Disposal

Information about sharps disposal can be found in the Safety Policies and Procedures Manual section S4.25.

J: Radioactive Waste Disposal

Information about radioactive waste disposal can be found in the Safety Policies and Procedures Manual section S9.00

K: Carcinogens

In order to provide the most current data available the following links are provided to the International Agency for Research on Cancer (IARC) and the National Toxicology Program (NTP) Report on Carcinogens (RoC):

IARC

NTP RoC 11th edition

Further assistance with determining the carcinogenicity of a substance can be obtained by contacting EH&S at 372-7163.

L: Reproductive Toxins

The OSHA Laboratory Standard defines a reproductive toxin as a chemical "which affects the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis)".

A number of reproductive toxins are chronic toxins that cause damage after repeated or long duration exposures and can have long latency periods. Women of childbearing potential should be especially careful when handling reproductive toxins. Pregnant women and women intending to become pregnant should seek the advice of their physician or WSU Health Services before working with known or suspected reproductive toxins.

More information on reproductive toxins, including numerous useful web links, can be found on the OSHA Safety and Health Topics for Reproductive Hazards webpage.

The State of California has developed an extensive list of Reproductive Toxins Known to the State of California through Prop 65. Please note, this list is being provided as additional information and is not legally mandated by Washington State. Further assistance with determining if a chemical is a reproductive toxin can be obtained by contacting EH&S at 372-7163.

M: Standard Operating Procedure Template

STANDARD OPERATING PROCEDURE (SOP)

Procedure No.:		**Revision:**		**Effective Date:**	
Title:				**Page Count:**	
Work Location:					
Procedure Review Cycle:	☐ Annual ☐ Other (cannot be less than annual):				

Summary:
This Standard Operating Procedure (SOP) describes the Standard operation of the Enter name of process

located/installed in: Enter location of process

Identified Hazards (X = applies)**:**

☐ Hazardous Environment ☐ Physical Hazards ☐ Radiological

☐ Hazardous Materials ☐ Other [state hazard]: _____

Maximum Relative Hazard Index (from Section 6):

Role	Name	Signature	Date
Procedure Preparation and Reviewer Concurrence			
Author			
Peer Reviewer			
Principal Investigator			
Affected Functions/Organizations and Subject Matter Expert Concurrence			
☐ Laboratory Manager			
☐ Unit Safety Committee Chair			
☐ Other:_____			
Procedure Approval note: approval must be documented from one of the following sources which may be campus specific, contact your department administration and/or EH&S for additional information.			
Department Chair			
Environmental Health & Safety			

This procedure is approved to be performed as indicated below. Violations will result in suspension of laboratory access privileges.

☐	This procedure may **not** be performed after hours. It can only be conducted during regular business hours (Monday-Friday, 7AM-5PM.
☐	This procedure may be performed after hours only when a second individual is present in the laboratory.
☐	Other:

CHANGE HISTORY

Revision	Effective Date	Description of Change

1.0 PURPOSE AND APPLICABILITY

This SOP describes the Standard operation of the Enter name of process located in the Enter location of process facility.

Brief description of the process (1-2 sentences):

Restrictions (Operator qualifications, training/location requirements

This SOP has been developed to supplement the requirements of the department, college, and university. The equipment-specific requirements described in this SOP apply *in addition to* all relevant WSU requirements.

2.0 RESPONSIBILITIES

Staff with responsibilities for implementing this procedure:

Principal Investigator: _____

Project Manager: _____

Operator (of the equipment/system): _____

Laboratory Coordinator or Manager: _____

3.0 DEFINITIONS

Operator: The staff member who has been trained to perform the work described in this SOP.

Principal Investigator: The faculty member responsible for the research project and possibly also the laboratory facility where the research is being performed.

Project Manager: The student, research assistant, staff, or faculty member conducting the research work identified in Section 1.0.

Laboratory Coordinator/Manager : Individual other than the PI who is responsible for overseeing the laboratory facility where the research is being performed (where applicable).

4.0 ACRONYMS AND ABBREVIATIONS

CHP	Chemical Hygiene Plan
DOSH	Department of Occupational Safety and Health
EHS	Environmental Health and Safety
LSM	Lab Safety Manual
OSHA	Occupational Safety and Health Administration
PPE	personal protective equipment
PI	Principal Investigator
R&D	research and development
RHI	Relative Hazard Index
SOP	Standard Operating Procedure

5.0 PROCESS/EQUIPMENT OVERVIEW

5.1 Process Overview

Describe the chemistry involved and provide an overview of the operating conditions/parameters. This information allows SOP users to see a concise summary of the process and key operating conditions/parameters near the beginning of the SOP.

Describe the chemistry involved:

Identify operating conditions per the SOP:

Parameter	**Experimental Operating Range**	**Equipment Maximum rating**
Temperature		
Pressure		
Product Flow Rate		
Liquids		
Gases		
Solids		

Identify all feed streams, and their associated flow rate (attach separate page if needed):

Feed Stream description	Flow rate

List all materials and supplies required for this process:

Equipment	Materials	Chemicals

5.2 Facility Description

Enter location of process is constructed/equipped with the following:

Equipment	Yes/No	Number/Capacity/Type
Laboratory Benches	☐Yes ☐No	
Chemical Fume Hoods	☐Yes ☐No	
Flammable Storage Cabinets	☐Yes ☐No	
Corrosive Storage Cabinets	☐Yes ☐No	
Other Storage Cabinets	☐Yes ☐No	
Gas Cylinder Storage (indicate type of storage)	☐Yes ☐No	
Fire suppression equipment (indicate type)	☐Yes ☐No	
Gas detection equipment	☐Yes ☐No	
Emergency Shower/eyewash	☐Yes ☐No	
Other (specify):		
Other (specify):		

5.3 Description of experimental Equipment/Systems

Describe the equipment, systems, and processes used in this procedure in sufficient detail to be meaningful in the context of the SOP and the intended use of the procedure (pictures are helpful). Attach additional page(s) as necessary.

Equipment/System	Function in this Process

6.0 HAZARD IDENTIFICATION

Identify and describe the hazards associated with the equipment, its operations, the location, the facility, etc. Describe precautions and limitations to mitigate risk to staff, the equipment, the facility, the public, and the environment. Several types of common hazards are identified below.

6.1 Chemical Hazards

List all chemicals used for this process, including concentration and quantity. Also list any microorganisms, bodily tissues/fluids, and/or radionuclides Attach additional page(s) as necessary.

Chemical	Concentration	Quantity

Indicate all hazard(s) associated with the chemicals identified above

☐ Irritant	☐Carcinogen	☐Corrosive	☐Pyrophoric
☐ Sensitizer	☐Reproductive Hazard	☐Explosive	☐Water Reactive
☐ Toxic	☐Respiratory Hazard	☐Flammable	☐Self-Reactive
☐ Poison		☐Oxidizer	☐Peroxide Former
☐Target Organ Hazard (specify organ):		☐Other Hazard (specify):	

6.1.1 Chemical Process Hazard Evaluation

Identify procedural elements where there is increased risk associated with the chemical hazards identified above, as a direct result of that procedural element (e.g. flammable gases potentially introduced to the atmosphere, potential hazardous reaction byproducts etc.

6.2 Physical Hazards & RHI

Describe the hazards and precautions associated with use of the chemicals, equipment, systems, or processes covered by the SOP. If no hazards exist, include a statement to this effect. Check all that apply.

Hazard	Check if present
Fire Hazards	☐
Elevated Temperatures	☐
Cryogenic/Low Temp	☐
Compressed Gases	☐
Pressure or Vacuum	☐
Biological	☐
Radiation	☐
Laser	☐
UV light	☐
Electrical	☐
Moving Parts	☐
Tools (hand/power)	☐
Noise/Vibration	☐
Sharps	☐
Other (Describe:)	☐

Provide details regarding each physical hazard here:

6.3 Hazard Control Summary

Indicate what control measures will be implemented to mitigate hazards identified in Sections 6.1 and 6.2 above (e.g. use of irritants will be confined to a fume hood, personnel will be wearing nitrile gloves and safety glasses).

Controls must be emplaced using engineering controls first, administrative controls second, and PPE only as a last resort. PPE selection must consider manufacturer data on chemical compatibility of materials.

Hazard Control Summary Table

Engineering Controls		
☐Chemical Fume Hood	☐ Biological Safety Cabinet	☐ Barrier (machine guards, blast shield, etc.)
☐ Other:		
Administrative Controls		
Describe policies, procedures, training, etc. which will administratively mitigate identified hazard(s):		
PPE:		
☐ Safety Glasses	☐ Splash Goggles	☐ Face Shield
☐ Lab Coat	☐ Other skin protection (apron, gauntlets, etc. – specify):	
☐ Dust mask	☐ Air-Purifying Respirator	☐ Supplied Air
☐ Gloves (specify type):		

Describe additional control measures here:

Chemical Hazards

(**Note: controls may be chemical specific or grouped per chemical hazard class as appropriate)**

Chemical/Hazard	**Engineering Controls**	**Administrative Controls**	**PPE**

Physical Hazards

Hazard	**Engineering Controls**	**Administrative Controls**	**PPE**

6.4 Hazard Assessment

For each hazard, indicate the potential severity as determined with only intrinsic controls (e.g. engineering), the probability as determined with all controls (e.g. a user applies a strap to a compressed gas cylinder), and the resulting relative hazard index as looked up from the following matrix. Use the risk matrix in this section to assign a Relative Hazard Index, and enter this value on the SOP cover sheet

Probability

- *Frequent*: Likely to occur repeatedly
- *Probable*: Likely to occur multiple but infrequent times
- *Occasional*: likely to occur at some time
- *Remote*: Possible, but not likely to occur
- *Improbable*: Very unlikely; can reasonably assume it will not occur

Severity

- *Catastrophic*: Death, permanent disability; system or facility loss; lasting public health or environmental impact
- *Severe*: Serious injury; temporary disability; subsystem loss or facility damage; temporary public health or environmental impact
- *Moderate*: Medical treatment; lost work days; minor facility damage; external reporting cleanup requirements
- *Minor*: First aid only; negligible or slight facility damage; routine cleanup

Risk Matrix for Determining Relative Hazard Index (RHI)		**Potential Severity of Hazard**			
		Catastrophic	**Severe**	**Moderate**	**Minor**
Likelihood of Occurrence or Exposure	**Frequent**	Critical RHI = 4	Critical RHI = 4	Serious RHI = 3	Medium RHI = 2
	Probable	Critical RHI = 4	Critical RHI = 4	Serious RHI = 3	Medium RHI = 2
	Occasional	Critical RHI = 4	Serious RHI = 3	Medium RHI = 2	Low RHI = 1
	Remote	Serious RHI = 3	Medium RHI = 2	Medium RHI = 2	Low RHI = 1
	Improbable	Medium RHI = 2	Low RHI = 1	Low RHI = 1	Minimal RHI = 0

6.4.1 Hazard RHI

For each chemical and physical hazard identified in Sections 6.1 and 6.2, assign a Relative Hazard Index based on:

- Conditions under which the object or material presenting the hazard is used
- Control measures identified in Section 6.3
- The hazard matrix in Section 6.4 above

6.4.1.1 Chemical Hazard RHI

For each hazard indicated in Section 6.1, assign a Relative Hazard Index score, as described in Section 6.4.

Hazard	RHI

6.4.1.2 Physical Hazard RHI

For each hazard indicated in Section 6.1, assign a Relative Hazard Index score, as described in Section 6.4.

Hazard	RHI

7.0 EMERGENCY RESPONSE

In the event of any life safety emergency, call 911,

then notify the Single Point of Contact (372-7234).

The Single Point of Contact emergency number (372-7234) is a monitored telephone line managed for the Safety needs of staff, students, and the general community in order to coordinate appropriate responses and actions for events. The Single Point of Contact will notify other required personnel.

7.1 General Emergency Procedures

Emergency information for the Enter location of process facility is found in the WSU Emergency Response Plan. It identifies:

- locations of fire alarm pull boxes and fire extinguishers
- locations of eyewash stations and Safety showers
- other items related to emergency responses and Safety.

7.2 Response to Process-Specific Alarms

Alarm	Response

7.3 Decontamination Procedures

Describe decontamination procedures for the chemicals used in the process. These procedures may be discussed in chemical specific SOPs attached to this document and referenced in this section

7.4 Accidental Release response

7.4.1 Minor Spill (as defined by Lab Safety Manual, Section II.I) Identify minor spills that will not be cleaned up per associated hazards if present.

7.4.2 Major Spill (any mercury spill, any release not defined as “minor”, any release which impacts a floor/sink drain)

7.5 Accidental Exposure / First Aid Response

7.5.1 Eye Contact

7.5.2 Skin Contact

7.5.3 Inhalation

7.5.4 Ingestion/Injection

8.0 GENERAL WORK PRACTICES

8.1 Training and Qualification

Training and qualification requirements for Enter name of process operators are based on a combination of system knowledge, procedure performance, and demonstrated practical skills.

Describe any ***specific*** requirements that an operator must meet before performing the procedure:

9.0 CONFIGURATION MANAGEMENT

During operation and maintenance of the Enter name of process system, changes to the equipment configuration may be required (e.g., to replace a faulty component) or desired (e.g., to improve usability or performance). Likewise, changes to the documentation – corrections and refinements to the drawings, instructions, and other information in the SOP – may also be needed. As described in the following sections, certain types of hardware modifications and pen-and-ink changes to the SOP are allowed during operation and maintenance. In order to maintain configuration control of the hardware and SOP, only authorized staff are allowed to make physical changes to the equipment or pen-and-ink changes to the SOP. All changes must be approved by the appropriate parties (identified below) before implementation, and all changes must be documented.

