UNIVERSITY OF HAWAIʻI

John A. Burns School of Medicine at Kakaʻako

CHEMICAL HYGIENE PLAN

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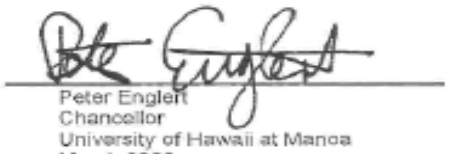
CONTENTS

PREFACE

The University of Hawaii has a fundamental obligation to safeguard the health, safety, and welfare of its students, personnel, and the visiting public whenever they participate in an official University activity. It is the policy of the University to provide for and maintain, through implementation of safety and health programs, conditions and practices that provide safe and healthful campus environments. In keeping with this commitment, this Chemical Hygiene Plan was developed as part of the UH Laboratory Safety Program.

The Chemical Hygiene Plan (CHP) is designed to protect laboratory personnel from potential hazards associated with the use of chemicals. It is for your reference while working with or around chemicals in laboratories at the University of Hawaii. Compliance is mandatory for all employees working in campus laboratories due to requirements of the Hawaii Occupational Safety and Health (HIOSH) division of the Department of Labor and Industrial Relations' standard on "Hazardous Chemicals In Laboratories". While these regulations pertain specifically to employees, provisions of the CHP apply to students and visitors depending on their activities when specified by supervisors.



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Chancellor
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INTRODUCTION

The objective of this Chemical Hygiene Plan (CHP) is to provide uniform requirements for safe use and disposal of potentially hazardous substances in University laboratories. A variety of hazardous chemicals are used in small quantities in research and teaching laboratories creating a unique environment with a number of risks. These chemicals may cause injury or damage because they are toxic, flammable, corrosive, or reactive with water and other materials. How these substances are handled will determine the degree of risk. General standard operating procedures are outlined, including work with select carcinogens, reproductive toxins, and substance with a high degree of acute toxicity. Specific standard operating procedures must be developed by each lab for operations posing a special hazard, for example, heating phosphoric acid, working with pyrophorics, conducting electrophoresis, distillations, extractions, etc. Maintaining a safe and healthy environment in the laboratory is ultimately the responsibility of the Supervisor or Principal Investigator. However, each individual is expected to conduct all operations and procedures involving chemicals in a safe and prudent manner.

I. PROGRAM ADMINISTRATION

A. WORKPLACE SAFETY COMMITTEE

1. Establish policies that will ensure that the University of Hawaii is in compliance with all federal, state, and local regulations, statutes, procedures, and principles relating to environmental and occupational safety, including in particular (1) the fire code, (2) the electrical code, and (3) the regulations relating to the purchase, storage, use, and disposal of hazardous chemicals. This task includes the review and maintenance of the UH Chemical Hygiene Plan (CHP).

2. Establish closeout procedures for hazardous chemical users that will minimize the hazardous waste burden to UH.

3. Review laboratory safety audit reports. In cases where problems have been noted by the Environmental Health and Safety Office (EHSO) and the responsible parties have been notified by the EHSO, initiate corrective actions if the problems have not been resolved within a reasonable amount of time.

4. Evaluate and approve the use of particularly hazardous substances such as select carcinogens, reproductive toxins, and highly acute toxins. Prepare a list of such substances to facilitate oversight and control/regulation of their use.

5. The JABSOM Health and Safety Coordinator and/or EHSO will evaluate laboratory accidents and chemical spills and will ask the WSC to initiate corrective action if needed to prevent the reoccurrence of such incidents.

6. In cases where correction of a workplace safety problem requires the expenditure of money, authorize, with the approval of the Executive Vice Chancellor, the funds needed to correct the problem.

7. Where necessary, intervene in EHSO inspection and enforcement actions (see Appendix XIII).

B. DEAN/DIRECTOR/DEPARTMENT CHAIR

1. Have the primary responsibility of establishing and maintaining a safe and healthy environment for their employees, students and visitors.

2. Ensure that laboratories and other chemical storage sites within the department comply with all CHP requirements.

3. Take corrective action in cases where an inspection by the EHSO has indicated that a hazard exists in the workplace that has not been corrected in a timely manner, including (but not limited to) electrical hazards, fire safety hazards and chemical hazards. The WSC will stipulate the nature of the corrective action. The hazardous condition will be judged to have been corrected only when an inspection by the EHSO indicates that the condition has been corrected.

4. Ensure that Principal Investigators follow the closeout procedures (see Appendix XII) and take measures to enforce them when necessary.

5. Assign responsibility for shared labs/facilities to one person.

C. JABSOM Health and Safety Coordinator

1. Provide technical assistance to the WSC, principal investigators, supervisors and employees.

2. Is the Chemical Hygiene Officer (CHO).

3. Conduct laboratory surveys, including air monitoring if required. The CHO must inform the WSC about any deficiencies that are not corrected in a timely manner.

4. Maintain all relevant records such as training, air monitoring results and laboratory surveys.

5. Assist principal investigators and supervisors in complying with the CHP.

6. Provide chemical safety training for all JABSOM Kaka‘ako employees as required by the CHP.

D. PRINCIPAL INVESTIGATOR/SUPERVISOR

1. Have direct and overall responsibility for safety and chemical hygiene in the laboratory/workplace. This includes following the policies and procedures of the CHP and correcting deficiencies found during JABSOM Health and Safety Coordinator audits in a timely manner.

2. Ensure that employees are informed of and follow the rules and procedures of the CHP.

3. Inform personnel about their workplace hazards. This information must include written Standard Operating Procedures (SOP's) that detail

operations the employees will conduct. These SOP's should include safety precautions that employees must follow.

4. Provide personal protective equipment (gloves, lab coats, goggles, etc.) for employees and ensure that they are used.

5. Conduct and document the appropriate chemical hygiene training, including emergency procedures, for all workers.

6. Periodically survey the workplace to ensure safe working conditions. These surveys should include inspection of all emergency equipment such as eyewashes, safety showers and spill kits. All defective equipment must be immediately reported to the appropriate department.

7. Review MSDS and other sources for information about special first aid requirements for chemicals, e.g., hydrogen fluoride and cyanogen bromide, and prepare accordingly.

8. Restrict access to areas where an inspection by the EHSO indicates that a hazardous condition exists.

9. Follow the closeout procedures when departing from the University (see Appendix XII).

10. Keep lab equipment and chemicals secure against theft or tampering. Keep the laboratory doors closed and locked when no one is present.

E. LABORATORY WORKERS

1. Know the hazardous properties of the chemicals they use so that proper safety precautions can be determined and followed.

2. Plan and conduct each operation in accordance with the general safety procedures specified in the CHP, as well as whatever additional specific procedures are required by the principal investigator/supervisor.

3. Develop and maintain good personal chemical hygiene practices.

4. Immediately report improperly functioning safety equipment such as fume hoods directly to the principal investigator/supervisor.

5. Promptly complete required safety training sessions.

6. Immediately report any occupational injury or illness to your principal investigator/supervisor.

7. Know the location and operation of emergency equipment such as eyewashes, safety showers, etc.

8. Be aware of emergency reporting and evacuation procedures.

9. Immediately inform the principal investigator/supervisor about any unsafe workplace conditions.

II. EMPLOYEE INFORMATION AND TRAINING

PI's shall ensure that information and training are 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. PI's may contact the CHO for assistance in providing training. Refresher training shall be conducted and documented at least annually.

A. INFORMATION

All laboratory personnel shall be informed of:

1. requirements of the HIOSH Standard, "Hazardous Chemicals in Laboratories" (Appendix III);

2. the contents and availability of this Chemical Hygiene Plan;

3. permissible exposure limits (PELs) for HIOSH regulated substances (Appendix IV) or recommended exposure limits where there is no applicable HIOSH standard;

4. signs and symptoms associated with exposures to hazardous chemicals used in their laboratory;

5. the location of reference materials (including electronic) on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to, Material Safety Data Sheets (MSDS's).

B. TRAINING

Employee training shall include:

1. the physical and health hazards associated with chemicals stored and used in their work area;

2. the contents of this Chemical Hygiene Plan;

3. methods and observations that may be used to detect the presence or release of a hazardous chemical (e.g., exposure monitoring conducted by the CHO, visual appearance or odor of hazardous chemicals when being released, etc.).

III. PRIOR APPROVAL CIRCUMSTANCES

Employees must obtain prior approval to proceed with a laboratory task from the CHO or appropriate EHSO personnel when:

A. Radioactive materials will be used. Contact the EHSO Radiation Safety Program (956-6475).

B. Recombinant DNA or any biological commodities will be used. Contact the EHSO Biological Safety Program (956-3197).

C. It is likely that exposure limit concentrations could be exceeded or that other harm could occur. Contact the CHO (956-3204).

D. Certain hazardous chemicals will be used which require prior approval from the EHSO Hazardous Material Management Program before purchase (956-3198). Refer to Appendix V for a list of these chemicals.

Employees must stop working and contact the JABSOM Health and Safety Coordinator to gain approval for continuing to work when:

A. There is failure or suspected failure of any equipment used in the process, especially of safeguards such as chemical fume hoods.

B. A member of the laboratory staff becomes ill and you know or suspect the illness is related to the work environment in the laboratory.

IV. STANDARD OPERATING PROCEDURES

A. GENERAL RULES

1. For chemicals they are working with, all employees should know:

    a. the chemical's hazards, as determined from a MSDS and other appropriate references;

    b. appropriate safeguards for using that chemical, including personal protective equipment;

    c. how to properly store the chemical when it is not in use;

    d. proper chemical waste disposal procedures (Appendix V);

    e. proper personal hygiene practices;

    f. proper methods of transporting chemicals outside the laboratory;

    g. appropriate procedures for emergencies, including first aid, evacuation routes, and spill cleanup procedures.

2. Employees should avoid working alone. Arrangements should be made between individuals working in separate laboratories outside of regular working hours to crosscheck each other periodically. Alternatively, JABSOM Kaka‘ako Security may be asked to check on the employee. Experiments known to be hazardous should not be undertaken by an employee who is alone in the laboratory.

3. In the event of a power outage, the procedures in listed in Appendix VI should be followed.

4. Individuals who are not properly trained in laboratory safety and the JABSOM Kaka’ako CHP (e.g. employees' children, guests, etc.) shall not be allowed in University laboratories unless closely supervised and monitored.