9.1 Changes to the Equipment Configuration

A trained and qualified operator may **propose** changes to the physical configuration of the [equipment or system name]. All changes – both major and minor, as defined below – to the physical configuration must be documented and approved (in writing) by the PI. Changes that result in a discrepancy between the actual physical configuration of the equipment or system and the latest documented, approved configuration must be incorporated into updated documentation of the approved configuration (e.g., P&IDs, system description), and subjected to a complete review.

9.1.1 Minor Equipment Configuration Change

A minor equipment configuration change is a change that does not impact the operation of the equipment or degrade its Safety status. For example, replacing a faulty component with an identical one during maintenance could be considered minor equipment configuration change. As a rule, minor equipment configuration changes should not result in a physical discrepancy between the proposed equipment configuration and the latest documented, approved configuration.

Note: Replacement of an as-built equipment component with a similar – but not identical – component will constitute a major equipment configuration change unless use of the replacement component has previously been approved and documented.

A minor equipment configuration change can be implemented after review and written approval by the PI. Approved changes must be adequately documented. Additional required information includes the date and time when the changes were made and the initials of the individuals approving the change. Incorporate approved changes into an updated version of the SOP and associated documents.

9.1.2 Major Equipment Configuration Change

A major equipment configuration change is any equipment configuration change that directly impacts the operation of the equipment or degrades its Safety status. Any equipment configuration change that does not meet the above definition of "minor equipment configuration change" is considered a major equipment configuration change. Changes of this type include those that will result in an actual physical discrepancy between the unit and the latest documented, approved configuration, as well as non-identical component changes (e.g., ball valves of different capacity or material of construction) that were not previously approved.

A major equipment configuration change must be considered a new process, and must be accompanied by completion of a new SOP, to be reviewed and approved by the Principal Investigator, Unit-level Safety Committee, EH&S, and may require approval from the Authority Having Jurisdiction (e.g. Fire Marshal and Facilities Services) before the change can be implemented.

9.2 Changes to the SOP

During operation and maintenance of the Enter name of process , staff may identify errors, additions, improvements, and other proposed SOP changes. As described in the following subsections, the nature and scope of the proposed change will determine the reviews and approvals required before the change can be implemented. All SOP changes approved for implementation – including red-line markups of

drawings, additions or deletions of process steps, modifications to the checklists, etc. – must be documented. At the end of the operation or maintenance campaign, incorporate SOP changes into a revision of the SOP.

Note: Changes made to the SOP must not result in a violation the Standard operating envelope of the system, or a weakening or elimination of any hazard controls.

9.2.1 Minor SOP Changes

A minor change is a change with limited scope and effect. The change is straightforward, readily understood, and does not materially affect the technical content of the document. Minor changes are often editorial in nature. The following items are considered minor changes:

- correction of grammar or spelling;
- renumbering sections or attachments that does not affect the chronological sequence of work or usability of the document;
- adding explanatory text to improve document clarity or usability (e.g., detailed instructions for a form, clarifying documentation requirements);
- updating organizational titles (if organization responsibilities are unchanged).

Note: A change in an organizational title accompanied by a change in responsibilities is <u>not</u> considered a minor change.

Minor changes require review and approval of the change by the PI.

9.2.2 Major SOP Changes

A major SOP change is any document change that doesn't meet the definition of a minor change.

Major changes require review and approval of the change by the Principal Investigator, Unit-level Safety Committee, EH&S, and possibly from the Authority Having Jurisdiction (e.g. Fire Marshal), and Facilities Services.. Management may specify additional required reviews

10.0 OPERATIONAL INSTRUCTIONS

Describe, using the amount of detail necessary to ensure Standard operation, the steps required to operate the equipment or system covered by the SOP. Refer to attachments, exhibits, diagrams, pictures, checklists, etc. as needed. For stepwise activities that should be acknowledged as performed or that will be performed multiple times, it's a good practice to describe those actions in one or more checklists. Divide actions and activities into logical groupings and address in separate sections and/or checklists. This improves SOP usability and makes it easier to maintain the SOP as changes are identified.

10.1 <u>Prerequisite Conditions (required as elements of all SOPs)</u>

The following prerequisite conditions must be verified for all procedures, before starting work:

- Ensure that at least one working phone is available that can call the Single Point of Contact phone number (372-7234) in case of emergency.
- Identify any conditions or restrictions regarding staffing requirements for Standard operation of the equipment or system e.g. equipment is calibrated per manufacturers recommendations, equipment change-out schedule is current and up to date, etc..
- Identify tests and activities that must be performed before operating the equipment or system, e.g., leak-checks, pressure checks, inspection of tubing, etc.
- Verify that the SOP being used is current.

10.2 Pre-Start Materials and Supplies

Identify specific materials and supplies which must be available before commencement of the process (such as compressed gases, sample containers, leak check meter, etc)

10.3 Pre-start Safety Checks

Identify specific operational conditions which must be satisfied before commencement of the process (such as leak testing, power supply deactivation, etc.). A pre-start checklist may be developed to meet this requirement, and included as an attachment to this SOP.

Check Item	Description/Parameter to verify

10.4 Operation of Enter name of process installed in the Enter location of process facility.

Provide detailed instructions for operating the equipment or system covered by the SOP. Describe the steps required to operate the equipment or system covered by the SOP. Refer to attachments, exhibits, checklists, etc. as needed. Use multiple subsections, numbered and bulleted lists, etc. For stepwise activities that should be acknowledged as performed or that will be performed multiple times, it's a good practice to describe those actions in one or more checklists. Divide actions and activities into logical groupings and address in separate sections and/or checklists. The operation steps should be detailed enough so an untrained user could figure out the proper operation on their own. This improves SOP usability and makes it easier to maintain the SOP as changes are identified.

Use the following page and attach additional pages as necessary to completely describe the process.

11.0 OFF-NORMAL CONDITIONS

Identify operational parameters to be evaluated to ensure process safety. This may include verification of conditions such as temperature or pressure range, stability of materials, proper motion, sound/vibration, etc.)

Off-normal events that may occur during the execution of this SOP include:

- Power interruption
- Emergency shutdown due to an alarm
- Start-up after an emergency shutdown
- Other conditions specific to the process (specify below)
- For each off-normal condition identified below (e.g. over temperature or over pressure condition), consider the hazards identified in Sections 6.1 and 6.2 for the procedural element under review. If the controls identified in Section 6.3 are not sufficient to support the response, add additional controls to Section 6.3.

Condition	Response
Power Interruption	
Building Fire Alarm	
Gas Detection Alarm	

11.1 Conditions requiring Emergency Shutdown

Describe the procedure for conducting an emergency shutdown of the process:

11.2 Start-up After an Emergency Shutdown

Describe the procedure for re-starting after an emergency shutdown of the process:

12.0WASTE DISPOSAL

Describe each chemical waste stream that this procedure will generate:

Description	Contents	Quantity/Frequency

All wastes shall be collected in a sealable, airtight ☐ Glass ☐ Plastic Container.

Waste containers shall be located inside a ☐ polyethylene secondary containment bin ☐ chemical storage cabinet

The container(s) shall be stored away from

When containers are full or no longer being used, generators must complete a chemical collection request, ensure the containers are properly labeled and marked with a date filled, and place them in the appropriate storage area for collection by EH&S.

13.0MAINTENANCE

Maintenance checks include the following:

Item	Frequency

14.0RECORDS

Records that are generated and maintained as a result of this procedure include:

- Master Hardcopy SOP containing pen-and-ink markups
- Completed checklists for the pre-start safety checks and operational activities performed
- Operations Log

Identify where the records will be stored or maintained:

15.0REFERENCES

List other documents referenced in this SOP or which were used in its development. Include items such as:

1. Emergency Response Plan for the Enter location of process facility.
2. Other relevant reference(s), such as an interfacing SOP, planning documents, manufacturer's user manual, etc.

16.0TRAINING ACKNOWLEDGEMENT

The following table identifies individuals who have been trained to this SOP. Printed names and dated signatures of both the Trainer and the Trainee are required for each row used.

Date	Trainer		Trainee	
	Printed Name	Signature	Printed Name	Signature

17.0EXHIBITS

Exhibit #	Title
Exhibit A	
Exhibit B	
Exhibit C	
Exhibit D	

N: Procedures for Maintenance & Construction Activities in Laboratories

OPERATING PROCEDURES FOR PERFORMANCE OF MAINTENANCE & CONSTRUCTION ACTIVITIES IN LABORATORY FACILITIES

The performance of maintenance and construction activities in laboratory facilities creates special safety and research considerations.

These procedures help to ensure:

1. Facilities Operations personnel are protected from physical, chemical, biological and radioactive hazards by clearing / decontaminating the area ("Authorized Work Zone") before the maintenance / construction activities are conducted. If secondary measures must be taken because the PI was unable to decontaminate the area because of restrictions (drain traps, duct work, vacuum lines, etc.), Facilities Operations' Standard Operating Procedures will be followed to ensure personnel are protected. The secondary measures will only be used when the restrictions prevent the Principle Investigator (Laboratory Supervisor) from performing their responsibilities of clearing and decontaminating.
2. Research is not jeopardized by maintenance and construction activities by providing Facilities Operations personnel measures to follow before the work activities are conducted.
3. Maintenance and construction activities are conducted in an efficient manner by providing pertinent information (See Work Permit for Maintenance / Construction Activities in Laboratories) before the work activities are conducted.

Listed below are the primary steps to follow when Facilities Operations receives a work order to perform maintenance / construction activities in a laboratory. A detailed description is also provided for each primary step.

PRIMARY STEPS:

1. Facilities Operations contacts the PI / designee before performing maintenance / construction activities (work activities).
2. PI / designee completes "Work Permit" and prepares the "Authorized Work Zone" where Facilities Operations will be conducting maintenance / construction activities.
3. Facilities Operations discusses / reviews completed Work Permit with the PI / designee.
4. Facilities Operations signs and posts "Work Permit" and "CAUTION SIGN" at Entrance / Prepares for work activity.
5. Facilities Operation conducts the work activity.
6. Facilities Operation performs closeout of work activity.

DETAILED STEPS:

1. **Facilities Operations contacts the PI or designee before performing work activity.**

   Procedures:

   a. Facilities Operations confirms information about where the work activity will be conducted (Building, Room Number, Location = Authorized Work Zone) and the

type of work activity to be performed, and provides work order number, date / time the work activities will be conducted and anticipated date/time work will be completed.

b. Facilities Operations advises laboratory staff if utilities are to be interrupted or shut-off (electricity, water, gas, general ventilation, local exhaust hood ventilation, etc.).

2. **PI / designee completes "Work Permit for Maintenance / Construction Activities in Laboratories" and prepares the "Authorized Work Zone" for work activities. The PI / designee's duties include:**

   Procedures:

   a. Identifying lab person (contact name (s) and phone number (s)) that will be immediately available to answer questions that may arise during Facilities Operations work activities.

   b. Transferring information provided by Facilities Operations (Step 1. a.) to Work Permit.

   c. Contacting EHS (372-7163) if radioactive hazards are present in "Authorized Work Zone". EHS will work with the Radiation Safety Office (RSO) to ensure that satisfactory decontamination procedures have been completed and conduct a confirming survey. (If applicable, PI / designee attaches completed survey to work permit.)

   d. Advising Facilities Operations (See Step 3. b.) of the types of hazards (Physical, Chemical, Biological, Radioactive, etc.) within the laboratory. Facilities Operations can obtain additional information by requesting the PI's Laboratory Standard Operating Procedures for the laboratory where the work activities will be conducted, Safety Data Sheets, Laboratory Safety Manual, BioSafety Manual (if applicable), etc.)

   e. Following Standard Operating Procedures in Laboratory Safety Manual and / or Biosafety Manual for decontamination measures. Decontaminate all equipment / areas ("Authorized Work Zone") where work activities are to be conducted (e.g., fume cupboards, refrigerators, under benches and sinks, laboratory equipment, etc.). Where maintenance is to be performed, any infectious agents or chemicals must be removed and stored in a safe place until work is completed. If applicable, after decontamination procedures have been performed, the spaces under cupboards and benches will be left open to ventilate.

   f. Specifying date and time the hazards were decontaminated.

   g. Ensuring the "Authorized Work Zone" is cleared of laboratory equipment; Facilities Operations may need room to place their tools and ladder.

      NOTE: Facilities Operations will not remove, alter, or move laboratory equipment or hazardous materials.

   h. Providing safety recommendations, if applicable: Personal Protective Equipment (PPE) to be worn by Facilities Operations while performing work activities. The PPE

may be recommended as a secondary measure and should not be used to replace decontamination procedures.

i. Suspending research in the "Authorized Work Zone". Once the "Authorized Work Zone" has been decontaminated, PI / designee will secure and discontinue work in the "Authorized Work Zone" until Facilities Operations completes their assignment. In addition to the "CAUTION SIGN" and "Work Permit" (See Step 4.) posted at the entrance, the PI will inform all authorized laboratory staff / students that work / research will be discontinued in the "Authorized Work Zone" until the work activities have been completed and the PI has been notified.

j. Signing the work permit and authorizing access to the work area. Providing completed Work Permit to Facilities Operations.

NOTE: If Facilities Operations is satisfied the "Authorized Work Zone" is cleared and decontaminated, Facilities Operations will sign and post the work permit at the entrance and keep a completed copy of work permit for their records. (See Step 4.)

k. Notifying Facilities Operations if research activities resume in the "Authorized Work Zone" before maintenance / construction activities are completed. If research resumes before the activities are completed, the PI / designee will decontaminate the area and complete a new work permit before Facilities Operations can resume their duties.

3. **Facilities Operations meets with PI/ designee and discusses / reviews completed Work Permit.**

Procedures:

a. Facilities Operations meets with PI / designee. Facilities Operations and PI /designee discusses / reviews work permit and "Authorized Work Zone". Maintenance and construction work might involve activities that create loud noises, dusts, chemical vapors (e.g., paints, adhesives, sealants and solvents) and fumes (e.g., welding and torch cutting). Facilities Operations informs the PI or designee of these potential inconveniences/hazards that will be created during the work activities. Any questions, comments, concerns, or clarifications will be addressed at this time.

b. If satisfied with completed work permit and conditions of "Authorized Work Zone", Facilities Operations will proceed to Step 4. (Facilities Operations signs and posts work permit and Caution Sign at Entrance / Prepares for work activity).

c. If after meeting with PI / designee, Facilities Operations is not satisfied with the completed work permit or conditions of "Authorized Work Zone", Facilities Operations will contact Environmental Health and Safety (EH&S) at 372-7163. EH&S will review work permit / "Authorized Work Zone" and advise. If Facilities Operations is satisfied, they will proceed to Step 4.

d. If PI / designee is not able to decontaminate (e.g., ductwork, drain traps, vacuum lines and pumps, etc.), Facilities Operations will follow standard operating procedures for the work activity. Call EH&S, if consultation is needed or a standard operating procedure is not available. After meeting with EH&S, if satisfied, proceed to Step 4.

4. **Facilities Operations signs and posts work permit and Caution Sign at Entrance / Prepares for work activity.**

Procedures:

a. Facilities Operations assembles needed tools and personal protective equipment if applicable.

b. Facilities Operations confirms date(s) and time(s) of work activity with PI/designee.

c. Facilities Operations Signs Work Permit. Facilities Operations posts completed "Work Permit" and "CAUTION SIGN" at entrance notifying personnel that "Maintenance / Construction Activities are in Progress". The sign will provide date research is suspended in the "Authorized Work Zone" and contact numbers for PI / designee and Facilities Operations.

5. **Facilities Operations Conducts Work Activity**

Procedures:

a. Facilities Operations proceeds with the work activities in accordance with Work Permit. While conducting work activities, Facilities Operations:

i. Follows information on work permit,

ii. Follows Standard Operating Procedures, if applicable (e.g., personal protective equipment, emergency procedures, etc.),

iii. Does not eat or drink in laboratory area,

iv. Does not enter unauthorized areas, and

v. Looks for and obeys any special instructions (e.g., Warning / Caution Signs, etc.).

b. Facilities Operations contacts PI / Designee if work is interrupted and informs them on the status of the activity. Upon return, Facilities Operations contacts the PI / Designee to determine if the status of the "Authorized Work Zone" has changed. If research had resumed in the "Authorized Work Zone", the PI / designee must return to Step 2 - PI / designee completes "Work Permit for Maintenance / Construction Activities in Laboratories" and prepares the area for work activities.

Note: No maintenance / construction activities should be carried out until the above provisions have been complied with.

6. **Facilities Operations closes out work activities.**

Procedures:

a. Facilities Operations notifies laboratory staff of completion of work activities and date(s) and time(s) laboratory services will be restored to operation.

b. Facilities Operations removes "Work Permit" and CAUTION SIGN ("Maintenance / Construction Activities are in Progress") from entrance.

c. Facilities Operations retains a copy of the completed work permit.

O: Work Permit for Maintenance/Construction in Laboratories

http://ehs.wsu.edu/labsafety/manual/AppendixO.pdf

P: Laser Safety Information

Reserved. WSU Tri-Cities does not currently have laser labs.

Q: Laser Safety Program Template

Reserved. WSU Tri-Cities does not currently have laser labs.

R: Your Laboratory Specific Chemical Hygiene Plan

Your Laboratory Specific Chemical Hygiene Plan

Washington Administrative Code (WAC) 296-828, Hazardous Chemicals in Labs, AKA the "Lab standard" requires each laboratory to implement a written Chemical Hygiene Plan (CHP) and designate a "Chemical Hygiene Officer" responsible for ensuring that the plan is followed.

WAC 296-828 outlines the requirements of the CHP for all laboratories that use hazardous chemicals. Washington State University Environmental Health and Safety has developed the Laboratory Safety Manual (LSM) and this Chemical Hygiene Plan Guide to assist you with developing a Chemical Hygiene Plan specific to your laboratory (**SPPM 4.12 Chemical Hygiene Plan for Laboratories**).

In order to complete your Laboratory Chemical Hygiene Plan follow these steps.

1. Complete the pages in this Guide to provide laboratory specific information including designating individuals responsible for specific activities.

2. Review and transfer any current information or resources from your previous CHP to the current version.

3. Ensure that there is easy access to the most current version of WSU's Laboratory Safety Manual and your CHP for everyone that works or enters the laboratory. This can be done by:

- Bookmarking the electronic version of the LSM on the EH&S website **https://tricities.wsu.edu/documents/2017/10/wsutc-laboratory-safety-manual.pdf** and use the CHP Guide provided here in an electronic format to create your lab-specific CHP.

- Alternatively, add a paper copy of the completed CHP Guide to the front of your designated Laboratory Safety Manual binder that contains the most current print out of the electronic version and ensure it is in an easily identified location.

4. Familiarize yourself with the Table of Contents of the LSM. It has been developed to assist you to identify potential hazards that may need to be addressed. It also provides information that will help your laboratory run safely and efficiently.

5. Training is required and must be documented on your laboratory specific procedures including your CHP. An additional page is added to this guide to assist you with documenting that the training has been completed.

If you have any questions regarding chemicals, safety or your initial laboratory set up contact Scott Tomren, 372-7163.

Laboratory Chemical Hygiene Plan
(CHP)

Building: _____

Room(s): _____

Principal Investigator (name): _____

Implementation Date: _____

Annual Review Date(s): _____

_____

_____

_____

_____

Responsibility for Chemical Hygiene and Safety

Laboratory safety responsibilities are outlined in Washington State University's Laboratory Safety Manual section I.D. Complete the following information for your Laboratory Specific Chemical Hygiene Plan (CHP).

Each CHP must designate a Chemical Hygiene Officer – the person who is primarily responsible for preparing and implementing the CHP. Typically, this is the Principal Investigator or lab supervisor.

The CHP must also identify the area it covers. It may be applied to a single room or a portion of a room, or it may apply to multiple adjoining rooms as long as the CHP is accessible to all laboratory personnel at all times.

Chemical Hygiene Officer: _____

Describe the area covered by this plan (room number(s) or location within a room):

Describe the typical activities and procedures performed in this area. Specify any activities which require prior departmental approval:

Chemical Purchasing, Storage, and Dispensing

See Laboratory Safety Manual section II.B for further information.

Purchasing

Authorization to purchase chemicals should be limited to select individuals, in order to prevent duplication of orders and accumulation of excess chemicals.

Identify the individual(s) authorized to purchase chemicals for the laboratory:

_____ _____

List any chemical(s) that require prior departmental and/or laboratory approval for purchase, due to specialized hazards, storage, or use requirements:

All chemicals used in WSU Tri-Cities laboratories will be delivered to the Copy/Mail Center, West Building Room 127

Inventory & Storage

Develop and implement an inventory control system to determine which chemicals are necessary to laboratory operation and which are not, reducing inventories of unneeded chemicals.

Update chemical inventories when new chemicals are procured, when chemical stocks are consumed, or old chemicals are removed from the laboratory. Chemical inventories must be updated at least annually, and a copy provided to WSUTC EH&S.

Describe the location of your physical and/or digital chemical inventory system:

Each laboratory shall designate an individual responsible for:

1. Ensuring chemicals delivered include adequate identifying labels (identity, hazard information, and manufacturer), and are not leaking
2. Maintaining a complete inventory of chemicals in the laboratory, including identification of compounds which require special controls or surveillance (i.e., DHS Chemicals of Interest, Select Agents, Carcinogens, Pyrophorics, or peroxide formers).

3. Ensuring proper storage of chemicals, including concern for hazard, compatibility, and secondary containment.

Identify the individual(s) responsible for maintaining the chemical inventory and chemical storage for this Laboratory:

_____ _____

Dispensing

Chemicals shall be delivered to, dispensed from, and used within the same laboratory. No chemicals will be stored in another location and dispensed or picked up for use in the laboratory, without prior arrangement and approval by EHS**.**

Secondary Labeling System

*WSU's **Laboratory Safety Manual section II.H** provides information on labeling requirements.*

The primary labeling for chemical containers is the original manufacturers' labeling system. It shall be readable (in English), maintained in good condition, and replaced if it becomes missing/damaged/unreadable.

Secondary containers filled from the primary chemical container require labels (in English) so that occupants will be aware of the contents of the container. In the event of an emergency, such as a chemical spill, clear legible labels will enable responders to take action more efficiently.

Secondary containers are required to be labeled with:

- chemical or common name
- hazard warning (HMIS system or equivalent)

Alternative labeling systems are allowed if labeling the container itself is impractical or unreasonable (e.g. containers too small and numerous, such as test tubes/vials). Alternative methods include wire tags, labels attached to test tube racks, walls, shelves, etc. Abbreviations may be used if a poster with the full chemical name identifying chemical hazards associated with the abbreviation is prominently displayed.

If an alternative method of labeling (tags, shelf labels, etc.) is used please describe it below:

Identify the individual(s) responsible for ensure all labeling is completed in this laboratory:

Name	Title
Name	Title
Name	Title

Safety Data Sheets (SDSs)

Information on Safety Data Sheets is provided in WSU's Laboratory Safety Manual section II.M.

Safety Data Sheets are documents provided by chemical manufacturers describing the physical and health hazards and other information pertaining to hazardous chemicals (and trade name products) used in your laboratory. They must be accessible to all employees on all work shifts.

Describe where current SDSs can be found for the chemicals used in your laboratory, and identify the person responsible for obtaining and maintaining SDSs:.

Web address for Online SDSs (if applicable):

Location of hard copies of SDSs:
(building, room number, and description of binder)

- Hard copy SDSs are not required, though it is necessary all laboratory employees know where digital copies are maintained and how to access them at all times. Note: Simply indicating that SDSs are available from the manufacturer website is *not* permissible.
- If you produce chemicals in the laboratory for users outside the laboratory, an SDS for the chemical will need to be created per WAC 296-901-14014, **Safety Data Sheets**. Contact EH&S for assistance.

Name of person responsible for maintaining SDSs for this lab:

Name	Title

Standard Operating Procedures for Hazardous Substances

*WSU's **Laboratory Safety Manual section IV.C** provides direction on creating and documenting SOPs. EH&S makes **SOP Templates** available for use by WSU laboratories if needed.*

Standard Operating Procedures (SOPs) must be prepared for all procedures involving hazardous substances, defined as: *A chemical which is classified as posing one of the following hazardous effects: Acute toxicity (any route of exposure); skin corrosion or irritation; serious eye damage or eye irritation; respiratory or skin sensitization; germ cell mutagenicity; carcinogenicity; reproductive toxicity; specific target organ toxicity (single or repeated exposure); or aspiration hazard; or simple asphyxiant.* Laboratory specific procedures shall also be prepared identifying controls for physical hazards such as fire, explosion, over pressurization etc. if those hazard controls are not already identified in your Accident Prevention Program.

- SOPs are crucial in defining additional employee protection needed for select carcinogens, reproductive toxins, and chemicals with high degree of acute toxicity(formerly referred to as particularly hazardous substances). Additional protection includes exposure control areas, containment devices (fume hoods or glove boxes), and decontamination procedures.
- SOPs shall also include descriptions of circumstances when specific laboratory operation, activity, or procedure requires prior approval from the PI or their designated representative.
- SOPs for hazardous substances are considered part of the CHP and copies should be kept with the laboratory's CHP.

Describe where SOPs are stored:

Name of person responsible for developing and maintaining SOPs for this lab:

Name	Title

Chemical Spills

If there is a danger to life and health, or when a large spill has occurred, call 911

Employees can clean-up minor chemical spills ONLY when all of the following conditions are met:

- The chemical is known and the spill can be cleaned-up in ten minutes or less.
- Employees are trained to safely clean-up chemical spills.
- Employees can wear the same personal protective equipment that they wear during normal work activities.
- Appropriate clean-up supplies are readily accessible.
- The chemical does not have a Ceiling Limit listed in WAC 296-841 and it cannot create an Immediate Danger to Life and Health (IDLH) atmosphere. IDLH information can be found in the NIOSH Pocket Guide to Chemical Hazards.
- Clean-up materials are disposed of per SPPM 5.66

If ALL of these conditions are not met, evacuate the spill area and call 372-7234 for assistance.

Person(s) who have completed EHS' small spill cleanup training:

Name	Title
Name	Title
Name	Title

Mercury Spills

Employees cannot clean-up mercury spills. EH&S must respond to all mercury releases.

Recommended Spill Clean-Up Kit

Each laboratory should assemble a chemical spill clean-up kit consisting of:

- Personal protective equipment normally worn during routine work
- Absorbent pads
- One-gallon Ziploc bags
- Dust pan and brush
- Duct tape
- Five-gallon bucket with lid

The five-gallon bucket can be used to store spill clean-up materials and then can store contaminated items, such as gloves and absorbent pads, used during the clean-up. Once the spill is cleaned up the bucket must be closed and labeled as Dangerous Waste.