5. No animals, other than those approved for laboratory experimentation by the UH Institutional Animal Care and Use Committee (IACUC), shall be allowed in laboratories.

B. PERSONAL HYGIENE

1. Wash promptly whenever a chemical has contacted your skin.

2. Avoid inhalation of chemicals. Do not "sniff" to test chemicals.

3. Do not use mouth suction to pipet anything. Pipetting aids must be used at all times.

4. Do not bring food (including gum and candy), beverages, tobacco, or cosmetic products into chemical storage or use areas. Eating, drinking, and applying cosmetics is allowed in designated areas only. Smoking is prohibited in all University facilities.

5. Wash well with soap and water before leaving the laboratory. Avoid the use of solvents for washing skin. Solvents remove the natural protective oils from skin and can cause irritation and inflammation. In some cases, washing with solvent may facilitate absorption of toxic chemicals.

C. PROTECTIVE CLOTHING AND EQUIPMENT

1. Carefully inspect all protective equipment prior to use. Do not use defective equipment.

2. When the potential for a splash hazard is present (e.g. chemistry laboratories), eye protection in the form of chemical-resistant goggles shall be worn at all times in the laboratory. Ordinary prescription glasses and/or standard safety glasses are not considered effective eye protection since they lack necessary shielding. Chemical-resistant goggles should be worn over the glasses for employees who wear corrective lenses.

3. Consult with an optometrist prior to wearing contacts in the laboratory. Chemical-resistant goggles must be worn over contacts at all times.

4. When working with corrosive, toxic, allergenic, or sensitizing chemicals, rough or sharp-edged objects, very hot or very cold materials, gloves made of material known to be protective for the hazard shall be worn. No one glove can protect against all hazards. Cloth gloves, while not appropriate for use around liquids, can protect against light abrasive materials and moderate temperature changes. Synthetic or rubber gloves protect against corrosives, solvents, and poisons. Leather gloves, often used for tasks like welding, protect against sparks, heat, & rough abrasives. Consult the manufacturer's performance chart or contact the Chemical Hygiene Officer to determine the proper choice of glove material. Appendix X has a glove selection chart that can be used to inform glove choices.

5. Low-heeled shoes with fully covered uppers shall be worn at all times in the laboratory. Shoes or sandals with open toes shall not be worn.

6. Long pants and garments with long sleeves must be worn when working with or around chemicals.

7. Long hair should be held in place behind the head.

8. Caution should be taken when wearing loose clothing not to inadvertently allow cuffs, sleeves, or other materials to knock over or absorb chemicals.

9. A full-body-length rubber, plastic, or neoprene apron appropriate for the material being handled should be worn if there is risk of splash or spill.

10. A proper respirator must be worn whenever exposure by inhalation is likely to exceed the action level or PEL and a fume hood is not accessible. Procedures specified in the UHM Respiratory Protection Program must be followed. Employees must be medically qualified, trained, and fit-tested prior to using a respirator. Contact the CHO before doing any work requiring a respirator.

11. Remove all PPE before leaving the laboratory.

D. HOUSEKEEPING

Housekeeping is directly related to safety and must be given importance of equal value to other procedures. Lack of good housekeeping reduces work efficiency and may result in accidents. Laboratory personnel must adhere to the following:

1. All work areas, especially laboratory benchtops, should be kept clear of clutter.

2. Access to emergency equipment, showers, eyewashes, fire extinguisher, exits and circuit breakers shall never be blocked or obstructed.

3. All aisles, corridors, stairs, and stairwells shall be kept clear of chemicals, equipment, supplies, boxes, and debris.

4. Each laboratory must have a puncture resistant container (e.g., cardboard box) lined with plastic specifically designated for glassware disposal.

5. Food and drink for human consumption shall not be kept in the same refrigerator used to store chemicals and laboratory samples. Eating and office areas must be clearly separated from laboratory and chemical storage areas.

E. CHEMICAL MANAGEMENT

1. Chemical containers should be regularly monitored for proper labeling and container integrity. Labels which are fading, falling off, or deteriorating must be promptly replaced. If abbreviations are used, they should be kept to a minimum and clearly identify the contents of the container as well as hazards associated with use; e.g., $HgCl_2$/poison, HCl/corrosive, MeOH/flammable, H_2O_2/corrosiveoxidizer, nonhazardous buffer, etc. Improperly or unlabeled chemicals make hazard identification and disposal difficult, and may create a health hazard.

2. Segregate all chemicals in storage according to hazard class. The main hazard classes are flammable/combustible, oxidizer, acid, and base. See Appendix XI for more detailed chemical storage guidelines.

3. All chemicals should be placed in their proper storage areas at the end of each workday. Chemicals shall not be stored on desks, laboratory benchtops, floors, or in aisles.

4. Secondary containers (flasks, beakers, reaction vessels, etc.) should be labeled unless they are under the immediate control of the user. At the end of each workday, all unlabeled containers are to be labeled as to their contents or the contents must be disposed of as waste.

5. Chemical wastes must be clearly labeled including hazard identification, and stored according to hazard class. Refer to the Hazardous Material Management Plan in Appendix V for requirements.

6. Maintain an inventory of all chemicals in the laboratory, including all containers of chemicals in use or in storage, but excluding working solutions, synthetic intermediates, biological samples, chemical extracts, and waste. The chemical inventory should be kept in the laboratory's Chemical Hygiene Plan binder and updated annually. The inventory should include, at a minimum, the chemical name, the amount, the storage location, and the hazard class (see Appendix XI for guidelines). Appendix XIV contains a sample inventory form that may be used.

F. FLAMMABLE MATERIALS

Precautions for safe handling of flammable materials include the following:

1. Storage and handling of flammable and combustible substances shall be conducted in accordance with the requirements in Appendix VII.

2. Flammable substances shall be handled only in areas free of ignition sources.

3. Flammable substances should never be heated by using an open flame. Preferred heat sources include steam baths, water baths, oil baths, heating mantles, and hot air baths.

4. Class I liquids (see Appendix VII) shall not be transferred from one vessel to another in any exit passage way.

5. Transfer of flammable liquids shall be conducted in a laboratory fume hood or an approved flammable liquid storage room.

6. Empty containers (no pourable liquid remaining) shall be treated in the following manner:

    a. For water soluble solvents: triple rinse, deface the label, and dispose empty container appropriately.

    b. For non-water soluble solvents: allow to evaporate to dryness in a hood, deface the label, and dispose empty container appropriately.

G. REACTIVE CHEMICALS

A reactive chemical is one that:

1. Fits the HIOSH definition of "unstable" in 12-204-2 (Appendix III): "Unstable (reactive) means a chemical which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure, or temperature, or

2. Is ranked by the National Fire Protection Association (NFPA) as 3 or 4 for reactivity, or

3. Is identified by the Department of Transportation (DOT) as:

a. an oxidizer, or

b. an organic peroxide, or

c. a class A, B, or C explosive.

4. Violently reacts with exposure to water or air.

Handle reactive chemicals with all proper safety precautions. This includes designating a separate storage area, monitoring periodically for degradation, and using appropriate personal protection.

H. CORROSIVE CHEMICALS

1. Materials are classified as corrosive if they:

a. are capable of rapidly eroding building materials or metals, or
b. burn, irritate or destructively attack organic tissues such as skin, eyes, lungs and stomach.

Examples of commonly used chemicals that have corrosive properties are:

glacial acetic acid	hydrofluoric acid	hydrochloric acid
fluorine	nitric acid	bromine
sulfuric acid	chlorine	sodium hydroxide

Safe handling procedures will vary with each operation and the type and concentration of the corrosive chemical. Refer to the MSDS for specific safe handling procedures.

2. The following general guidelines should be followed for procedures involving acids and bases:

a. Never pour water into acid. Slowly add the acid to the water and stir.

b. Open bottles or carboys slowly and carefully, wearing protective equipment to guard hands, face, and body.

c. Suitable facilities, such as a safety shower and eyewash, shall be located within 50 feet or 10 seconds of the work area for quick drenching or flushing of the eyes and body. PI's shall ensure eyewash stations are flushed once every quarter.

d. Procedures requiring the use of concentrated acids and bases should be conducted in a fume hood.

e. Never mix acid wastes with other materials such as solvents, metalcontaminated solutions, etc. Noncontaminated acid wastes can be easily disposed by neutralization. Never dispose of acids or bases in the sanitary sewer system (i.e., down the drain) until neutralized (pH 5.5-8.5). Neutralization should be conducted in a fume hood, then the solution poured slowly down the drain with copious amounts of water; i.e., leave the water running for approximately 5 minutes.

f. When disposable containers are completely emptied of their contents, flush them thoroughly with water before throwing them away.

g. Contact JABSOM Health and Safety Coordinator (see Appendix V) for assistance with disposal of large quantities (more than 2 gallons or 1 pound) of acids and bases.

I. COMPRESSED GAS CYLINDERS

Use of compressed gases in the laboratory requires anticipating chemical, physical, and health hazards. Cylinders that are knocked over or dropped can be very dangerous. If a valve is knocked off, the cylinder can become a lethal projectile. Accidental releases may result in an oxygen deficient atmosphere or adverse health effects. In short, improper handling and use can cause structural damage, severe injury, and possibly death.

The following guidelines will help ensure safe handling, use, and storage of compressed gas cylinders.

RECEIVING AND STORAGE

1. Be sure to arrange a return agreement with suppliers prior to purchase since disposal of compressed gas cylinders is difficult and very expensive. Retain all documentation such as purchase orders to facilitate return of cylinders to the manufacturer.

2. Cylinders should not be accepted unless the cylinder contents are clearly labeled. Color code only should not be accepted, since it does not constitute adequate labeling.

3. Do not accept cylinders which are damaged or do not have a valve protection cap.

4. All gas cylinders in use shall be secured in an upright position in racks, holders, or clamping devices. When cylinders are grouped together, they should be individually secured and conspicuously labeled on the neck area.

5. Oxygen cylinders shall be separate from combustible materials (e.g. oils, greases, fuels, acetylene, etc.) a minimum distance of 20 ft or by a noncombustible barrier at least five feet high having a fire resistant rating of at least 1/2 hour. Systems and components used for other gases and must never be used for oxygen or interconnected with oxygen.