Location of Chemical Spill Kit: _____

Individual responsible for maintaining spill kit(s): _____

Regulated Hazardous Substances

*WSU's **Laboratory Safety Manual Appendix V.B** provides additional information on regulated hazardous substances that have specific rules.*

In addition to WAC 296-828, **Hazardous Chemicals in Laboratories**, some hazardous substances have their own individual rules which apply when using those substances in the workplace. If you use any of the substances listed in the table below, you should be familiar with the rule for that substance as they may contain additional provisions for employee exposure protection. Contact EH&S at 509-372-7163 for assistance.

Specified Washington State Regulated Hazardous Substances	
• Acrylonitrile • Arsenic (inorganic) • Asbestos • Benzene • Butadiene • Cadmium • Coke ovens • Cotton dust • 1,2-Dibromo-3-chloropropane • Ethylene oxide • Formaldehyde • Hexavalent chromium • Lead • Methylene chloride • Methylenedianiline • Thiram	• Vinyl chloride • Ionizing radiation • 4-Nitrobiphenyl • Alpha-Naphthylamine • 4,4'-Methylene bis (2-chloroaniline) • Methyl chloromethyl ether • 3,3'-Dichlorobenzidine (and its salts) • Bis-chloromethyl ether • Beta-Naphthylamine benzidine • 4-Aminodiphenyl • Ethyleneimine • Beta-Propiolactone • 2-Acetylaminofluorene • 4-Dimethylaminoazobenzene • N-Nitrosodimethylamine

Washington State Regulated Hazardous Chemical Classe	
• Listed or Specific Carcinogens • Select Carcinogens*	• Reproductive Toxins • Compounds with high acute toxicity

* Select Carcinogens include any compounds:
- regulated by DOSH as carcinogens
- Listed as "Known to be carcinogens" by the National Toxicity Program (NTP)
- Listed in Group IA, 2A, or 2B in IARC monographs, or
- Listed as "Reasonably anticipated to be carcinogens by the NTP

If this laboratory uses any of the chemicals listed on the previous page, please list them here:

Additional requirements and procedures are required for use of any of these compounds. Contact EHS for assistance.

Site Specific Ventilation Information

*WSU's **Laboratory Safety Manual section III.C** describes fume hood certification, general ventilation, and maintenance and repair requirements for WSU facilities.*

In order to protect employees and keep exposure levels below those in **WAC 296-841**, specific measures may need to be taken to ensure fume hoods and other protective equipment in your laboratory provide proper and adequate performance and are properly functioning.

Describe any additional ventilation requirements or usage in your laboratory (i.e. fume hood sashes must be left open at all times, snorkel procedures, clean benches procedures):

Diagram of Laboratory Layout

*WSU's **Laboratory Safety Manual section III.A** provides information on how to create a laboratory floor plan and provides an example. Additionally, EH&S can provide you with a scaled building plan section of your laboratory room(s) to help you create the floor plan in lieu of sketching it. Contact EH&S at 509-372-7163 for more information.*

Floor plans must indicate the location of safety equipment and other features such as emergency washing facilities, first aid kits, fume hoods, biosafety cabinets, flammable storage cabinets, refrigerators, local exhaust units, fire extinguisher, control areas and hazardous substance storage and use areas.

Employee Training

*WSU's **Laboratory Safety Manual section II.J** provides detailed information on employee training and the PI or Laboratory Supervisor's responsibilities.*

Describe the lab-specific training requirement(s), including content and frequency, which will ensure that employees are informed of information specific to the hazards associated with the employee's assignment and work area, use of hazardous substances, and details of the laboratory Chemical Hygiene Plan and Standard Operating Procedures.

Identify the person responsible for providing training for this laboratory:

Name	Title

All training must be documented upon completion, and records retained by the department.

S: Custodial Notice Forms

CAUTION

POTENTIAL HAZARD

UNKNOWN SPILL IN ROOM

ACCESS PROHIBITED

Date: _____ Time: _____

NOTICE OF IMPROPER DISPOSAL PRACTICES

WSU TRI-CITIES CUSTODIAL SERVICES

ATTENTION: LABORATORY PERSONNEL

YOUR WASTE WAS NOT COLLECTED BY THE CUSTODIAN FOR THE FOLLOWING REASON(S):

- ☐ A hazard warning label observed on or in the waste container:
  - ☐ Radioactive material label
  - ☐ Biohazard label
  - ☐ Dangerous Waste label
  - ☐ Other hazard warning:_____
- ☐ Trash contains the following improperly disposed material(s):
  - ☐ Sharps (e.g. needles), not in a Sharps Container
  - ☐ Glass, not in a glass disposal box
  - ☐ Capped and/or unrinsed chemical bottles
  - ☐ Unknown powder or free liquid
  - ☐ Blood or blood-soaked items
- ☐ Chemical odor from waste container
- ☐ Other:_____

Location of Problem: _____

Date & Time: _____

For instructions regarding proper waste disposal, refer to the WSU Tri-Cities Laboratory Safety Manual, WSU Safety Policies & Procedures manual, or contact EH&S at 372-7163.

Post this notice on laboratory entrance, and forward a copy to EH&S

T: Equipment Fact Sheets

Centrifuge Safety: High-Speed Hazards

Centrifuges

Centrifuges are important pieces of equipment. When used properly, they can perform well and for a long time. However, when abused, they become defective quickly and can create very real hazards.

Safe Centrifuge Use

It is essential that all centrifuges be used, cared for, and maintained in a safe manner. Possible damage from a centrifuge accident can include damage to the unit, the laboratory, and other lab equipment, as well as chemical spills and fires and injury to lab personnel.

To prevent centrifuge accidents:

- Familiarize yourself with the operating procedures written by the manufacturer of your centrifuge. Keep the manual near the unit for easy reference, and contact the manufacturer to replace a lost manual.
- Handle, load, clean and inspect rotors as recommended by the manufacturer.
- Always make sure that you have secured the lid to the rotor and the rotor to the centrifuge.
- Lids shall be closed at all times during operation. Never open a centrifuge until the rotor has stopped.
- Pay careful attention to the instructions for balancing your samples. Don't leave the centrifuge until full operating speed is attained and machine appears to be running safely without vibration.
- If vibration occurs, stop the centrifuge immediately and check load balances.
- Check the condition of tubes and bottles every time you use the centrifuge. Discard tubes that are cracked or worn.
- Use only the types of rotors that are specifically approved for use in a given centrifuge unit.
- With infectious/biologically hazardous material, wait 10 minutes after the rotor has stopped before opening the centrifuge. Allow aerosols to settle, then wipe the rotor and centrifuge interior thoroughly.
- Maintain the centrifuge in good condition. Broken door latches and other problems should always be repaired before any use of the centrifuge unit.

Care and Maintenance

- Read and follow the manufacturer's recommendations in the manual regarding cleaning, polishing, inspections and lubricating the o-rings.
- Clean all spills immediately and decontaminate the rotor after use with radioactive or biological materials
- Rotors and cups should be cleaned and disinfected after each use with <u>non-corrosive</u> cleaning solutions (mild detergent and distilled water is recommended).

- All traces of detergents should be removed prior to air drying.
- Store the rotor upside down, in a warm, dry place, to prevent condensation in the tubes.
- Test tube brushes must not be used for cleaning the cup cavities.
- Remove adapters after use and inspect for corrosion.
- Remove from use any rotor that has been dropped or shows any sign of defect, and report it to a manufacturer's representative for inspection.

Maintaining a Log Book

To avoid catastrophic rotor failure, many types of rotors must be "de-rated" (limited to a maximum rotation speed that is less than the maximum rotation speed specified for the rotor when it is new) after a specified amount of use, and eventually taken out of service and discarded. Therefore, it is important to have a separate log book for the use of each rotor to record the speed and length of time for each use.

Emergency Procedures

In case of a centrifuge malfunction, rotor failure, or test tube failure, a risk exists of hazardous chemicals and/or infectious material being released as aerosols. If a centrifuge malfunctions while in operation, it must be turned off immediately and unplugged.

The operator, wearing gloves, should remove all debris and clean and disinfect the interior of the centrifuge and the head (or cups) according to the manufacturer’s instructions. If the problem was a result of broken or damaged equipment, take the centrifuge out of service and notify your supervisor of the needed repairs.

Getting Assistance

If you have questions about centrifuge use, care, or cleaning, contact the manufacturer directly. For assistance with incident/spill clean up and decontamination, contact EH&S.

Electrophoresis Power Supply Safety

Many laboratories routinely use electrophoresis equipment without incident. However, the power supply runs at a voltage and amperage sufficient to deliver a potentially fatal electric shock. Therefore, it is essential to use electrophoresis power supplies safely.

Electrical Hazards

The electric shock from an electrophoresis power supply can cause burns and damage to skin, muscles and nerves. In general, the greater the amperage, the greater the hazard. Amperages greater than 50 milliamps (mA) can be fatal. Typical electrophoresis power supplies produce direct current (DC) up to 3,000 volts and 500 mA.

Voltage and Amperage

Most electrophoresis power supplies carry clearly visible labels warning "Danger, High Voltage". Granted, although a shock of a few thousand volts is uncomfortable, it's not going to harm most people. The current, or amperage, is what poses the danger. While the volts cause the shock, the amps cause the physical damage to the body. The high current or amperage found in most electrophoresis power supplies is sufficient to cause harm. The common saying among electricians is "current kills". Even a relatively low voltage shock can be fatal, if the amperage is high enough. So why worry about voltage? To understand that, we need to review Ohm's law which correlates current (I), voltage (E) and resistance (R):

$$I = E / R$$

Current (I) is directly proportional to the voltage (E) (i.e., the power supply) and inversely proportional to the resistance (R) of the circuit (i.e., whatever the power passes though).
If your wet hands touch exposed live power leads, your body would have a resistance between 1000 to 10,000 W. At 120 V (DC), the current passing through you would be between 12 and 120 mA. As the table below shows, a 12 mA current delivers a shock, however a 120 mA current is sufficient to cause respiratory paralysis. Given that most power supplies deliver up 3,000 V (DC), the risk of physical harm is very real.

Physical Effects of Electric Shock

An electrical shock can overstimulate nerves causing wide ranging physiological effects.

- Your heart may stop or flutter. Your arteries also may contract, making it harder for your heart to pump blood.
- Electricity through the muscles causes them to contract, or spasm. This might make it so you can't let go of the energized equipment. Contractions of the chest muscles may make it difficult to breathe.
- Electricity can damage nerves, causing unconsciousness, paralysis, brain damage, and other problems.
- Electricity can burn skin where it enters and exits. These burns may be sufficient to kill a person or destroy an arm or a leg.

Equipment Inspections

Inspect electrophoresis equipment and ensure it is functioning properly by checking components before each use.

- Inspect power cords and leads for frayed, cracked or dried out cords; exposed copper wire at the banana jacks (caused by pulling on the wire instead of the jack when trying to remove the jack); and corroded or loose fitting banana plugs, banana jacks, or electrode connection nut, which may cause electrical arcing between the plugs, resulting in fire or irreproducible results.
- Discard and replace all cords that do not pass the inspection. Some manufacturers recommend replacing banana jacks annually.
- Inspect gaskets on vertical electrophoresis chambers to ensure they are not leaking. If leaks are found, contact the manufacturer for replacement gaskets.
- Inspect the electrophoresis chamber for buffer leaks, caused by crazing or cracks in the plastic. Loss of buffer can lead to electrical arcing and fires.
- Inspect the safety guards to ensure proper function, including no load sensors, open load sensors, and ground leakage detectors on the power supply and safety interlocks on the cover.

Preventing Injuries

- Read and follow the manufacturer's instructions.
- Develop and implement written Standard Operating Procedures (SOPs) and train employees and students.
- Do not alter or modify the equipment without written approval from the manufacturer.
- Repairs and maintenance should only be done by a qualified technician.
- Do not defeat or remove safety interlocks.
- Keep the area free of organics, solvents, and combustibles.
- Only use electrophoresis chambers with covers, preferably ones that are interlocked with the power supply.
- Be sure that banana plugs are fully seated. Arcing may occur if the plugs are not completely inserted.
- Make sure power supplies and apparatus are properly matched. Some chambers may be damaged by high voltages.
- Always shut off the power prior to disconnecting leads, accessing the chamber, or adjusting the settings.
- Handle power leads one lead at a time with only one hand to reduce the likelihood of electrical shock.
- You are strongly encouraged to only use newer power supplies with no load sensors and chambers that are equipped with safety interlocks.

Getting Assistance

Questions relating to safe operation of electrophoresis power supplies and chambers should be directed to the manufacturer.

EH&S can provide additional training regarding a wide range of laboratory practices, including the safe operation of electrophoresis units.

Laboratory Refrigerators and Freezers

Refrigerator and Freezer Hazards

The potential hazards posed by laboratory refrigerators and freezers involve vapors from the contents, the possible presence of incompatible chemicals, and spillage.
Loss of electrical power can produce extremely hazardous situations. Flammable or toxic vapors may be released from refrigerators and freezers as chemicals warm up and/or certain reactive materials may decompose energetically upon warming.

Laboratory Refrigerator/Freezer Design

Only refrigerators and freezers designed for laboratory use should be utilized for the storage of chemicals. These refrigerators have been constructed with special design factors, such as heavy duty cords and corrosion- resistant interiors to help reduce the risk of fire and explosion. Only chemicals should be stored in chemical storage refrigerators; lab refrigerators should not be used for food storage or preparation.

Refrigerator/Freezer Labeling

Refrigerators and freezers should be labeled clearly for their intended purpose (e.g., “No Food or Drink to be Stored in this Refrigerator”, “Refrigerator For Food Only”, "NO FOOD - CHEMICAL STORAGE ONLY", "Not For Flammable Storage", etc.)