6. Cylinders should have current hydrostatic test date (normally less than 5 years old for steel and 3 years old for aluminum) engraved on the cylinder. Cylinders should be returned to the supplier for servicing prior to the expiration date.

7. Do not place cylinders near heat, sparks, or flames or where they might become part of an electrical circuit.

8. Do not store cylinders in exit corridors or hallways.

HANDLING AND USE

1. Only Compressed Gas Association fittings and components are permitted for use with gas cylinders. Only use regulators approved for the type of gas in the cylinder. Do not use adapters to interchange regulators. Never lubricate any fitting or component of a gas cylinder.

2. Before opening the cylinder valve, be sure that the T-valve is backed out and turns loosely. Open cylinder valves slowly and be sure that the T-valve is not facing anyone, including yourself. Never force a gas cylinder valve. If the valve cannot be opened by the wheel or small wrench provided, the cylinder should be returned.

3. No attempt shall be made to transfer gases from one cylinder to another, to refill cylinders, or to mix gases in a cylinder in the laboratory.

4. All cylinders are to be considered full unless properly identified as empty by the user. Empty cylinders must be returned to the supplier and not accumulated.

5. Compressed gases must not be used to clean your skin or clothing.

6. Never heat cylinders to raise internal pressure.

7. Do not use copper (>65%) connectors or tubing with acetylene. Acetylene can form explosive compounds with copper, silver, and mercury.

8. Always leave at least 30 psig minimum pressure in all "empty" cylinders. Do not leave an empty cylinder attached to a pressurized system.

TRANSPORTATION

1. Gas cylinders must be transported with carts/hand-trucks that are designed for transporting gas cylinders.

2. Safety chain or strap on cart/hand-truck must be used to secure the gas cylinder.

3. Certain gases (such as Liquid Nitrogen) that can displace oxygen and cause asphyxiation *cannot* be transported in an occupied passenger elevator. These gases must be transported in an open-air freight elevator, or if one is not available, an *unoccupied* passenger elevator may be used.

V. CONTROL MEASURES

A. VENTILATION

1. Laboratory ventilation is normally designed to provide eight air changes per hour. This flow is not necessarily sufficient to prevent accumulation of chemical vapors. Laboratory work shall be conducted in a fume hood, glove box, or similar device when:

   a. Procedures call for work with toxic substances which are volatile; i.e., evaporate at normal temperature and pressure, or

   b. There is a possibility the action level or PEL (see Appendix III) will be exceeded.

2. The protection provided by the laboratory fume hoods is dependent upon two important factors:

a. proper use of the hood, and

b. maintenance of adequate airflow through the hood.

3. The way the hood is used will determine the degree of protection it will provide. Each employee is responsible for implementing the following work practices when using a hood.

   a. Continually monitor air being drawn into the hood by attaching a kim wipe or light-weight strip of paper to the bottom of the sash.

   b. Operate the hood at the proper sash position; i.e., maximum 12 inch sash height for hoods with vertical sliding (up and down) sashes and the sashes closed as much as possible for hoods with horizontal sliding (left and right) sashes. This helps to ensure optimum protection when conducting operations in the hood. A small sash opening maximizes air velocity through the hood face and may provide additional protection from unexpected splashes or chemical reactions.

   c. Avoid using the hood for storage of bottles and equipment, especially along the back wall. Any apparatus that must be housed within the hood should fit completely inside the hood. Elevate the apparatus on blocks (at least 2 inches off the benchtop) to allow air to flow freely around and beneath.

   d. Manipulations within the hood should be performed at least 6 inches inside the face of the hood or as far towards the back of the hood as possible. This minimizes the possibility of contaminants escaping from the hood.

   e. Fully close the hood sash and turn off the fan (if possible) when the hood is not in use. The fan should remain on if volatile materials are being temporarily (i.e., for the duration of a current project) stored in the hood.

   f. Things which cause air turbulence across the face of the hood such as fans, window air conditioning units, or excessive movement should be avoided.

   g. Exhaust hoods do not provide adequate protection for all operations involving toxic materials. A higher level of containment should be used for procedures where minor contamination can be serious. If you are in doubt about the

level of containment needed for your operation, ask your PI or contact the CHO.

4. The JABSOM Health and Safety Program and EHSO conduct annual surveys of fume hoods to ensure adequate airflow is maintained through the hood face. Face velocities should be between 80 and 120 feet per minute (fpm) with the sash lowered to within one foot of the bottom of the hood. Hoods that do not meet these minimum standards are considered "inadequate" and should not be used for protection from toxic or volatile materials. Contact the JABSOM Health and Safety Coordinator (692-1855) if you suspect the hood is not working properly.

5. At no time shall laboratory fume hood alarms be tampered with or disabled. Upon activation of the alarm, work within the hood should cease and facilities and/or the JABSOM Health and Safety Coordinator (692-1855) must be notified.

B. SPILL CLEAN-UP PROCEDURES

The range and quantity of hazardous substances used in laboratories requires preplanning to respond safely to chemical spills. The cleanup of a chemical spill should only be done by knowledgeable and experienced personnel. Spill kits with instructions, adsorbents, reactants, and protective equipment are required in all JABSOM Kaka’ako labs to use in the event of a minor spill. A minor spill is one that does not spread rapidly, does not endanger people or property except by direct contact, does not endanger the environment, and the laboratory staff is capable of handling safely without the assistance of safety and emergency personnel. All other chemical spills are considered major. In the event of a major spill the following procedures shall be carried out:

1. Attend to anyone who may be hurt or contaminated if it can be accomplished without endangering yourself.

2. If flammable materials are spilled, de-energize electrical devices if can be done without endangering yourself.

3. Call the JABSOM Health and Safety Coordinator (692-1855).

In the event of a minor spill the following procedures shall be carried out:

1. Attend to anyone who may have been contaminated or hurt.

2. Ensure that the fume hood(s) is on. Open windows where possible to increase exhaust ventilation and if the spilled material is flammable, turn off all ignition and heat sources.

3. Secure cleanup supplies. Neutralize acids and bases, if possible. Ensure protective apparel is resistant to the spill material.

4. Control the spread of the liquid by containing the spill.

5. Absorb the liquid by adding appropriate absorbent materials from the spill's outer edges toward the center.

6. Collect and contain the cleanup residues by scooping it into a plastic bucket or other appropriate container.

7. Properly dispose of the waste as hazardous waste.

8. Decontaminate the area and affected equipment. Ventilating the spill area may be necessary.

9. Document what happened, why, what was done, and what was learned. Such documentation can be used to avoid similar instances in the future. Major incidents are almost always preceded by numerous near misses.

In any event, there should be supplies and equipment on hand to deal with the spill, consistent with the hazards and quantities of the spilled substance. These cleanup supplies should include neutralizing agents (such as sodium carbonate or sodium bisulfate) and absorbants (such as vermiculite and sand). Paper towels and sponges may also be used as absorbent-type cleanup aids, although this should be done cautiously. For example, paper towels used to clean up a spilled oxidizer may later ignite, and appropriate gloves should be worn when wiping up highly toxic material with paper towels. Also, when a spilled flammable solvent is absorbed in vermiculite or sand, the resultant solid is highly flammable and gives off flammable vapors and, thus, must be properly contained or removed to a safe place. If you have questions regarding spill clean up requirements please contact the JABSOM Health and Safety Coordinator (692-1855).

VI. EXPOSURE MONITORING

Exposure monitoring shall be performed when there is reason to believe that exposures are in excess of the action-level or the PEL. Materials which require monitoring under these conditions are listed in Appendix III. If an employee would like to have an exposure assessment conducted, the JABSOM Health and Safety Coordinator (692-1855) should be contacted. Exposure assessments and

monitoring may be conducted by the JABSOM Health and Safety Coordinator (692-1855) or UH Industrial Hygienist. Documentation of exposure monitoring shall be kept and maintained as part of each employee's personnel record.

VII. MEDICAL CONSULTATIONS AND EXAMINATIONS

Employees shall be provided an opportunity to receive medical attention, including any related follow-up examinations, at the University's expense, under the following circumstances:

1. An individual develops signs or symptoms associated with exposure to hazardous chemicals in the laboratory.
2. Exposure monitoring reveals an exposure level routinely above the action level or PEL for a HIOSH regulated substance for which there are exposure monitoring and medical surveillance requirements.
3. An accident such as a spill, leak, equipment failure, or explosion results in possible over-exposure to hazardous chemicals.

The PI and department Personnel Offices are responsible for establishing and maintaining an accurate record of any medical consultations and examinations provided to an employee.

VIII. SELECT CARCINOGENS, REPRODUCTIVE TOXINS, HIGHLY ACUTE TOXINS

The procedures described in this section are mandatory when performing laboratory work with greater than 10 mg or 100 mL of any carcinogen, reproductive toxin, or substance that has a high degree of acute toxicity.

A. DEFINITIONS

1. Select carcinogens: any substance defined as such in Title 12 Chapter 204-2 (refer to Appendix III page 204-2-4, and Appendix VIII).

2. Reproductive toxin: chemicals that affect reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

3. Highly Acute Toxin is any substance for which:

   a. the median oral LD_{50} is less than or equal to 50 mg/kg when administered orally to albino rats, or

   b. the median inhalation lethal concentration, LC_{50}, value is less than or equal to 200 ppm by volume of gas or vapor, or 2 mg/liter or less of dust, mist, or fume when administered continuously for one hour or less to albino rats, or

   c. the median LD_{50} is less than or equal to 200 mg/kg when administered by continuous contact for 24 hours or less with the bare skin of albino rabbits.

4. Designated area: a hood, glove box, portion of a laboratory, or an entire laboratory room, designated as the only area where work shall be conducted with quantities of select carcinogens, reproductive toxins, or highly acute toxins in excess of the limits specified above.

B. DESIGNATED AREA

Access to designated areas shall be restricted. Only trained employees will be allowed to work with chemicals in the designated area. All such persons will:

1. Use the smallest amount of chemical that is consistent with the requirement of the work to be done.

2. Always use these chemicals in a hood with adequate airflow (face velocity between 80 and 120 feet per minute with the sash one foot from the work surface of the hood) or other containment device for procedures which may result in the generation of aerosols or vapors containing the substance.

3. Use high-efficiency particulate air (HEPA) filters or high-efficiency scrubber systems to protect vacuum lines and pumps.

4. Contact the JABSOM Health and Safety Coordinator (692-1855) for more information about reproductive toxins. A partial list of reproductive toxins is listed in Appendix IX.

5. Decontaminate designated areas before normal work is resumed there. This includes contaminated equipment.

6. Remove any protective apparel, place it in an appropriately labeled container, thoroughly wash hands, forearms, face, and neck on leaving a designated area.

7. Prepare wastes for disposal in accordance with the JABSOM Kakaʻako Hazardous Material Management Program (Appendix V).

8. Do not wear jewelry when working in designated areas since decontamination of jewelry may be difficult or impossible.

APPENDIX I

EMERGENCY TELEPHONE NUMBERS

JABSOM KAKA'AKO SECURITY (24 Hours) 692-1911 or 692-0911

EMERGENCY SERVICES (HPD, HFD, EMT, etc) 911

POISON CENTER 941-4411

John A. Burns School of Medicine (JABSOM) Safety Resources

JABSOM Health and Safety Program 692-1855
Paul De Soto, JABSOM Health & Safety Coordinator

Facilities Management Office
Work Requests 692-0913

UH Environmental Health & Safety Office (EHSO) Resources

Laboratory Safety 956-5180
Hans Nielsen, Chemical Hygiene Officer

Biological Safety 956-3197
Hubert Olipares, Biological Safety Officer

Radiation Safety 956-6475
Irene Sakimoto, Radiation Safety Officer

Industrial Hygiene 956-3204
Emma Kennedy, Industrial Hygienist

Hazardous Waste Disposal 956-3198
Tim O'Callaghan, Hazardous Material Management Officer

HMMP Training/Auditing 956-3201
Loren Kaehn, Environmental and Occupational Safety Specialist

Diving Safety 956-6420
Dave Pence, Diving Safety Officer

Fire Safety 956-4953
Junior Gappe, Fire Safety Officer

Environmental Compliance 956-9173
Stacie Cheramie, Environmental Compliance Officer

APPENDIX II

LABORATORY INSPECTION CHECKLIST

LABORATORY CHECK-UP

DATE:_____

BLDG/ROOM: _____

PI/LAB SUP:_____

I. GENERAL (YES/NO and COMMENTS)

a. Laboratory work and storage areas are clean and orderly?

b. Emergency notification procedures, contacts, and phone numbers are posted?

c. First aid kit readily accessible? Adequately stocked?

d. Aisles have minimum 28 inches clearance?

e. Food is stored properly; i.e., not in refrigerators or cabinets used to store laboratory samples or chemicals?

f. Bicycles are not stored in the laboratory?

g. Safety guards are in place for equipment with moving parts (belts, fans, sawblades)?

h. Multi-outlet connectors (power strips) are secured?

i. Equipment cord insulation is intact; i.e., not cracked or frayed?

j. Equipment is grounded?

k. A trash container is specifically designated for glass?

l. No trip hazards (e.g., cords, equipment, etc.)?

m. Safety shower and/or eyewash stations are unobstructed and testing is up to date?

n. Exit doors are unobstructed?

o. A fire extinguisher is readily accessible? Inspection date current?

Notes:

II. HAZARDOUS CHEMICALS & WASTE (YES/NO and COMMENTS)

a. All containers are intact and properly labeled, including hazard identification?

b. Chemicals and waste are segregated by hazard class and chemical compatibility?

c. Glass containers not stored on floor?

d. Flammable liquids are properly stored and handled?

e. Peroxide forming compounds are properly stored and labeled with last date opened?

f. Water and air reactive compounds are properly stored?

g. Gas cylinders are stored properly (secured upright, valve cap in place when not in use)?

h. Waste is properly labeled and stored in a satellite accumulation area?

i. Old chemicals have been disposed?

j. Chemical spill kit(s) present in the lab (right spill kit for the type of work being done)?

k. Household-type refrigerators are not used for flammable liquid storage?

l. Fume Hood/Biological Safety Cabinet certification up to date?

III. CHEMICAL HYGIENE PLAN (YES/NO and COMMENTS)

a. Written plan is current? Readily accessible?

b. Laboratory personnel training is up-to-date? Documented?

c. Material Safety Data Sheets and other references are readily accessible in the lab?

d. Lab personnel are wearing appropriate PPE? Eye Protection? Gloves? Other?

NOTES:

Inspection conducted by:

APPENDIX III

"HAZARDOUS CHEMICALS IN LABORATORIES"

STATE OF HAWAII OCCUPATIONAL SAFETY & HEALTH STANDARDS

ADMINISTRATIVE RULES

TITLE 12 DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS

SUBTITLE 8

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH

CHAPTER 204

HAZARDOUS CHEMICALS IN LABORATORIES

§12-204-1 Purpose

(a) The purpose of this chapter is to prescribe minimum performance standards for the maintenance of employee health and safety that reflect the unique workplace circumstances of laboratories and the risks associated with the use of multiple hazardous substances in these environments.

(b) Scope and application.
(1) This chapter shall apply to all employers engaged in the laboratory use of hazardous chemicals as defined below.

(2) Where this chapter applies, it shall supersede, for laboratories, the requirements of all other DOSH health standards in chapter 12-202, except as follows:

(A) For any DOSH health standard, only the requirement to limit employee exposure to the specific permissible exposure limit shall apply for laboratories, unless that particular standard states otherwise or unless the conditions of subparagraph (C) below apply.

(B) Prohibition of eye and skin contact where specified by any DOSH health standard shall be observed.

(C) Where the action level (or in the absence of an action level, the permissible exposure limit) is routinely exceeded for a DOSH regulated substance with exposure monitoring and medical surveillance requirements, sections 12-204-4 and 12-204-8 shall apply.

(3) This chapter shall not apply to:

(A) Uses of hazardous chemicals which do not meet the definition of laboratory use, and in such cases, the employer shall comply with the relevant standard in chapters 12-202 and 12-203, even if such use occurs in a laboratory.

(B) Laboratory uses of hazardous chemicals which provide no potential for employee exposure. Examples of such conditions might include:

(i) Procedures using chemically-impregnated test media such as Dip-and-Read tests where a reagent strip is dipped into the specimen to be tested and the results are interpreted by comparing the color reaction to a color chart supplied by the manufacturer of the test strip; and

(ii) Commercially prepared kits such as those used in performing pregnancy tests in which all of the reagents needed to conduct the test are contained in the kit. [Eff. 3/22/91; am 6/8/92] (Auth: HRS §396-4) (Imp: HRS §396-4)

§12-204-2 Definitions

As used in this chapter:

"Action level" means a concentration for a specific substance, calculated as an 8-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

"Carcinogen" (see "select carcinogen").

"Chemical Hygiene Officer" means an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organizational structure.

"Chemical Hygiene Plan" means a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that:

(1) Are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace; and

(2) Meets the requirements of section 12-204-5.

"Combustible liquid" means any liquid having a flashpoint at or above 100° F (37.8° C), but below 200° F (93.3° C), except any mixture having components with flashpoints of 200° F (93.3° C), or higher, the total volume of which make up 99 per cent or more of the total volume of the mixture.

"Compressed gas" means:

(1) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70° F (21.1° C); or

(2) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130° F (54.4° C) regardless of the pressure at 70° F (21.1° C); or

(3) A liquid having a vapor pressure exceeding 40 psi at 100° F (37.8° C) as determined by ASTM D-323-72.

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

"Emergency" means any occurrence such as, but not limited to, equipment failure, rupture of containers or failure of control equipment which results in an

uncontrolled release of a hazardous chemical into the workplace.

"Employee" means an individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.

"Explosive" means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

"Flammable" means a chemical that falls into one of the following categories:

(1) "Aerosol, flammable" means an aerosol that yields a flame projection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;

(2) "Gas, flammable" means:

(A) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 per cent by volume or less; or

(B) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 per cent by volume, regardless of the lower limit;

(3) "Liquid, flammable" means any liquid having a flashpoint below 100° F (37.8° C), except any mixture having components with flashpoints of 100° F (37.8° C) or higher,
the total of which make up 99 per cent or more of the total volume of the mixture.

(4) "Solid, flammable" means a solid, other than a blasting agent or explosive as defined in section 12-98-1, that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing; or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if it ignites and burns with a self-sustained flame at a rate greater than 1/10 of an inch per second along its major axis.

"Flashpoint" means the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows:

(1) Tagliabue Closed Tester (See American National Standard Method of Test for Flash Point by Tag Closed Tester, Z11.24-1979 (ASTM D 56-79))--for liquids with a viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100° F (37.8° C), that do not contain suspended solids and do not have a tendency to form a surface film under test; or

(2) Pensky-Martens Closed Tester (see American National Standard Method of Test for Flash Point by Pensky-Martens Closed Tester, Z11.7-1979 (ASTM D 93-79))--for liquids with a viscosity equal to or greater than 45 SUS at 100° F (37.8° C), or that contain suspended solids, or that have a tendency to form a surface film under test; or

(3) Setaflash Closed Tester (see American National Standard Method of Test for Flash Point by Setaflash Closed Tester (ASTM D 3278-78)). Organic peroxides, which undergo auto accelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.

"Hazardous chemical" means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees.

The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes. (Appendices A and B of the Hazard Communication Standard chapter 12-203 provide further guidance in defining the scope of health hazards and determining whether or not a chemical is to be considered hazardous for purposes of this standard.)

"Laboratory" means a facility where the "laboratory use of hazardous chemicals" occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

"Laboratory scale" means work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and

safely manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials.

"Laboratory-type hood" means a device located in a laboratory, enclosed on five sides with a moveable sash or fixed partial enclosure 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.

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 chemicals.

"Laboratory use of hazardous chemicals" means handling or use of such chemicals in which all of the following conditions are met:

(1) Chemical manipulations are carried out on a "laboratory scale";

(2) Multiple chemical procedures or chemicals are used;

(3) The procedures involved are not part of a production process, nor in any way simulate a production process; and

(4) "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

"Medical consultation" means a consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to hazardous chemical may have taken place.