Flammable Liquid Storage Standard refrigerators have electrical fans and motors that make them potential ignition sources for flammable vapors. Therefore, flammable chemicals or chemical mixtures that must be kept below room temperature must be stored in refrigerators or freezers specifically designed by the manufacturer to be explosion proof. Flammable liquid-approved refrigerators are designed with spark-producing parts on the outside to avoid accidental ignition. If refrigeration is needed inside a flammable-storage room, you should use an explosion-proof refrigerator.

All other refrigerators or freezers not specifically designed to be explosion proof should be labeled with a prominent warning sign indicating that they are unsuitable for the storage of flammable substances. Electric heaters used to defrost the freezing coils can also spark. To ensure its effective functioning, a freezer should be defrosted manually when ice builds up
Frost-free refrigerators should also be avoided since many of them have a drain tube or hole that carries water, and possibly any spilled materials, to an area near the compressor, which may present a spark hazard.

Refrigerator/Freezer Contents

All materials in refrigerators or freezers should be labeled with the contents, owner, date of acquisition or preparation, and nature of any potential hazard. All containers should be sealed, preferably with a cap, and placed in secondary containers or catch pans. Since refrigerators are often used for storage of large quantities of small vials and test tubes, a reference to a list outside of the refrigerator could be used. Labels and ink used to identify materials in the refrigerators should be water-resistant.

Refrigerator/Freezer Explosions
Flammable liquids must only be stored in refrigerators which have no internal ignition sources.

Consider this picture from a laboratory refrigerator explosion in 1982. Many small tubes of petroleum ether were stored in an ordinary domestic freezer. Petroleum ether, a very flammable liquid, has a flash point as low as -56° F, and is classified as a Class 1A flammable with an NFPA 704 fire hazard rating of 4. Apparently the tubes were not sealed well, and over time, the petroleum ether evaporated in sufficient quantity that the concentration exceeded the low explosive limit, about 1.0%. A spark from an internal component (e.g., thermostat, light switch) caused the vapor of the liquid to detonate.

There were no personal injuries in this case, as the explosion took place at night. However, along with the freezer, one liquid scintillation was destroyed, and another was seriously damaged. The result was $11,000 in damage to the room and $25,000 damage to equipment. Today, this would amount to more than $250,000.

Preventing Explosions
To prevent refrigerator and freezer explosions, lab supervisors must vigorously enforce the following:

- All materials with a flashpoint below 100° F may only be stored in a UL approved flammable materials storage refrigerator or freezer. These units do not have any internal ignition sources.
- All ordinary domestic refrigerators and freezers should be labeled with the phrase “No materials with a flashpoint below 100° F may be stored in this refrigerator/ freezer” or “Not for flammable storage.”

Getting Assistance
For additional information about selecting appropriate refrigerators and freezers, storing flammable chemicals and chemical compounds with low flash points, or proper labeling for laboratory refrigerators and freezers, contact EH&S at 372-7163.

Pipetting: Precision without Pain

Using Pipettes

The pipette is a universal laboratory device for the volumetric measurement and transfer of fluids from one container to another. The following rules apply to all types of pipettes.

- Never put a pipette in your mouth.
- Draw the liquid into the pipette using a rubber bulb or pipette pump.
- Never withdraw a liquid from a nearempty container. If you attempt to fill a pipette under conditions where air can enter the pipette, the liquid will shoot up into the bulb or pump.
- Never lay a pipette flat on a table or turn upside down with the bulb or pump attached. The liquid will flow into the bulb/pump, contaminating the bulb/pump.
- Dispose of broken pipettes in the appropriate glass-disposal container (see SPPM S80.14).

Is Pipetting Causing You Pain?

Many pipette users experience pain, numbness, or tingling in their hands, fingers, or shoulders. These symptoms may be related to your job. Symptoms may start gradually, but if ignored, symptoms can get worse and become harder to treat. Symptoms that occur at night may still be work-related. Even if they go away during vacation or on your days off, it doesn't mean the condition is gone. Inform your supervisor and get medical care if you have symptoms. The symptoms may indicate serious injuries and can interfere with your work and personal life. They can even lead to permanent disability.

Why Do Pipette Users Have Pain?

Repeated motion such as pipetting, reaching for supplies, and twisting to read protocols - over and over, all day long - can injure muscles, tendons, and joints.

- Pipettes that are heavy or require a lot of thumb force make muscles work harder than they should.
- Pipettes that are too long or too thin require too much force to grip them.
- Long work hours with few breaks or little task rotation mean your muscles and joints don't have time to recover.
- An uncomfortable work position such as bending your wrist for long periods or reaching too far for supplies can result in pain and injury.
- Cold temperatures, vibrations, and hard edges can make injury more likely (e.g., work in cold rooms, vibrations from vortexing, and pressing against hard lab benches for long periods).

Preventing Injuries

Injuries from pipetting, like other types of ergonomic injuries, can be reduced or eliminated through a few simple steps.

- Reduce pipetting tasks and review protocols to remove extra steps or unnecessary pipetting. Pipetting more than one hour a day increases the risk of injury, so rotate tasks, if possible.
- Take micro-breaks every 20-30 minutes if you pipette for long periods. Hold the pipette loosely and relax hands periodically. Textured gloves may help.
- Use a cutout or "V"-shaped lab bench (if possible) to bring the work closer.

- Use chairs with adjustable backrests and seats and position the chair to support your back for work that requires leaning forward. Use adjustable footrests, as foot rings on stools may not be adequate.
- Train on safe work procedures and recognition of early symptoms of injury. EH&S can help with workstation evaluations and adjustments.
- Organize your workstation and position frequently used items to minimize reaching or leaning, use a top disposal container that is lower than the container into which you're pipetting, post protocols straight ahead at eye level to prevent bending or twisting, and pad hard edges or surfaces you rest against.
- Use as little force as possible when putting on tips or pressing the plunger.
- Use pipettes that reduce your risk of injury (see next section).

Choosing the Right Pipette

- Choose a lightweight pipette that is cushioned or contoured to your hand.
- Select pipettes that use your fingers to operate a trigger instead of your thumb to press down a plunger. Pick a plunger with low spring pressure and short length of travel.
- Use pipettes that fit. If your hand wraps around less than half of the pipette, the pipette is too big. It is too small if your hand wraps around the whole pipette.
- Choose a tip ejector that requires little force. Use thin-walled tips for easy ejection. Use pipette-specific tips if possible. Avoid generic tips.

Automated pipettes are the best way to reduce injury because they eliminate hand pipetting altogether and can be programmed to do repetitive pipetting tasks. However, they are the most expensive ergonomic option.

Electronic pipettes are lightweight, promote better overall thumb and hand postures, eliminate forceful action, and some are also repetitive dispensers. However, they still involve some repetition, accuracy varies by model, and they are expensive compared to some other options.

Latchmode pipettes reduce repetitive plunging and there is no need to continuously hold thumb down due to a magnetic assist. However, the thumb remains in an awkward position when dispensing and some force is still required.

Repetitive pipettes dispense the same amount of liquid repetitively with a minimal amount of refills and have many use finger-operated triggers. However, they still require repetitive thumb motions and high force.

Getting Assistance

The recommendations in this fact sheet are based on research studies, published information, and general ergonomic principles and may not be appropriate for every laboratory. Contact EH&S at 2-7163 for assistance, including ergonomic evaluations and recommendations.

Laboratory Vacuum Pumps: Care and Use

Mechanical vacuum pumps used in laboratories pose common hazards. These are the mechanical hazards associated with any moving parts and the chemical hazards of contaminating the pump oil with volatile substances and subsequently releasing them into the lab. A few guidelines will help in the safe use of these devices.

Vacuum Systems

Vacuum systems pose severe implosion hazards. Follow these guidelines and requirements to ensure system safety:

- Ensure that pumps have belt guards in place during operation.
- Ensure that service cords and switches are free from defects.
- Do not place pumps in an enclosed, unventilated cabinet.
- Do not operate pumps near containers of flammable chemicals.
- Do not use solvents which might damage the pump.
- Always close the valve between the vacuum vessel and the pump before shutting off the pump to avoid sucking vacuum oil into the system.
- Place a pan under pumps to catch oil drips.
- Check oil levels and change oil when necessary. Replace and properly dispose of vacuum pump oil that is contaminated with condensate. Used pump oil must be disposed as hazardous waste.
- Conduct all vacuum operations behind a table shield or in a fume hood and always wear safety glasses.
- Always use a trap on vacuum lines to prevent liquids from being drawn into the pump, house vacuum line, or water drain.

Traps

When using a vacuum source, it is important to place a trap between the experimental apparatus and the vacuum source. The vacuum trap:

- protects the pump and the piping from the potentially damaging effects of the material,
- protects people who must work on the vacuum lines or system, and
- prevents vapors and related odors from being emitted back into the laboratory or system exhaust.

When using a vacuum-filtration assembly, pay strict attention to the liquid levels in the trap bottle. Use a secondary trap bottle so that if liquid in the primary trap bottle reaches the inlet tubes, the liquid will be vacuumed into the secondary container instead of the pump. This will help reduce vapors in the atmosphere and expensive vacuum pump replacement costs.

If you are directly vacuuming large quantities of gases over a long period of time, contact Environmental Health & Safety for assistance in identifying appropriate filters for minimizing vapor release.

If a vacuum pump is required for lower pressures, the pump must be fitted with a cold trap to condense the volatiles. A cold trap is a condensing device to prevent moisture contamination in a vacuum line. When using a cold trap:

- Locate the cold trap between the system and vacuum pump.

- Ensure that the cold trap is of sufficient size and cold enough to condense vapors present in the system.
- Check frequently for blockages in the cold trap.
- Use isopropanol/dry ice or ethanol/dry ice instead of acetone/dry ice to create a cold trap. Isopropanol and ethanol are less expensive, less toxic, and less prone to foam.
- Use gloves when handling the dry ice.
- Do not use dry ice or liquefied gas refrigerant bath as a closed system. These can create uncontrolled and dangerously high pressures.
- Liquid nitrogen should only be used with sealed or evacuated equipment, and then only with extreme caution. If the system is opened while the cooling bath is still in contact with the trap, oxygen may condense from the atmosphere and react vigorously with any organic material present.
- Maintain a cold trap between a vacuum pump and the apparatus - do not use liquid nitrogen as trap coolant when pumping organic compounds (liquid oxygen may condense in the trap, leading to explosive oxidation).
- A disinfectant trap should be used in-line when a vacuum is used with hazardous biological materials.
- Container Selection
- Do not apply a vacuum to a flatbottomed flask. Use only containers that can withstand vacuum operations - heavy-walled round-bottomed glassware or specifically-designed glassware (e.g., Erlenmeyer filtration flasks).
- Wrap exposed glass with tape to prevent flying glass if an implosion occurs.
- Carefully inspect vacuum glassware before and after each use. Dispose of any glass that is chipped, scratched, broken, or otherwise stressed.

Desiccators

It is important to use properly designed equipment for experiments carried out under reduced or elevated pressure.

- Vacuum desiccators should be enclosed in approved shielding device or protected with a framework of wire, nylon or other suitable material.
- Glass desiccators often have a slight vacuum due to contents cooling. When possible, use molded plastic desiccators with high tensile strength. For glass desiccators, use a perforated metal desiccator guard.
- Air admittance should be carried out gradually. When opening, make sure atmospheric pressure has been restored.
- Never carry an evacuated desiccator.

Getting Assistance

If you have questions regarding the safe use of vacuum pumps, contact your supervisor or EH&S.

Laboratory Autoclaves - Care and Use

Steam sterilization is a time proven and economical process of killing microorganisms through the application of moist heat (saturated steam) under pressure. Although autoclaves are common laboratory tools, they must be properly used and maintained to be effective.

Preparing Materials for Autoclaving

Correct packaging ensures that steam penetrates the load. Containers packed to capacity will not be properly decontaminated even if autoclave parameters are observed.

- Use special caution when autoclaving containers that may have become pressurized. Never autoclave a sealed container of liquids as this may result in an explosion of superheated liquid during the cycle or when the container is opened.
- Do not put sharp or pointed contaminated objects into an autoclave bag. Place them in an appropriate rigid sharps disposal container.
- Never lift a bag from the bottom to load it into the chamber - handle the bag from the top in case sharp objects were inadvertently placed in the bag.

Loading the Autoclave

- Do not overload the chamber with containers that are too large for the capacity of the autoclave.
- While clean and contaminated items may be sterilized in the same autoclave, do not mix them together during the same cycle-they require different heat exposure times.
- Follow the guidelines set by the posted autoclave parameter signs when setting cycle time and temperature.
- Conduct autoclave sterility testing on a regular basis using appropriate biological indicators (B. stearothermophilus spore strips) to monitor efficacy. Use indicator tape with each load to verify it has been autoclaved.
- To prevent spills and accidents, be sure that the exhaust setting is appropriate for the type of material being autoclaved. Use FAST exhaust for solid items (solid waste, instruments) and SLOW exhaust for liquids and liquid wastes.
- Do not leave an autoclave operating unattended for a long period of time. Always be sure someone is in the vicinity while an autoclave is cycling in case there is a problem.
- Don't autoclave flammable or volatile items, such as solvents or corrosive chemicals (phenol, trichloroacetic acid, ether, chloroform, etc.), or any radioactive materials.