"Organic peroxide" means an organic compound that contains the bivalent -0-0-structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

"Oxidizer" means a chemical other than blasting agent or explosive as defined in section 12-98-1, that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

"Physical hazard" means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, or organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive.

"Protective laboratory practices and equipment" means those laboratory procedures, practices and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.

"Reproductive toxins" means chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

"Select carcinogen" means any substance which meets one of the following criteria:

(1) It is regulated by DOSH as a carcinogen; or

(2) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or

(3) It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or

(4) It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

(A) 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/m^3;

(B) After repeated skin application of less than 300 mg/kg of body weight per week; or

(C) After oral dosages of less than 50 mg/kg of body weight per day.

"Unstable (reactive)" means a chemical which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.

"Water-reactive" means a chemical that reacts with water to release a gas that is either flammable or presents a health hazard. [Eff. 3/22/91] (Auth: HRS §396-4) (Imp: HRS §396-4)

§12-204-3 Permissible exposure limits.

For laboratory uses of DOSH regulated substances, the employer shall ensure that laboratory employees' exposures to such substances do not exceed the permissible exposure limits specified in chapter 12-202. The permissible exposure limit for this standard refers to any DOSH exposure limit whether it be a TWA (time weighted average), STEL (short term exposure limit), or ceiling. [Eff. 3/22/91] (Auth: HRS §396-4) (Imp: HRS §396-4)

§12-204-4 Employee exposure determination.

(a) Initial monitoring. The employer shall measure the employee's exposure to any substance regulated by a standard in chapter 12-202 which requires monitoring if there is reason to believe that exposure levels for that substance routinely exceed the action level (or in the absence of an action level, the PEL).

(b) Periodic monitoring. If the initial monitoring discloses employee exposure over the action level (or in the absence of an action level, the PEL), the employer shall immediately comply with the exposure monitoring provisions of the relevant standard in chapter 12-202.

(c) Termination of monitoring. Monitoring may be terminated in accordance with the relevant standard in chapter 12-202.

(d) Employee notification of monitoring results. The employer shall, within 15 working days after the receipt of any monitoring results, notify the employee of these results in writing either individually or by posting results in an appropriate location that is accessible to employees. [Eff. 3/22/91] (Auth: HRS §396-4) (Imp: HRS §396-4)

§12-204-5 Chemical hygiene plan.

(a) Where hazardous chemicals as defined by this standard are used in the workplace, the employer shall develop and carry out the provisions of a written

Chemical Hygiene Plan which is:

(1) Capable of protecting employees from health hazards associated with hazardous chemicals in that laboratory; and

(2) Capable of keeping exposures below the limits specified in section 12-204-3.

(b) The Chemical Hygiene Plan shall be readily available to employees, employee representatives and, upon request, to the director, and director's representative.

(c) The Chemical Hygiene Plan shall include each of the following lements and shall indicate specific measures that the employer will take to ensure laboratory employee protection:

(1) Standard operating procedures to be followed when laboratory work involves the use of hazardous chemicals;

(2) Criteria that the employer will use to determine and implement control measures to reduce employee exposure to hazardous chemicals including engineering controls, the use of personal protective equipment and hygiene practices; particular attention shall be given to the selection of control measures for chemicals that are known to be extremely hazardous;

(3) A requirement that fume hoods and other protective equipment are functioning properly and specific measures that shall be taken to ensure proper and adequate performance of such equipment;

(4) Provisions for employee information and training as prescribed in section 12-204-7;

(5) The circumstances under which a particular laboratory operation, procedure, or activity shall require prior approval from the employer or the employer's designee before implementation;

(6) Provisions for medical consultation and medical examinations in accordance with section 12-204-8;

(7) Designation of personnel responsible for implementation of the Chemical Hygiene Plan including the assignment of a Chemical Hygiene Officer and, if appropriate, establishment of a Chemical Hygiene Committee; and

(8) Provisions for additional employee protection for work with particularly hazardous substances. These include "select carcinogens," reproductive toxins, and substances which have a high degree of acute toxicity. Specific consideration shall be given to the following provisions which shall be included where appropriate:

(A) Establishment of a designated area;

(B) Use of containment devices such as fume hoods or glove boxes;

(C) Procedures for safe removal of contaminated waste; and

(D) Decontamination procedures.

(d) The employer shall review and evaluate the effectiveness of the Chemical Hygiene Plan at least annually and update it as necessary. Appendix A is non-mandatory but provides guidance to assist employers in the development of the Chemical Hygiene Plan.) [Eff. 3/22/91] (Auth: HRS §396-4) (Imp: HRS §396-4)

§12-204-6 Hazard identification.

(a) With respect to labels and material safety data sheets:

(1) Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced.

(2) Employers shall maintain any material safety data sheets that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible to laboratory employees.

(b) The following provisions shall apply to chemical substances developed in the laboratory:

(1) If the composition of the chemical substance which is produced exclusively for the laboratory's use is known, the employer shall determine if it is a hazardous chemical as defined in section 12-204-2. If the chemical is determined to be hazardous, the employer shall provide appropriate training as required under section 12-204-7;

(2) If the chemical produced is a byproduct whose composition is not known, the employer shall assume that the substance is hazardous and shall follow the procedures in section 12-204-5; and

(3) If the chemical substance is produced for another user outside of the laboratory, the employer shall comply with chapter 12-203 including the requirements for preparation of material safety data sheets and labeling. [Eff. 3/22/91] (Auth: HRS §396-4) (Imp: HRS §396-4)

§12-204-7 Employee information and training.

(a) The employer shall provide employees with information and training to ensure that they are apprised of the hazards of chemicals present in their work area.

(b) Such information shall 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. The frequency of refresher information and training shall be determined by the employer.

(c) Information. Employees shall be informed of:

(1) The contents of this standard and its appendices which shall be made available to employees;

(2) The location and availability of the employer's Chemical Hygiene Plan;

(3) The permissible exposure limits for DOSH regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable DOSH standard;

(4) Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory; and

(5) The location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to, material safety data sheets received from the chemical supplier.

(d) Training.

(1) Employee training shall include:

(A) Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by the employer or chemical hygiene officer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

(B) The physical and health hazards of chemicals in the work area; and

(C) The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used.

(2) The employee shall be trained on the applicable details of the employer's written Chemical Hygiene Plan. [Eff. 3/22/91] (Auth: HRS §396-4) (Imp: HRS §396-4)

§12-204-8 Medical consultation and medical examinations.

(a) The employer shall provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary, under the following circumstances:

(1) Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the

laboratory, the employee shall be provided an opportunity to receive an appropriate medical examination.

(2) Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for a DOSH regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance shall be established for the affected employee as prescribed by the particular standard.

(3) Whenever an accident takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee shall be provided an opportunity for a medical consultation. Such consultation shall be for the purpose of determining the need for a medical examination.

(b) All medical examinations and consultations shall be performed by or under the direct supervision of a licensed physician and shall be provided without cost to the employee, without loss of pay, and at a reasonable time and place.

(c) Information provided to the physician. The employer shall provide the following information to the physician:

(1) The identity of the hazardous chemical(s) to which the employee may have been exposed;

(2) A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and

(3) A description of the signs and symptoms of exposure that the employee is experiencing, if any.

(d) Physician's written opinion.

(1) For each examination or consultation required under this standard, the employer shall obtain a written opinion from the examining physician which shall include the following:

(A) Any recommendation for further medical follow-up;

(B) The results of the medical examination and any associated tests;

(C) Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous chemical found in the workplace; and

(D) A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

(2) The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure. [Eff. 3/22/91] (Auth: HRS §396-4) (Imp: HRS §396-4)

§12-204-9 Use of Respirators.

Where the use of respirators is necessary to maintain exposure below permissible exposure limits, the employer shall provide, at no cost to the employee, the proper respiratory equipment. Respirators shall be selected and used in accordance with the requirements of section 12-64-6. [Eff. 3/22/91] (Auth: HRS §396-4) (Imp: HRS §396-4)

§12-204-10 Recordkeeping.

(a) The employer shall establish and maintain for each employee an accurate record of any measurements taken to monitor employee exposures and any medical consultations and examinations, including tests or written opinions required by this chapter.

(b) The employer shall assure that such records are kept, transferred, and made available in accordance with section 12-202-3. [Eff. 3/22/91] (Auth: HRS §396-4) (Imp: HRS §396-4)

§12-204-11 Appendix.

The information contained in the appendices is not intended, by itself, to create any additional obligations not otherwise imposed or to detract from any existing obligation.

Appendix A

NATIONAL RESEARCH COUNCIL RECOMMENDATIONS CONCERNING CHEMICAL HYGIENE IN LABORATORIES

NON-MANDATORY

TABLE OF CONTENTS

FOREWORD

As guidance for each employer's development of an appropriate laboratory Chemical Hygiene Plan, the following non-mandatory recommendations are provided. They were extracted from "Prudent Practices for Handling Hazardous Chemicals in Laboratories" (referred to below as "Prudent Practices"), which was published in 1981 by the National Research Council and is available from the National Academy Press, 2101 Constitution Ave., N.W., Washington, D.C. 20418. "Prudent Practices" is cited because of its wide distribution and acceptance and because of its preparation by members of the laboratory community through the sponsorship of the National Research Council. However, none of the recommendations given here will modify any of the requirements of the laboratory standard. This appendix merely presents pertinent recommendations from "Prudent Practices", organized into a form convenient for quick reference during operation of a laboratory facility and during development and application of a Chemical Hygiene Plan. Users of this appendix should consult "Prudent Practices" for a more extended presentation and justification for each recommendation.

"Prudent Practices" deals with both safety and chemical hazards while the laboratory standard is concerned primarily with chemical hazards. Therefore, only those recommendations directed primarily toward control of toxic exposures are cited in this appendix, with the term "chemical hygiene" being substituted for the word "safety". However, since conditions producing or threatening physical injury often pose toxic risks as well, page references concerning major categories of safety hazards in the laboratory are given in section F.

The recommendations from "Prudent Practices" have been paraphrased, combined, or otherwise reorganized, and headings have been added. However, their sense has not been changed.

CORRESPONDING SECTIONS OF THE STANDARD AND THIS APPENDIX

The following table is given for the convenience of those who are developing a Chemical Hygiene Plan which will satisfy the requirements of section 12-204-5 (Chemical Hygiene Plan) of the standard. It indicates those sections of this appendix which are most pertinent to each of the paragraphs of section 12-204-5.

Paragraph and topic in laboratory standard	**Relevant Appendix Section**
(c)(1) Standard operating procedures for handling toxic chemicals	C, D, E
(c) (2) Criteria to be used for implementation of measures to reduce exposures	D
(c)(3) Fume hood performance	C4b
(c)(4) Employee information and training (including emergency procedures)	D10, D9
(c)(5) Requirements for prior approval of laboratory activities	E2b, E4b
(c)(6) Medical consultation and medical examinations	D5, E4f
(c)(7) Chemical hygiene responsibilities	B
(c)(8) Special precautions for work with particularly hazardous substances	E2, E3, E4

In this appendix, those recommendations directed primarily at administrators and supervisors are given in Sections A-D. Those recommendations of primary concern to employees who are actually handling laboratory chemicals are given in section E.

A. GENERAL PRINCIPLES FOR WORK WITH LABORATORY CHEMICALS

In addition to the more detailed recommendations listed below in sections B-E, "Prudent Practices" expresses certain general principles, including the following:

1. It is Prudent to Minimize all Chemical Exposures. Because few laboratory chemicals are without hazards, general precautions for handling all laboratory chemicals should be adopted, rather than specific guidelines for particular chemicals. Skin contact with chemicals should be avoided as a cardinal rule.

2. Avoid Underestimation of Risk. Even for substances of no known significant hazard, exposure should be minimized; for work with substances which present special hazards, special precautions should be

taken. One should assume that any mixture will be more toxic than its most toxic component and that all substances of unknown toxicity are toxic.

3. Provide Adequate Ventilation. The best way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by use of hoods and other ventilation devices.

4. Institute a Chemical Hygiene Program. A mandatory chemical hygiene program designed to minimize exposures is needed; it should be a regular, continuing effort, not merely a standby or short-term activity. Its recommendations should be followed in academic teaching laboratories as well as by full-time laboratory workers.

5. Observe the PELs, TLVs. The Permissible Exposure Limits of OSHA and the Threshold Limit Values of the American Conference of Governmental Industrial Hygienists should not be exceeded.

B. CHEMICAL HYGIENE RESPONSIBILITIES

Responsibility for chemical hygiene rests at all levels including the:

1. Chief Executive Officer, who has ultimate responsibility for chemical hygiene within the institution and must, with other administrators, provide continuing support for institutional chemical hygiene.

2. Supervisor of the Department or other Administrative Unit, who is responsible for chemical hygiene in that unit.

3. Chemical Hygiene Officer(s), whose appointment is essential and who must:

(a) Work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices;

(b) Monitor procurement, use, and disposal of chemicals used in the lab;

(c) See that appropriate audits are maintained;

(d) Help project directors develop precautions and adequate facilities;

(e) Know the current legal requirements concerning regulated substances; and

(f) Seek ways to improve the chemical hygiene program.

4. Laboratory Supervisor, who has overall responsibility for chemical hygiene in the laboratory including responsibility to:

(a) Ensure that workers know and follow the chemical hygiene rules, that protective equipment is available and in working order, and that appropriate training has been provided;

(b) Provide regular, formal chemical hygiene and housekeeping inspections including routine inspections of emergency equipment;

(c) Know the current legal requirements concerning regulated substances;

(d) Determine the required levels of protective apparel and equipment; and

(e) Ensure that facilities and training for use of any material being ordered are adequate.

5. Project Director or Director of Other Specific Operation, who has primary responsibility for chemical hygiene procedures for that operation.

6. Laboratory Worker, who is responsible for:

(a) Planning and conducting each operation in accordance with the institutional chemical hygiene procedures; and

(b) Developing good personal chemical hygiene habits.

C. THE LABORATORY FACILITY

1. Design. The laboratory facility should have:

(a) An appropriate general ventilation system (see 4 below) with air intakes and exhausts located so as to avoid intake of contaminated air;

(b) Adequate, well-ventilated stockrooms/storerooms;

(c) Laboratory hoods and sinks;

(d) Other safety equipment including eyewash fountains and

drench showers; and

(e) Arrangements for waste disposal.

2. Maintenance. Chemical-hygiene-related equipment (hoods, incinerator, etc.) should undergo continuing appraisal and be modified if inadequate.

3. Usage. The work conducted and its scale must be appropriate to the physical facilities available and, especially, to the quality of ventilation.

4. Ventilation.

(a) General laboratory ventilation. This system should: provide a source of air for breathing and for input to local ventilation devices but not be relied on for protection from toxic substances released into the laboratory; ensure that laboratory air is continually replaced, preventing increase of air concentrations of toxic substances during the working day; and direct air flow into the laboratory from non-laboratory areas and out to the exterior of the building.

(b) Hoods. A laboratory hood with 2.5 linear feet of hood space per person should be provided for every 2 workers if they spend most of their time working with chemicals; each hood should have a continuous monitoring device to allow convenient confirmation of adequate hood performance before use. If this is not possible, work with substances of unknown toxicity should be avoided or other types of local ventilation devices should be provided.

(c) Other local ventilation devices. Ventilated storage cabinets, canopy hoods, snorkels, etc. should be provided as needed. Each canopy hood and snorkel should have a separate exhaust duct.

(d) Special ventilation areas. Exhaust air from glove boxes and isolation rooms should be passed through scrubbers or other treatment before release into the regular exhaust system. Cold rooms and warm rooms should have provisions for rapid escape and for escape in the event of electrical failure.

(e) Modifications. Any alteration of the ventilation system should be made only if thorough testing indicates that worker protection from airborne toxic substances will continue to be adequate.

(f) Performance. Rate: 4-12 room air changes an hour is normally adequate general ventilation if local exhaust systems such as hoods are used as the primary method of control.

(g) Quality. General airflow should not be turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas; airflow into and within the hood should not be excessively turbulent; hood face velocity should be adequate (typically 60-100 lfm).

(h) Evaluation. Quality and quantity of ventilation should be evaluated on installation, regularly monitored (at least every 3 months), and reevaluated whenever a change in local ventilation devices is made.

D. COMPONENTS OF THE CHEMICAL HYGIENE PLAN

1. Basic Rules and Procedures. (Recommendation for these are given in section E, below.)

2. Chemical Procurement, Distribution, and Storage.

(a) Procurement. Before a substance is received, information on proper handling, storage, and disposal should be known to those who will be involved. No container should be accepted without an adequate identifying label. Preferably, all substances should be received in a central location.

(b) Stockrooms/storerooms. Toxic substances should be segregated in a well-identified area with local exhaust ventilation. Chemicals which are highly toxic or other chemicals whose containers have been opened should be in unbreakable secondary containers. Stored chemicals should be examined periodically (at least annually) for replacement, deterioration, and container integrity. Stockrooms/storerooms should not be used as preparation or repackaging areas, should be open during normal working hours, and should be controlled by one person.

(c) Distribution. When chemicals are hand carried, the container should be placed in an outside container or bucket. Freight-only elevators should be used if possible.

(d) Laboratory storage. Amounts permitted should be as small as practical. Storage on bench tops and in hoods is inadvisable. Exposure to heat or direct sunlight should be avoided. Periodic

inventories should be conducted, with unneeded items being discarded or returned to the storeroom/stockroom.

3. Environmental Monitoring. Regular instrumental monitoring of airborne concentrations is not usually justified or practical in laboratories but may be appropriate when testing or redesigning hoods or other ventilation devices or when a highly toxic substance is stored or used regularly (e.g., 3 times a week).

4. Housekeeping, Maintenance, and Inspections.

   (a) Cleaning. Floors should be cleaned regularly.

   (b) Inspections. Formal housekeeping and chemical hygiene inspections should be held at least quarterly for units which have frequent personnel changes and semiannually for others; informal inspections should be continual.

   (c) Maintenance. Eye wash fountains should be inspected at intervals of not less than 3 months. Respirators for routine use should be inspected periodically by the laboratory supervisor. Safety showers should be tested routinely. Other safety equipment should be inspected regularly, e.g., every 3-6 months. Procedures to prevent restarting of out-of-service equipment should be established.

   (d) Passageways. Stairways and hallways should not be used as storage areas. Access to exits, emergency equipment, and utility controls should never be blocked.

5. Medical Program.

   (a) Compliance with regulations. Regular medical surveillance should be established to the extent required by regulations.

   (b) Routine surveillance. Anyone whose work involves regular and frequent handling of toxicologically significant quantities of a chemical should consult a qualified physician to determine on an individual basis whether a regular schedule of medical surveillance is desirable.

   (c) First aid. Personnel trained in first aid should be available during working hours and an emergency room with medical personnel should be nearby.

6. Protective Apparel and Equipment. These should include for

each laboratory:

(a) Protective apparel compatible with the required degree of protection for substances being handled;

(b) An easily accessible drench-type safety shower;

(c) An eyewash fountain;

(d) A fire extinguisher;

(e) Respiratory protection, fire alarm and telephone for emergency use should be available nearby; and

(f) Other items designated by the laboratory supervisor.

7. Records.

(a) Accident records should be written and retained.

(b) Chemical Hygiene Plan records should document that the facilities and precautions were compatible with current knowledge and regulations.

(c) Inventory and usage records for high-risk substances should be kept listing materials on hand, amounts used, and the names of the workers involved.

(d) Medical records should be retained by the institution in accordance with the requirements of state and federal regulations.

8. Signs and Labels. Prominent signs and labels of the following types should be posted:

(a) Emergency telephone numbers of emergency personnel and facilities, supervisors, and laboratory workers;

(b) Identity labels, showing contents of containers (including waste receptacles) and associated hazards;

(c) Location signs for safety showers, eyewash stations, othersafety and first aid equipment, exits and areas where food and beverage consumption and storage are permitted; and (d) Warnings at areas or equipment where special or unusual hazards exist.

9. Spills and Accidents.

(a) A written emergency plan should be established and communicated to all personnel; it should include procedures for ventilation failure, evacuation, medical care, reporting, and drills.

(b) There should be an alarm system to alert people in all parts of the facility including isolation areas such as cold rooms.

(c) A spill control policy should be developed and should include consideration of prevention, containment, cleanup, and reporting.