Unloading the Autoclave

- After the cycle is completed, wait until the chamber pressure gauge reads zero before attempting to open the autoclave door.
- Open door slowly and stand back to let residual steam escape gradually. Opening the autoclave door too quickly may result in glassware breakage and/or steam burns on your skin.
- If door won't open, don't force it. Door is locked if steam pressure isn't zero.
- Remember that all surfaces inside the autoclave are still extremely hot; allow materials to cool for several minutes before removing.
- Make sure nothing has broken, spilled, or splashed. Be aware of molten agar that may have collected in the secondary container during the cycle. Use a secondary tray to catch

any potential leakage from an autoclave bag rather than allowing it to leak onto the autoclave chamber floor.

- If there is a spill inside the autoclave chamber, allow the unit to cool completely before attempting to clean up the spill.
- Use the appropriate personal protective equipment, including heat and fluid resistant autoclave gloves, a lab coat, and goggles if a splash hazard is present.
- If glass breaks in the autoclave, use tongs, forceps or other mechanical means to recover fragments. Do not use bare or gloved hands to pick up broken glassware.
- Be on the alert when handling pressurized containers. Superheated liquids may spurt from closed containers. Never seal a liquid container with a cork or stopper. This could cause an explosion inside the autoclave.

Care and Maintenance

Autoclave users should know the function of all controls and locking mechanisms, as well as the importance of all safety devices. Inexperienced users should use the autoclave under supervision from more knowledgeable personnel.

- Check autoclaves periodically to ensure that safety devices are working properly and that all mechanisms are in good condition. If a problem is found, notify your supervisor.
- Never override an autoclave's built-in safety control features; if you suspect there is a problem with your autoclave's performance, contact your autoclave repair representative for assistance.
- Do not operate an autoclave until it has been properly repaired.

Getting Assistance

If you have any questions about safe operation of autoclaves or waste disposal, contact EH&S.

Chemical Fume Hoods: Vital Ventilation

Importance of Laboratory Fume Hoods

Fume hoods or other local exhaust hoods are an important safety component to any laboratory handling toxic solvents, corrosives, or other volatile chemicals. A chemical fume hood is a partially enclosed work space that is exhausted to the outside. Laboratory fume hoods are the first defense to minimize chemical exposure to research workers. They are considered the primary means of protection from inhalation of hazardous vapors because they capture, contain, and expel emissions generated by hazardous chemicals. It is, therefore, important that all potentially harmful chemical work be conducted inside a properly functioning fume hood. The following is intended to outline exposure control practices in relation to the hood.

Types of Fume Hoods

Chemical fume hoods are approved for three general types of uses: general purpose, radioisotope, and perchloric acid. Hoods approved for each of these uses will appear alike but require different functional and operating parameters. Never use perchloric acid in a hood unless the hood is specifically designed for that purpose.

A chemical fume hood is designed to protect the user by drawing contaminants away from you. Therefore, work with hazardous chemicals should not be done on a clean air bench, which is designed to protect biological specimens by drawing air from the back of the hood toward the user. Likewise a biosafety cabinet (which can exhaust contaminated air back into the work environment) cannot safely be used with hazardous gases and vapors.

Before Using a Fume Hood

- The hood should be inspected annually by a trained professional. Verify that a inspection is current by checking the date on the inspection sticker.
- Make sure the hood is functioning properly and has good air flow.
- The face velocity of the hood should be between 80-120 lfpm to work properly. If the hood is outside these parameters, contact EH&S about hood repair.
- Sash is the term used to describe the movable glass panel that covers the face area of a fume hood. Keep the hood sash completely closed when not in use.
- Never remove, modify, or override installed sash stops.
- Attach a piece of light paper, such as a "Kimwipe" to the inside bottom corner of the hood sash. Inward movement of the paper indicates air is being drawn into the hood. The paper should be moving, but not so rapidly that it tears or comes off.
- Avoid storing excess chemicals or equipment in the hood. If a small amount must be stored in the hood, keep them away from the baffle slots in the rear of the hood or place on blocks so that air can flow to the bottom opening of the baffle.
- Never use the hood as a waste disposal mechanism (e.g., for evaporation of excess chemicals).
- Avoid cross-drafts which can cause turbulence and reduce the efficiency of the hood.

Working in a Fume Hood

- Use the fume hood when handling volatile or highly toxic chemicals.
- Select the proper exhaust speed setting for your work. If the speed is adjustable, the "low" velocity setting is appropriate when chemicals are stored inside the hood, and the "high"

setting is appropriate when working with chemicals. Control the rate of release of particles or vapors from reactions in order to minimize exposure to such chemicals.

- Do not leave a reaction unobserved for more than a few minutes.
- Place a mark on the front of the fume hood where the sash is raised to 18 inches. Perform work at or below the sash stop level.
- Perform all work in the hood at least six inches inside the hood sash.
- Never put your head in the hood.
- No extension cords or powerstrips should be present in the hood. Ensure that no sources of ignition or spark is present when flammable or explosive chemicals are being used.
- Wear appropriate protective clothing.
- Seal all chemical containers when not in use to avoid the possible build-up of vapors in the hood.
- If especially hazardous or corrosive vapors will be evolved, these exit gases should be passed through scrubbers or absorption trains.

Hood Maintenance

- Keep the hood clean by removing excess chemicals and used equipment and cleaning up any spills or chemical residues. Make sure you can see through the glass of the sash.
- Do not adjust the hood damper (located in the outgoing air pipe). This could seriously affect the performance of hoods in other rooms. The baffles of the hood (located in the rear of the hood) may be adjusted depending on the work being performed.
- Do not attach exhaust ducts or snorkels to fume hoods without checking with EH&S or Facilities Operations first. Installation of these ducts may affect air flow in the hood.

Getting Assistance

If you have any questions about fume hood use or your hood need to be repaired or inspected, contact EH&S at 372-7163.

Emergency Washing Facilities - Determining Need & Location

Emergency washing facilities

(EWF), such as eyewash, showers, or both, are needed where employees may be exposed to corrosive, strong irritant, toxic, or skin-absorptive chemicals that could injure the eyes or body. These facilities are designed to provide copious amounts of water to wash contaminants from the eyes and body.

Determining Need

Assess the workplaces to identify chemicals that could injure the eyes or get onto the body during the course of work. Observe work practices, interview workers and review sources of information, such as material safety data sheets (MSDS), written standard operating procedures (SOPs), or similar documents that may help determine if personal protective equipment (PPE) and emergency washing facility are required.

Conduct assessments whenever new equipment, processes or chemicals are introduced or an injury or illness indicates the need.

Personal Protective Equipment

The availability of an EWF does not replace the need for PPE. Select PPE based on the types of hazards identified during the assessments, level of protection needed, fit and comfort.

Contact lenses do not provide protection from chemical splashes, but can be worn safely in combination with appropriate personal protective eyewear. For additional information, see EH&S fact sheet – Eye and Face Protection and SPPM S3.10.

EWF Types

Emergency washing facilities are either plumbed, self-contained, or personal units. Plumbed units are preferred where a clean water source is readily available. Self-contained units are effective where a water source is not readily available. Personal units are supplementary.

There are several types of units available. Plumbed units include:

- eyewashes (a device to irrigate and flush the eyes),
- eye/face washes (a device to irrigate and flush both the face and the eyes),
- safety showers (an assembly of a shower head controlled by a stay-open valve and operated by an approved control valve actuator),
- hand-held drench hoses (a single-headed emergency washing device connected to flexible hoses used to irrigate and flush the face or other parts of the body). If your workplace is equipped with a drench hose and no eyewash, the drench hose can be used in case of emergency; however, an ANSI approved eyewash should be installed as soon as possible. Until installation, provisions should be made to always have two or more persons in the workplace when using chemicals that could damage the eyes. One person can then assist the injured by holding and directing the drench hose while the injured party is free to hold open the eyelids. Drench hoses provide support for emergency shower and eyewash units, but they do not replace them, and cannot be used as a sole means of protection. However, a

drench hose is useful when the spill is small and does not require an emergency shower and can be used with a shower for local rinsing, particularly on the lower extremities.
- combination units (a combination of eyewash/shower or drench hose designed so all components operate individually).

Several self-contained units are also available:
- Eyewash/safety showers in which the device contains its own flushing fluid and must be refilled or replaced after use. Self-contained systems must never hold expired fluids.
- Personal eyewash units with solution/ squeeze bottles (supplementary eyewash that supports plumbed units, self - contained units, or both by delivering immediate flushing fluid for less than 15 minutes) . They provide support for plumbed or self-contained eyewash units, but they do not replace them. They cannot be used as a sole means of protection. However, they are useful because they allow for quick flushing of the eyes when plumbed or self-contained units are not immediately available. Upon flushing, personnel should seek a plumbed or self-contained unit and thoroughly flush the eyes according to the MSDS or available information.

If an EWF is used to flush the eyes, prompt medical attention is important, regardless of the severity of the injury.

Getting Assistance

If an EWF is available, but you are not familiar with the specifications, responsibilities, and training, see the Fact Sheet – Emergency Washing Facilities-Specifications, Responsibilities, and Training, the Laboratory Safety Manual, or SPPM S5.15.

If an EWF is required but one is not available, contact your supervisor, departmental safety committee, or Environmental Health and Safety (EH&S). EH&S provides EWF assessments and will work with supervisors and safety committees to ensure installation of an ANSI approved EWF.

For additional information, contact EH&S at 2-7163.

Emergency Washing Facilities - Specifications, Responsibilities, & Training

Emergency washing facilities (EWF), such as eyewashes and showers, are needed where employees may be exposed to corrosive, strong irritant, toxic, or skin-absorptive chemicals that could injure the eyes or body.

Specifications

EWF are designed to provide copious amounts of water to wash contaminants from the eyes and body and should meet the following specifications.

- Installation meets manufacturer's requirements including criteria for water pressure, flow rate, and system testing.
- An on-off valve is capable of being activated in one second or less, remains open without the use of hands allowing personnel to use both hands to hold eyes open or remove clothing, and is capable of providing a water flow for at least 15 minutes.
- Water is the appropriate temperature to ensure that user discomfort will not discourage proper use of the equipment.
- Location is within the vicinity (no more than 50 feet) of the hazard, and it takes no more than 10 seconds to reach the EWF.
- EWFs using water not fit for drinking have signs stating the water is "NONPOTABLE WATER".

Supervisor Responsibilities

Supervisors / principal investigators are responsible for ensuring the equipment is in good working order. They should:

- Follow the manufacturer's instructions regarding operation, inspection, and maintenance of the EWF;
- Activate the eye washes and drench hoses weekly to check the proper function of the valves, hardware and availability of water. The eyewash/drench hoses should be activated until the water is clear and any debris is removed.
- Inspect the eyewash/drench hoses annually, including examination of the plumbing and ensuring water is available at the appropriate temperature, quality, and quantity. The water stream should be adequate to flush the eyes, face or other parts of the body at a velocity low enough to be noninjurious to the user.
- Facilities Operations conducts annual inspection of emergency showers.
- If self-contained eyewash equipment or personal eyewash units are used, they must be inspected and maintained according to the manufacturer's instructions and annually inspected to check for proper operation. Self-contained systems must never hold expired fluids. Sealed personal eyewashes must be replaced after the manufacturer's expiration date. Most manufacturers recommend replacing fluid in open self-contained eyewashes every six months and sealed containers are typically two years.
- Keep emergency washing facilities free of obstacles, allowing access in the event of an emergency. It is recommended that highly visible signs be installed at each EWF. The area should have good lighting.

- Provide personal protective equipment (e.g., chemical goggles, lab coats, long sleeve shirts, etc.) when there is the potential of chemical exposure to the eyes or body. The presence of EWF does not replace the need for personal protective equipment. Contact lenses do not provide protection from chemical splashes but can be worn safely in combination with appropriate personal protective eyewear.
- If electrical outlets are located within six feet of the EWF, ensure the outlets are equipped with ground fault circuit interrupters (GFCI).
- Train employees/students in the proper use of the EWF.

Training

In areas where an EWF is available, employees and students must be trained, including:

- Instructions on the location, proper use, and application of the EWF.
- Instructions on rinsing the eyes, holding the eyelids open and rolling the eyeballs so flushing fluid flows on all surfaces of the eye and under the eyelid. If there is a drench hose but not an eyewash station, provisions should be made to always have two or more persons in the workplace when using chemicals that could damage the eyes. One person can then assist the injured by holding and directing the drench hose while the injured party is free to hold the eyelid open. Drench hoses provide support for emergency washing facilities; however, they do not replace them.
- Instructions on reporting accidents and seeking prompt medical attention after flushing the eyes regardless of the severity of the injury.
- Documentation of the training.

Additional Information

For more information regarding EWFs (plumbed, self-contained, and personal) or PPE, see the Fact Sheet – Emergency Washing Facilities-Determining Need & Location, SPPM S5.15 "Eyewashes and Safety Showers", or SPPM S3.10 "General Requirements for Personal Protective Equipment."

Getting Assistance

If the plumbed EWF does not meet the specifications, contact Facilities Operations. If you need assistance or have questions regarding EWF or PPE, contact EH&S.

U: Safety Fact Sheets

Compressed Gas Cylinders: Safety Under Pressure

Variety of Gases and Hazards

Compressed gas cylinders are used in a variety of university settings, including maintenance work, fabrication shops, fine arts, and instructional and research laboratories.

Although compressed gases serve WSU in many ways, gases under high pressure present a number of safety and health hazards. Gases may be combustible, explosive, corrosive, poisonous, inert, or a combination of hazards.

Cylinders, if not used properly, may rupture violently, releasing potentially hazardous contents and/or becoming dangerous projectiles. However, gas cylinders are reasonably safe when they are appropriately labeled, used, stored and transported.

Cylinder Labels

Cylinders must be properly labeled, including the gas identity and the appropriate hazard warning. Cylinders have several stamped markings. The top mark is either a Department of Transportation or an Interstate Commerce Commission designation. Other stamp markings include service pressure, serial number, hydrostatic test date, and a symbol indicating the identity of the manufacturer.