(d) All accidents or near accidents should be carefully analyzed with the results distributed to all who might benefit.

10. Information and Training Program.

(a) Aim: To assure that all individuals at risk are adequately informed about the work in the laboratory, its risks, and what to do if an accident occurs.

(b) Emergency and Personal Protection Training: Every laboratory worker should know the location and proper use of available protective apparel and equipment. Some of the full-time personnel of the laboratory should be trained in the proper use of emergency equipment and procedures. Such training as well as first aid instruction should be available to and encouraged for everyone who might need it.

(c) Receiving and stockroom/storeroom personnel should know about hazards, handling equipment, protective apparel, and relevant regulations.

(d) Frequency of Training: The training and education program should be a regular, continuing activity - not simply an annual presentation.

(e) Literature and Consultation: Literature and consulting advice concerning chemical hygiene should be readily available to laboratory personnel, who should be encouraged to use these information resources.

11. Waste Disposal Program.

(a) Aim: To assure that minimal harm to people, other organisms, and the environment will result from the disposal of waste laboratory chemicals.

(b) Content: The waste disposal program should specify how waste is to be collected, segregated, stored, and transported and include consideration of what materials can be incinerated. Transport from the institution must be in accordance with DOT regulations.

(c) Discarding Chemical Stocks: Unlabeled containers of chemicals and solutions should undergo prompt disposal; if partially used, they should not be opened. Before a worker's employment in the laboratory ends, chemicals for which that person was responsible should be discarded or returned to storage.

(d) Frequency of Disposal: Waste should be removed from laboratories to a central waste storage area at least once per week and from the central waste storage area at regular intervals.

(e) Method of Disposal: Incineration in an environmentally acceptable manner is the most practical disposal method for combustible laboratory waste. Indiscriminate disposal by pouring waste chemicals down the drain or adding them to mixed refuse for landfill burial is unacceptable. Hoods should not be used as a means of disposal for volatile chemicals. Disposal by recycling or chemical decontamination should be used when possible.

E. BASIC RULES AND PROCEDURES FOR WORKING WITH CHEMICALS

The Chemical Hygiene Plan should require that laboratory workers know and follow its rules and procedures. In addition to the procedures of the sub programs mentioned above, these should include the rules listed below.

1. General Rules. The following should be used for essentially all laboratory work with chemicals.

(a) Accidents and Spills:

(i) For eye contact, promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention;
(ii) For ingestion, encourage the victim to drink large amounts of water;
(iii) For skin contact, promptly flush the affected area with water and remove any contaminated clothing; if symptoms persist after washing, seek medical attention; and

(iv) For clean-up, promptly clean up spills, using appropriate protective apparel and equipment and proper disposal.

(b) Avoidance of "Routine" Exposure: Develop and encourage safe habits; avoid unnecessary exposure to chemicals by any route:

(i) Do not smell or taste chemicals. Vent apparatus which may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust devices;
(ii) Inspect gloves and test glove boxes before use; and
(iii) Do not allow release of toxic substances in cold rooms and warm rooms, since these have contained recirculated atmospheres.

(c) Choice of Chemicals: Use only those chemicals for which the quality of the available ventilation system is appropriate.

(d) Eating, Smoking, etc.: Avoid eating, drinking, smoking, gum chewing, or application of cosmetics in areas where laboratory chemicals are present; wash hands before conducting these activities. Avoid storage, handling, or consumption of food or beverages in storage areas, refrigerators, glassware, or utensils which are also used for laboratory operations.

(e) Equipment and Glassware: Handle and store laboratory glassware with care to avoid damage; do not use damaged glassware. Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur. Use equipment only for its designed purpose.

(f) Exiting: Wash areas of exposed skin well before leaving the laboratory.

(g) Horseplay: Avoid practical jokes or other behavior which might confuse, startle, or distract another worker.

(h) Mouth Suction: Do not use mouth suction for pipeting or starting a siphon.

(i) Personal Apparel: Confine long hair and loose clothing.

Wear shoes at all times in the laboratory but do not wear slipper sandals, perforated shoes, or sneakers.

(j) Personal Housekeeping: Keep the work area clean and uncluttered, with chemicals and equipment being properly labeled and stored; clean up the work area on completion of an operation or at the end of each day.

(k) Personal Protection: Assure that appropriate eye protection is worn by all persons, including visitors, where chemicals are stored or handled:

(i) Wear appropriate gloves when the potential forcontact with toxic materials exists; inspect the gloves before each use, wash them before removal, and replace them periodically;
(ii) Use appropriate respiratory equipment when air contaminant concentrations are not sufficiently restricted by engineering controls, and inspect the respirator before use;
(iii) Use any other protective and emergency apparel and equipment as appropriate;
(iv) Avoid use of contact lenses in the laboratory unless necessary; if they are used, inform supervisor so special precautions can be taken; and
(v) Remove laboratory coats immediately on significant contamination.

(l) Planning: Seek information and advice about hazards, plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation.

(m) Unattended Operations: Leave lights on, place an appropriate sign on the door, and provide for containment of toxic substances in the event of failure of a utility service (such as cooling water) to an unattended operation.

(n) Use of Hood: Use the hood for operations which might result in release of toxic chemical vapors or dust.

(i) As a rule of thumb, use a hood or other local ventilation device when working with any appreciably volatile substance with a PEL or TLV of less than 50 ppm.
(ii) Confirm adequate hood performance before use; keep hood closed at all times except when adjustments within the hood are being made; keep

materials stored in hoods to a minimum and do not allow them to block vents or air flow.
(iii) Leave the hood "on" when it is not in active use if toxic substances are stored in it, or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "off".

(o) Vigilance: Be alert to unsafe conditions and see that they are corrected when detected.

(p) Waste Disposal: Ensure that the plan for each laboratory operation includes plans and training for waste disposal.

(i) Deposit chemical waste in appropriately labeled receptacles and follow all other waste disposal procedures of the Chemical Hygiene Plan;
(ii) Do not discharge to the sewer concentrated acids or bases; highly toxic, malodorous, or lachrymatory substances; or any substances which might interfere with the biological activity of waste water treatment plants, create fire or explosion hazards, cause structural damage or obstruct flow.

(q) Working alone: Avoid working alone in a building; do not work alone in a laboratory if the procedures being conducted are hazardous.

2. Working with Allergens and Embryotoxins.

(a) Allergens (examples: diazomethane, isocyanates, bichromates): Wear suitable gloves to prevent hand contact with allergens or substances of unknown allergenic activity.

(b) Embryotoxins (examples: organomercurials, lead compounds, formamide): If you are a woman of childbearing age, handle these substances only in a hood whose satisfactory performance has been confirmed, using appropriate protective apparel (especially gloves) to prevent skin contact.

(i) Review each use of these materials with the research supervisor and review continuing uses annually or whenever a procedural change is made.
(ii) Store these substances, properly labeled, in an adequately ventilated area in an unbreakable secondary container.

(iii) Notify supervisors of all incidents of exposure or spills; consult a qualified physician when appropriate.

3. Work with Chemicals of Moderate Chronic or High Acute Toxicity (examples: diisopropylfluorophosphate, hydrofluoric acid, hydrogen cyanide).

(a) Aim: To minimize exposure to these toxic substances by any route using all reasonable precautions.

(b) Applicability: These precautions are appropriate for substances with moderate chronic or high acute toxicity used in significant quantities.

(c) Location: Use and store these substances only in areas of restricted access with special warning signs. Always use a hood (previously evaluated to confirm adequate performance with a face velocity of at least 60 linear feet per minute) or other containment device for procedures which may result in the generation of aerosols or vapors containing the substance; trap released vapors to prevent their discharge with the hood exhaust.

(d) Personal Protection: Always avoid skin contact by use of gloves and long sleeves (and other protective apparel as appropriate). Always wash hands and arms immediately after working with these materials.

(e) Records: Maintain records of the amounts of these materials on hand, amounts used, and the names of the workers involved.

(f) Prevention of Spills and Accidents: Be prepared for accidents and spills:

(i) Ensure that at least 2 people are present at all times if a compound in use is highly toxic or of unknown toxicity;
(ii) Store breakable containers of these substances in chemically resistant trays; also work and mount apparatus above such trays or cover work and storage surfaces with removable, absorbent, plastic backed paper; and
(iii) If a major spill occurs outside the hood, evacuate the area; assure that cleanup personnel wear suitable protective apparel and equipment.

(g) Waste: Thoroughly decontaminate or incinerate contaminated clothing or shoes. If possible, chemically decontaminate by chemical conversion. Store contaminated waste in closed, suitably labeled, impervious containers (for liquids, in glass or plastic bottles half-filled with vermiculite).

4. Work with Chemicals of High Chronic Toxicity (examples: dimethylmercury and nickel carbonyl, benzo-a-pyrene, Nnitrosodiethylamine, other human carcinogens or substances with high carcinogenic potency in animals.)

(a) Access: Conduct all transfers and work with these substances in a "controlled area" (a restricted access hood, glove box, or portion of a lab, designated for use of highly toxic substances, for which all people with access are aware of the substances being used and necessary precautions).

(b) Approvals: Prepare a plan for use and disposal of these materials and obtain the approval of the laboratory supervisory.

(c) Non-contamination/Decontamination: Protect vacuum pumps against contamination by scrubbers or HEPA filters and vent them into the hood. Decontaminate vacuum pumps or other contaminated equipment, including glassware, in the hood before removing them from the controlled area. Decontaminate the controlled area before normal work is resumed there.

(d) Exiting: On leaving a controlled area, remove any protective apparel (placing it in an appropriate, labeled container) and thoroughly wash hands, forearms, face, and neck.

(e) Housekeeping: Use a wet mop or a vacuum cleaner equipped with a HEPA filter instead of dry sweeping if the toxic substance was a dry powder.

(f) Medical Surveillance: If using toxicologically significant quantities of such a substance on a regular basis (e.g., 3 times per week), consult a qualified physician concerning desirability of regular medical surveillance.

(g) Records: Keep accurate records of the amounts of these substances stored and used, the dates of use, and names of users.

(h) Signs and Labels: Ensure that the controlled area is conspicuously marked with warning and restricted access signs and that all containers of these substances are appropriately labeled with identity and warning labels.