The label and markings must not be defaced or removed. Cylinders that do not have a label or appropriate stamps must not be used. Segregate the cylinder and return it to Central Stores or the vendor.

Using Cylinders

All users should know the identity of the gas and be familiar with the safety, health, flammability and reactivity hazards (refer to the material safety data sheet for each particular gas).

- Visually inspect gas cylinders and their connections prior to each use.
- Make sure all valves, regulators, hoses, gauges, and couplings, are compatible with the cylinder pressure and contents.
- Make sure all cylinder components are clean and free of oil and grease.
- Make sure all connections are tight. Locate leaks by applying soapy water; bubbling areas indicate leaks.
- Use cylinders in an upright position, unless otherwise instructed by the manufacturer.
- Open cylinder valves slowly, always standing away from the face and back of the gauge.
- Turn off all valves when the cylinder is not in use and bleed the lines.
- Always release pressure from the regulator before disconnecting.
- Keep the valve protection cap screwed all the way down on the cylinder's neck except when the cylinder is in use.

Storing Cylinders

The large amount of potential energy resulting from compression of the gas makes the cylinder a potential rocket or fragmentation bomb, so they must be stored and transported very carefully.

- Store cylinders in a well-protected, well-ventilated, dry location away from open flames and heat sources.
- Storage spaces should be located where cylinders will not be knocked over or damaged by passing or falling objects.
- Full cylinders should be stored separately from empty cylinders.

- Clearly mark empty cylinders with a tag or sign reading "Empty" or "MT".
- Secure cylinders in an upright position to prevent tipping by attaching them to a bench top or individually to the wall with a chain or strap, or placing them in a cylinder holding cage, hand truck, rack or post.
- Group cylinders by types of gas (e.g., flammables, oxidizers or corrosives). Inert gases can be stored with any other type of gas.
- Separate oxygen cylinders from fuel gas cylinders or combustible materials by a minimum of 20 feet.

Moving and Transporting Cylinders

- Always use a suitable hand truck or similar device to move cylinders.
- Transport cylinders in a secured, upright position.
- When moving cylinders a very short distance and/or into position, the cylinder may be rolled on the bottom edge.
- Never drop cylinders or allow them to strike each other or other objects.
- Cylinders should never be rolled on their side or dragged.
- Remove regulators, close valves and put protective valve caps in place before moving cylinders. Do not lift or move the cylinder by the cap.

Leaking/Damaged Cylinders

If a cylinder is damaged, in poor condition, leaking, or the contents are unknown, move it to a safe place (if it is safe to do so) and inform EHS or the supplying vendor as soon as possible. Under no circumstances should you attempt to repair a cylinder or valve.

Training

All personnel utilizing compressed gases must receive training, including the associated hazards of the materials, necessary safety precautions, personal protective equipment and emergency response procedures. Appropriate material safety data sheets and other gas supplier product information must be accessible to compressed gas users.

Getting Assistance

If you need additional information about gas cylinder use, storage, or transport or would like to view a training video, contact EH&S.

Chemical Monitoring and Sampling

Environmental Health & Safety (EH&S) can monitor and sample for most dusts, fumes, and vapors to evaluate exposures to chemical air contaminants.
Monitoring and sampling results are used to determine the need for engineering controls (e.g., supplemental ventilation) or personal protective equipment (e.g., respiratory protection) and assure compliance with regulatory standards.
EH&S uses a variety of sampling and monitoring equipment when evaluating air contaminants because current technology does not offer a "single" instrument that can detect everything that may be present in the air.

How Does EH&S Determine The Need For Monitoring / Sampling?

Generally, there are two situations when EH&S receives requests to monitor or sample. One is when someone wants to know the chemical exposure levels during a specific process (e.g., painting, welding, research, etc.).
The other situation is when someone wants to know "What is that smell?" or "What is in the air?" These two situations require different approaches.
Evaluating a specific process for air contaminants is the easier of the two because EH&S:

- knows what chemicals need to be monitored / sampled;
- has the time to evaluate the process and determine the monitoring instrument, proper sampling media and protocol; and
- can obtain sampling media (stock or order) in a reasonable time.
- Determining "What is that smell?" or "What's in the air?" is not as easy. While people asking these questions may want answers immediately, these situations normally take additional time:
- Although EH&S has several direct reading instruments for specific chemicals and sampling media for chemicals routinely used, there is no single, universal sampling/ monitoring instrument available;
- the source of the contaminants is unknown, and an investigation is needed to determine what contaminants need to be sampled or monitored, what instrumentation is to be used, and the sampling protocol; and
- uncertainty of when the sampling media will be needed and the associated expiration dates, make it impossible to keep all types of media in stock.

There are times when identifying contaminant(s) to monitor/sample is extremely difficult.

So EH&S Has Monitored/Sampled, What Are The Results?

EH&S obtains monitoring/sampling results in two ways:

1. Retrieving information from a direct reading instrument. Air contaminants are sampled and analyzed within the instrument in a relatively short time (seconds to minutes); and
2. Sending the sample media to an accredited lab. The results may be available within a couple of days to several weeks.

Once obtained, results are compared to regulatory limits and recommended levels.

Controlling Air Contaminant Exposure

If the monitoring / sampling results show levels above regulatory limits, EH&S will work with the department to control the exposure.

Occupational exposures can be controlled through substitution of a less hazardous material, ventilation, enclosures, equipment maintenance, process changes, and/or personal protective equipment (last resort).

To determine if the controls are effective, EH&S can conduct additional monitoring/sampling. Employees and students monitored will receive copies of the results.

Health Effects Below Regulatory Limits

Results below established limits and recommendations may still produce symptoms similar to those indicated on the Material Safety Data Sheet (MSDS). This may be due to a wide variation in individual susceptibility.

A small percentage of people may experience discomfort from some substances at concentrations at or below the established limits or recommendations. These effects are usually minor and brief with no long term effects.

An even smaller percentage of people may experience more prolonged symptoms because of pre-existing conditions. For example, individuals may be sensitive or otherwise unusually responsive to some chemicals because of genetic factors, age, medications, or previous exposure. In these situations, it is recommended that EH&S and an occupational physician be consulted.

Requesting Evaluation / Monitoring

If you have questions or concerns about chemical exposures in your work area, notify your supervisor or contact EH&S for an evaluation, and if necessary, EH&S will conduct monitoring/sampling.

Getting Assistance

For additional information, see the WSU Laboratory Safety Manual or contact EH&S.

Personal Protective Equipment?

Personal protective equipment, or PPE, is designed to protect employees from serious workplace injuries or illnesses resulting from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards.

Hazard Assessments

Regulations require that employers conduct a hazard assessment of their workplaces to determine what hazards are present that require the use of PPE, provide workers with appropriate PPE, and require them to use and maintain it in sanitary and reliable condition.
Departments are to conduct and document the PPE assessments. To assist supervisors in this process, PPE guidelines, charts, and forms are available on the EH&S web site.

Controlling Hazards

Using PPE is often essential, but is not the preferred method for protecting employees from hazards. Rather, PPE should be used when hazards cannot be eliminated or managed by engineering and/or administrative controls.

Engineering controls physically change equipment or the work environment to prevent exposure to hazards. Examples of engineering controls are machine guards and ventilation.

Administrative controls change how or when employees do their jobs to reduce exposures to workplace hazards. Administrative controls include job rotation, training, and work practices.

Assessment Guidelines

To assess the need for PPE, consider each task performed and determine if personnel may encounter hazards, such as:

- Impact (falling/flying objects)
- Penetration (sharp objects which might pierce the feet or cut the hands
- Compression (rollover or pinching objects)
- Chemical exposure (inhalation, ingestion, skin contact, eye contact, or injection)
- Exposure to biological materials
- Temperature extremes
- Light (optical) radiation (welding, brazing, cutting, furnaces, lasers, etc.)
- Water
- Vibration
- Excessive noise
- Electricity
- Elevated work surfaces

Selection Guidelines

If the hazards cannot be reduced or eliminated through engineering or administrative controls and PPE is necessary:

1. Become familiar with the potential hazards and what PPE is available and what it can do (splash protection, impact protection, etc.) to prevent injuries and illnesses.
2. Compare the hazards with the capabilities of the available PPE.
3. Select the PPE which ensures a level of protection greater than the required minimum.

4. Fit the user with the device and provide instructions on use, care, and limitations.

Fitting the User

Careful consideration must be given to fit and comfort. PPE that fits poorly will not afford the necessary protection. Also, PPE is more likely to be worn. Adjustments should be made on an individual basis for a comfortable fit while maintaining the PPE in proper position.

EH&S conducts hazard assessments for noise and respiratory contaminants. If an employee needs respiratory protection, contact EH&S for the required medical evaluation and enrollment in the respiratory protection program.

Employee Training

Employees who are required to wear PPE must be trained on how do the following:

- Use PPE properly
- Be aware of when PPE is necessary
- Know what kind of PPE is necessary
- Understand the limitations of PPE in protecting employees from injury
- Don, adjust, wear, and doff PPE, and
- Maintain PPE properly.

Employee training should be documented using the Safety and Health Training Record form.

Reassessment of Hazards

It is the supervisor's responsibility to periodically review the workplace to identify and evaluate new equipment and processes and reevaluate the suitability of previously selected PPE.

Getting Assistance

Additional fact sheets are available specific to hand, head, foot, and eye and face protection. Call EH&S for copies, or view/print them directly from the EH&S website.

If you have additional questions about workplace hazard assessments or need assistance with the selection of PPE, contact EH&S.

What is Personal Protective Equipment?

Personal protective equipment, or PPE, is designed to protect employees from serious workplace injuries or illnesses resulting from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards.

Hazard Assessments

Regulations require employers conduct hazard assessments of the workplace to determine what hazards are present that require the use of PPE, provide workers with appropriate PPE, and train employees to use and maintain it in clean and reliable condition.

Eye and Face Injuries

Thousands of people are blinded each year from work-related eye injuries that could have been prevented with the proper selection and use of eye and face protection. Eye injuries alone cost more than $300 million per year in lost production time, medical expenses, and worker compensation. Safety glasses, goggles, helmets, and face shields can protect employees from the hazards of flying fragments, large chips, hot sparks, and splashes, as well as objects, particles, sand, dirt, mists, dusts, and glare. The type of eye or face protection required depends on the hazard.

Safety Glasses

Safety glasses effectively protect the eye from solid materials (dust and flying objects), but are less effective at protecting the eyes from chemical splashes.

- Use safety glasses for general working conditions where there may be minor dust, chips, or flying particles.
- Use safety glasses with side protection such as side shields or wraparound style where there is a potential of being struck by projectile flying objects such as:
    - Chiseling
    - Drilling
    - Machining
    - Milling
    - Fastening (e.g., staple guns)
    - Grinding or abrasive wheels
    - Cutting (e.g., power saws)
    - Power actuated tools
    - Turning
- Use safety glasses treated for anti-fog.
- Use an eyewear retainer to keep the glasses tight to the face or hanging from the neck if not in use.
- Departments are required to provide eye protection for employees engaged in activities that produce objects which may enter the eye. While departments are not required to purchase prescription safety glasses, there is a policy for providing such eyewear. Contact your supervisor for details. Also, the department may provide an alternate type of eye protection (e.g., goggles) instead of purchasing prescription safety glasses.

Goggles

Goggles should be worn in situations where there is potential for chemical fumes, splashes, mists, sprays, or dust exposure to the eyes. Chemical goggles form a liquid-proof seal around the eyes, protecting them from splashes.

- Goggles for splash or fine dust protection should have indirect venting. Use direct vented goggles for less fogging when working with large particles.
- Safety goggles designed after ski type goggles with high air flow minimize fogging while providing better particle and splash protection.

Face Shields

Goggles with a face shield are required when handling highly reactive substances or large quantities of hazardous chemicals, corrosives, poisons and hot chemicals, projectiles, or radiant energy. *Face shields are not a substitute for eye protection. Always wear safety glasses or goggles under a face shield.*

- Use face shields for highest impact, full face protection for spraying, chipping, grinding, and critical chemical or biohazards.
- Face shields may be tinted or metal coated for heat and splatter protection.
- The curve of the face shield will direct particles or chemicals coming from the side into the eyes.

Filtered Lenses

Eye and face protection with filter lenses are required where there is a potential of being exposed to injurious light radiation, such as welding and work with lasers.

Fit, Care and Maintenance

- Ensure your eye protection fits properly. Eye size, bridge size, and temple length all vary. Safety glasses should be individually assigned and fitted.
- Wear safety glasses so that the temples fit comfortably over the ears. The frame should be as close to the face as possible and adequately supported by the bridge of the nose.
- Clean eye protection daily according to the manufacturer's instructions. Avoid rough handling that can scratch lenses, which impair vision and weaken lenses.
- Store eye protection in a clean, dry place where they cannot fall or be stepped on. Keep them in a case when they are not being worn.
- Replace scratched, pitted, broken, bent, or ill-fitting eye protection with identical parts from the original manufacturer to ensure the same safety rating.

Getting Assistance

Contact EHS if you need assistance evaluating eye impact hazards in your work area and determining if safety eyewear is required.

What Is Personal Protective Equipment?

Personal protective equipment, or PPE, is designed to protect employees from serious workplace injuries or illnesses resulting from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards.

Hazard Assessments

Regulations require employers conduct hazard assessments of the workplace to determine what hazards are present that require the use of PPE, provide workers with appropriate PPE, and train employees to use and maintain it in clean and reliable condition.

Protective foot equipment should be routinely considered for occupations such as, but not limited to, carpenters, electricians, machinists, plumbers and pipefitters, dry wallers, welders, grounds-keepers, shipping and receiving clerks, warehouse workers, and employees using chemicals.

Foot and Leg Injuries

According to one survey, most of the workers in selected occupations who suffered foot injuries were not wearing protective footwear. Furthermore, most of their employers did not require them to wear safety shoes.

The typical foot injury was caused by objects falling fewer than 4 feet, and the median weight was about 65 pounds. Most workers were injured performing their normal job duties at their regular worksite.

When to Use PPE

A variety of protective gear is available depending upon the workplace hazards.

Used alone or in combination, foot guards, safety shoes, and leggings (e.g., leather, aluminized rayon, or other appropriate material) can help prevent injuries by protecting employees from hazards.

Employers must provide foot and leg protection if the workplace hazard assessment reveals potential dangers to the lower extremities of the body, such as:

- Heavy objects such as barrels or tools that might roll onto or fall on employees' feet,
- Rolling or pinching equipment,
- Sharp objects such as nails or spikes or broken glass that might pierce the soles or uppers of ordinary shoes,
- Molten metal that might splash on feet or legs,
- Electrical hazards,
- Fire/explosion hazards,
- Hot or wet surfaces,
- Slippery surfaces,
- Chemical hazards.

Safety Shoes/Boots

Consider the following when selecting safety shoes and boots:

- must comply with the ANSI standards;
- must be sturdy;

- impact-resistant toes to protect against falling objects;
- puncture and heat-resistant soles that protect against hot work surfaces common in roofing, paving, and hot metal industries and stepping on sharp objects such as nails, tacks, screws, or broken glass;
- metal insoles provide additional protection against puncture wounds.

In cases where foot protection is needed only on an occasional or temporary basis, strap-on metatarsal and/or toe guards may be appropriate. Made of aluminum, steel, fiber, or plastic, metatarsal and toe guards are strapped to the outside of regular shoes and only protect against impact and compression hazards.

Electrically Conductive Safety Shoes

- protect against the buildup of static electricity by grounding the person wearing them;
- required for locations where static electricity could produce a spark and cause an explosion or fire;
- not suitable for work involving electrical hazards

Electrical Hazard Safety-Toe Shoes;

- non-conductive and will prevent the feet from completing an electrical circuit to the ground;
- can protect against open circuits of up to 600 volts in dry conditions;
- should be used in conjunction with other insulating equipment and precautions.

Chemical Resistant Shoes/Boots

- impervious boot or bootie covering the shoe;
- commonly made of rubber, latex, or pvc;
- worn so pant leg or lab coat cover the tops and prevent chemical exposure;
- may be worn over regular shoes.

Care and Maintenance

The most important element in a good safety boot or shoe is how well it fits the wearer. Since proper fit is so important, select safety shoes or boots at the end of the day when the feet are a bit swollen and have both feet measured. The best fit will be the length of the longer foot and the width of the wider one. If possible, before making a selection, try to walk on the type of surface on which you work.

Like other types of PPE, leg and foot protection must be regularly inspected, cleaned, and maintained. If the piece of PPE is in need of repair or replacement, bring it to the immediate attention of your supervisor. Never use PPE that is in disrepair or cannot perform its intended function.

Getting Assistance

For additional information about leg and foot PPE or to get assistance with PPE selection, contact EHS.

Personal Protective Equipment

Personal protective equipment, or PPE, is designed to protect employees from serious workplace injuries or illnesses resulting from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards.

Hazard Assessments

Regulations require employers conduct hazard assessments of the workplace to determine what hazards are present that require the use of PPE, provide workers with appropriate PPE, and train employees to use and maintain it in clean and reliable condition.

Hand Injuries

Two of the most intricately designed instruments that we work with are our hands. There are probably no other " tools" that could take the beatings our hands take and still carry out precision maneuvers. But most of us take our hands for granted, which can be a painful mistake when you consider that hand injuries account for roughly a third of all disabling on-the-job injuries each year. Hand injuries are often complex and require lengthy recovery times. Injuries range from simple lacerations to complex replants of whole fingers, if not whole hands. It is often underestimated how much a simple injury can affect the hand.

Selecting Gloves

Hand protection is necessary when workers may be exposed to harmful substances through skin absorption, cuts or lacerations, abrasions, chemical burns, thermal burns, and cold temperature.

- Always use the right glove for the job; incorrect ones may not provide protection
- No one glove will withstand all hazards
- Determine glove use requirements and select ones with the properties and features that best suit your needs
- Consider:
  - specific task(s) being performed, including duration and frequency,
  - the degree of dexterity required,
  - environmental conditions present,
  - degree of exposure of the hazard
  - duration of hand protection use while performing the task,
  - physical stresses that will be applied,
  - the actual hazards, and
  - potential hazards.

Cotton/Fabric Gloves

- general work gloves for parts handling and general maintenance
- improve grip when handling slippery objects
- provide some abrasion resistance
- insulate hands from mild heat or cold

Leather/Cut Resistant Gloves

- best for handling sharp objects that might cause lacerations, such as blades, knives, glass, or sheet metal;
- guard against injuries from heat, sparks, or rough surfaces;
- used in combination with an insulated liner when working with electricity.

Metal Mesh Gloves

- protect hands from accidental cuts and scratches;
- used by persons working with cutting tools or other sharp instruments, such as glass handling, metal fabrication and food processing applications.

Rubber Gloves

- insulated and voltage rated for work with electricity.

Disposable Gloves (Latex)

- usually made of light-weight plastic;
- widely used in labs, custodial work, and health care environments;
- help guard against mild irritants, biological materials, and cleaning solutions;
- should be used with care by those who have or are prone to latex sensitivity.

Shock-Absorbing Gloves

- protect against repetitive pushing and pounding or extended contact and help lessen the effects of constant vibration.

Chemical-Resistant Gloves

- made of rubber, neoprene, polyvinyl, alcohol, or nitrile;
- protect hands when working with chemicals such as corrosives, oils, and solvents;
- always consult the chemical SDS for instructions regarding glove selection when working with chemicals, paying particular attention to chemicals with local skin effects or skin absorption toxicity;
- for mixtures and formulated products, select gloves based on the chemical component that will breakthrough the glove material in the shortest time.

Glove Care and Use

- Select the size that is most comfortable for you.
- Discard disposable gloves in appropriate waste containers.
- Inspect gloves for signs of deterioration, cuts, tears, and holes prior to each use.
- Replace worn or damaged gloves.
- Do not wear watches, rings, or other jewelry that could puncture gloves.
- Wash and dry your hands before and after glove use to reduce contamination.

Getting Assistance

Contact EHS if you have any questions about glove selection or care.

Why Respiratory Protection?

Certain work-related tasks and duties performed by WSU employees require the use of respiratory protection to ensure acceptable breathing air quality. Examples of work-related tasks for which respiratory protection may be needed are:

- Use of cleaning agents, solvents, paints, or varnishes in poorly ventilated areas.
- Working with lead or lead-containing products, scraping, sanding, or welding.
- Applying pesticides or entering areas where pesticides may have been used.
- Working in dusty areas, cleaning, or raising dusts in areas where rodent droppings are present.
- Handling radioactive materials in areas where no fume hoods are present.

In many of these cases, there is a potential for harmful concentrations of contaminants to be present in the breathing air in the workplace. It is the responsibility of the employer to install, if possible, hoods or other ventilation devices to protect the employee against respiratory exposures to toxic agents . In cases where it is not reasonable to install hoods or other ventilation devices, employees may be required to wear respiratory protection.

WSU Respirator Program

WSU maintains a respirator program designed to protect all employees from overexposure to harmful airborne toxins. This includes:

- Identifying employees and students who may be at risk of exposure to airborne toxins.
- Performing a hazard assessment to determine the level of risk to the exposed employee.
- Providing the required medical evaluation, respirator training, and fit-testing for each individual in the respiratory protection program.
- Providing a mechanism for medical monitoring of employees whose respiratory health may be compromised.
- Ensuring that proper respirator use occurs in the workplace through supervisory training and periodic worksite inspections.

In addition to the training required for respirator users, supervisors of employees who utilize respirators must also receive training. However, it is not necessary for the supervisor to be fit-tested unless she/he will also wear a respirator in the workplace. Supervisors must be trained for each type of respirator worn by his/her employees.

Hazard Assessment

A hazard assessment must be completed for each task that is performed by WSU employees. The hazard assessment includes, but is not limited to:

- Identifying the process or duties that may cause exposure.
- Evaluating the site or location where exposure may occur.
- Estimating the exposure concentration and evaluating the risks associated with the contaminant.
- Determining the feasibility of the use of engineering controls (ventilation hoods, etc.).
- Assessing which type(s) of respirators will protect the employee.

Upon completion of the hazard assessment, the appropriate respirator model(s) are selected and displayed for the employee to try on. Employees are permitted to choose the model of respirator that fits best.

If the respirator is a filter-type unit, the respirator cartridge containing the proper filtering medium is determined by the hazard assessor. The cartridge for each respirator is chosen based on the agent the wearer must be protected against. For example, a high efficiency particulate air filter (HEPA) filter cartridge would protect individuals from exposure to particulates, dusts, and mists. On the other hand, an organic vapor (OV) cartridge contains an absorbent that is specifically designed to absorb organic vapors and thus purify the breathing air.

Types of Respirators

Respirators are either air-purifying or atmosphere-supplying. Supplied air respirators do not require the use of a respirator cartridge to ensure breathing air quality because an appropriate grade of air is supplied from a bottle or a remote compressor through an air hose.

Air-purifying respirators come in a variety of models and styles and enable the wearer to breathe air filtered through cartridges attached to the face piece.

Both atmosphere-supplying and air-purifying respirators come in half-facepiece and the full-facepiece models. Full facepiece respirators have a visor and cover the entire face; half facepiece respirators only cover the nose, mouth and chin. Full-facepiece respirators fit better and are more protective than half-facepiece respirators. Full-facepiece respirators may be used when eye protection is recommended in addition to respiratory protection.

Getting Assistance

For additional information about the university's respiratory protection program or to obtain a fit test, contact EH&S at 372-7163.

Power Failure: Laboratory Procedures

The Importance of an Emergency Plan

Like any other part of the infrastructure, electrical power to the campus can fail, either as an isolated incident (e.g., tripped circuit breakers or blown fuses) or as part of a larger event (regional power outages or natural disaster). When power failures occur, health and safety issues need to be addressed.

Planning makes any emergency easier to handle, and the emergency plan for any laboratory should include a well-defined list of procedures to be used by those working in the laboratory should an emergency occur.

Before the Power Fails

- Designate two emergency contact persons for each laboratory who can be reached 24 hours a day. They should be familiar with the lab and have adequate knowledge of the chemicals and procedures performed in the laboratory.
- Supply an emergency source of light (i.e., flashlights) and notify all personnel as to the location and operation of such equipment.
- Do not overload any power strips; restrict all operation of extension cords to emergency use only.
- Include in your emergency plan procedures for safely concluding hazardous chemical procedures during a power failure.
- If possible, program equipment that operates unattended to shut down safely during a power failure and not restart automatically when power returns.
- Make a list of equipment that must be reset or restarted once power returns. Keep instructions for doing so close to the equipment.
- Make sure that all fume hoods have a physical, nonelectrical indicator that they are running. This could be as simple as a strip of hanging tissue paper that will flutter when the fume hood is running.
- Ensure that no flammable chemicals are stored in domestic refrigerators and freezers. When the power returns to these appliances, a reaction may be ignited by the refrigerator light or other electrical source.

While the Power is Off

- Turn off and unplug all non-essential electrical equipment. This will reduce the risk of power surges and other unforeseen damage or injury that could result when the power returns.
- Cap all open containers of solvents to reduce volatile chemical vapors that may drift into the room air and cause exposure or explosion risks.
- Discontinue all work in fume hoods and close each hood sash.
- Secure current experimental work according to the emergency plan. Make sure that experiments are stable and do not create uncontrolled hazards. If the work is to be transported to a safe location, make sure to avoid any hazardous chemical spills during the move.
- Shut down experiments that involve hazardous material or equipment which automatically restarts when power is available.

- Turn off all spare gas cylinders at the tank valves. (Exception: if a low flow of inert gas is being used to control a reactive compound or mixture, the decision may be made to keep the gas on. However, this decision should be part of a written pre-approved standard operating procedure for the material or process).
- Close all lab refrigerators and freezers (do not unplug) and avoid opening them. Although refrigerators and freezers will maintain their temperature for several hours if they are not opened, identify an emergency source of dry ice if you have items that must be kept cold and the outage lasts more than a few hours. However, do not use dry ice in walk-in refrigerators or other confined areas because hazardous concentrations of carbon dioxide gas will accumulate.
- Help coworkers move out of darkened areas, and if asked to leave the area, please do so promptly.
- If experimental animals are in use, special precautions may need to be taken to secure those areas such as emergency power, alternative ventilation, etc. Proceed according to the emergency plan provisions.

When the Power Returns

- Upon returning to the laboratory, check for any strange odors. Call 911, evacuate the laboratory, and alert the contact person if any strange odors or spills are found.
- Reset/restart/check equipment as necessary.
- Once the fume hoods have been restarted, check that the air flow has been restored and keep the sash down for at least 5 minutes to dispose of any vapors accumulated in the hood.
- If a refrigerator or freezer fails, keep the door closed until it has been repaired and returns to a safe working temperature.

Getting Assistance

If you have additional questions about power failure procedures or would like assistance with the preparing your emergency response plans, contact EH&S.