(i) Spills: Ensure that contingency plans, equipment, and materials to minimize exposures of people and property in case of accident are available.

(j) Storage: Store containers of these chemicals only in a ventilated, limited access area in appropriately labeled, unbreakable, chemically resistant, secondary containers.

(k) Glove Boxes: For a negative pressure glovebox, ventilation rate must be at least 2 volume changes per hour and pressure at least 0.5 inches of water. For a positive pressure glovebox, thoroughly check for leaks before each use. In either case, trap the exit gases or filter them through a HEPA filter and then release them into the hood.

(l) Waste: Use chemical decontamination whenever possible; ensure that containers of contaminated waste (including washings from contaminated flasks) are transferred from the controlled area in a secondary container under the supervision of authorized personnel.

5. Animal Work with Chemicals of High Chronic Toxicity.

(a) Access: For large-scale studies, special facilities with restricted access are preferable.

(b) Administration of the Toxic Substance: When possible, administer the substance by injection or gavage instead of in the diet. If administration is in the diet, use a caging system under negative pressure or under laminar airflow directed toward HEPA filters.

(c) Aerosol Suppression: Devise procedures which minimize formation and dispersal of contaminated aerosols, including those from food, urine, and feces (e.g., use HEPA filtered vacuum equipment for cleaning, moisten contaminated

bedding before removal from the cage, mix diets in closed containers in a hood).

(d) Personal Protection: When working in the animal room, wear plastic or rubber gloves, fully buttoned laboratory coat or jumpsuit and, if needed because of incomplete suppression of aerosols, other apparel and equipment (shoe and head coverings, respirator, etc.).

(e) Waste Disposal: Dispose of contaminated animal tissues and excreta by incineration if the available incinerator can convert the contaminant to non-toxic products; otherwise, package the waste appropriately for burial in an EPA-approved site.

F. SAFETY RECOMMENDATIONS

The above recommendations from "Prudent Practices" do not include those which are directed primarily toward prevention of physical injury rather than toxic exposure. However, failure of precautions against injury will often have the secondary effect of causing toxic exposures. Therefore, we list below page references for recommendations concerning some of the major categories of safety hazards which also have implications for chemical hygiene.

1. Corrosive agents: (35-36)
2. Electrically powered laboratory apparatus: (179-192)
3. Fires, explosions: (26, 57-74, 162-164, 174-175, 219-220, 226- 227)
4. Low temperature procedures: (26-88)
5. Pressurized and vacuum operations (including use of compressed gas cylinders): (27, 75-101)

G. MATERIAL SAFETY DATA SHEETS

Material safety data sheets are presented in "Prudent Practices" for the chemicals listed below. (Asterisks denote that comprehensive material safety data sheets are provided).

*Acetyl peroxide
*Acrolein
*Acrylonitrile
Ammonia (anhydrous)
*Aniline
*Benzene
*Benzo[a]pyrene
*Bis(chloromethyl)either
Boron trichloride
Boron trifluoride
*Fluorine
*Formaldehyde
*Hydrazine and salts
Hydrofluoric acid
Hydrogen bromide
Hydrogen chloride
*Hydrogen cyanide
*Hydrogen sulfide
Mercury and compounds
*Methanol

Bromine
*Tert-butyl hydroperoxide
*Carbon disulfide
Carbon monoxide
*Carbon tetrachloride
*Chlorine
Chlorine trifluoride
*Chloroform
Chloromethane
*Diethyl ether
Diisopropyl fluorophosphate
*Dimethylformamide
*Dimethyl sulfate
*Dioxane
*Ethylene dibromide
*Morpholine
*Nickel carbonyl
*Nitrobenzene
Nitrogen dioxide
N-nitrosodiethylamine
*Peracetic acid
*Phenol
*Phosgene
*Pyridine
*Sodium azide
*Sodium cyanide
Sulfur dioxide
*Trichloroethylene
*Vinyl chloride

Appendix B

REFERENCES

NON-MANDATORY

The following references are provided to assist the employer in the development of a Chemical Hygiene Plan. The materials listed below are offered as non-mandatory guidance. References listed here do not imply specific endorsement of a book, opinion, technique, policy or a specific solution for a safety or health problem. Other references not listed here may better meet the needs of a specific laboratory.

(a) Materials for the development of the Chemical Hygiene Plan:

1. American Chemical Society, Safety in Academic Chemistry Laboratories, 4th edition, 1985.
2. Fawcett, H.H. and W.S. Wood, Safety and Accident Prevention in Chemical Operations, 2nd edition, Wiley-Interscience, New York, 1982.
3. Flury, Patricia A., Environmental Health and Safety in the Hospital Laboratory, Charles C. Thomas Publisher, Springfield, IL, 1978.
4. Green, Michael E. and Turk, Amos, Safety in Working with Chemicals, Macmillan Publishing Co., NY, 1978.
5. Kaufman, James A., Laboratory Safety Guidelines, Dow Chemical Co., Box 1713, Midland, MI 48640, 1977.
6. National Institutes of Health, NIH Guidelines for the Laboratory Use of Chemical Carcinogens, NIH Pub. No. 81-

2385, GPO, Washington, D.C. 20402, 1981.
7. National Research Council, Prudent Practices for Disposal of Chemicals from Laboratories, National Academy Press, Washington, D.C., 1983.
8. National Research Council, Prudent Practices for Handling Hazardous Chemicals in Laboratories, National Academy Press, Washington, D.C. 1981.
9. Renfrew, Malcolm, Ed., Safety in the Chemical Laboratory, Vol. IV, J. Chem. Ed., American Chemical Society, Easton, PA, 1981.
10. Steere, Norman V., Ed., Safety in the Chemical Laboratory, J. Chem. Ed., American Chemical Society, Easton, PA, 18042, Vol I, 1967, Vol. II, 1971, Vol. III, 1974.
11. Steere, Norman V., Handbook of Laboratory Safety, the Chemical Rubber Company, Cleveland, OH, 1971.
12. Young, Jay A., Ed., Improving Safety in the Chemical Laboratory, John Wiley & Sons, Inc., New York, 1987.

(b) Hazardous Substances Information:

1. American Conference of Governmental Industrial Hygienists, Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes, P.O. Box 1937, Cincinnati, OH, 45201 (latest edition).
2. Annual Report on Carcinogens, National Toxicology Program U.S. Department of Health and Human Services, Public Health Service, U.S. Government Printing Office, Washington, D.C. (latest edition).
3. Best Company, Best Safety Directory, Vols. I and II, Oldwick, N.J., 1981.
4. Bretherick, L., Handbook of Reactive Chemical Hazards, 2nd edition, Butterworths, London, 1979.
5. Bretherick, L., Ed., Hazards in the Chemical Laboratory, 3rd edition, Royal Society of Chemistry, London, 1986.
6. Code of Federal Regulations, 29 CFR Part 1910 Subpart Z.U.S. Govt. Printing Office, Washington, D.C., 26402, (latest edition).
7. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man, Work Health Organization Publications Center, 49 Sheridan Avenue, Albany, New York, 12210 (latest editions).
8. NIOSH/OSHA Pocket Guide to Chemical Hazards, NIOSH Pub. NO. 85-114, U.S. Government Printing Office, Washington, D.C., 1985 (or latest edition).

9. Occupational Health Guidelines, NIOSH/OSHA NIOSH Pub. No. 81-123, U.S. Government Printing Office, Washington, D.C., 1981.
10. Patty, F.A., Industrial Hygiene and Toxicology, John Wiley & Sons, Inc., New York, NY (Five volumes)
11. 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, D.C., 20402.
12. The Merck Index: An Encyclopedia of Chemicals and Drugs, Merck and Company Inc., Rahway, N.J., 1976 (or latest edition).
13. Sax, N.I., Dangerous Properties of Industrial Materials, 5th edition, Van Nostrand Reinhold, N.Y., 1979.
14. Sittig, Marshall, Handbook of Toxic and Hazardous Chemicals, Noyes Publications, Park Ridge, N.J., 1981.

(c) Information on Ventilation:

1. American Conference of Governmental Industrial Hygienists Industrial Ventilation, 16th edition, Lansing, MI, 1980.
2. 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, N.Y., 1979.
3. Imad, A.P. and Watson, C.L., Ventilation Index: An Easy Way to Decide about Hazardous Liquids, Professional Safety pp. 15-18, April 1980.
4. National Fire Protection Association, Fire Protection for Laboratories Using Chemicals NFPA-45, 1982. Safety Standard for Laboratories in Health Related Institutions, NFPA, 56c, 1980. Fire Protection Guide on Hazardous Materials, 7th edition, 1978. National Fire Protection Association, Batterymarch Park, Quincy, MA, 02269.
5. Scientific Apparatus Makers Association (SAMA), Standard for Laboratory Fume Hoods, SAMA LF7-1980, 1101 16th Street, N.W. Washington, D.C., 20036. [Eff. 3/22/91] (Auth: HRS §396-4) (Imp: HRS §396-4)

APPENDIX IV

"LIMITS FOR AIR CONTAMINANTS"
STATE OF HAWAII OCCUPATIONAL SAFETY & HEALTH STANDARDS
TITLE 12 CHAPTER 202-4

§12-202-4.02 Air contaminants.

(a) An employee's exposure to any substance listed in tables 202-1 and 202-2 in this section, or table 202-3 in section 12-202-9 shall be limited in accordance with the requirements of this section.

(1) Air Contaminants Limits Column. An employee's exposure to any substance listed in table 202-1 shall not exceed the PEL-TWA, PEL-STEL and PEL-Ceiling specified for that substance shown in table 202-1.

(A) Because many industrial exposures are not continuous, but instead are short-term, or intermittent, to which the PEL-TWAs cannot be applied, PEL-STELs for selected air contaminants are listed in table 202-1.

(B) The PEL-STELs listed in table 202-1 are 15-minute time-weighted average (TWA) exposures which shall not be exceeded at any time during a workday.

(C) Exposures at the PEL-STEL shall not be longer than 15-minutes and shall not be repeated more than four times per day. There shall be at least 60 minutes between successive exposures at the PEL-STEL.

(2) Skin Designation. To prevent or reduce skin absorption, an employee's skin exposure to substances listed in table 202-1 with an "X" in the Skin Designation columns shall be prevented or reduced to the extent necessary in the circumstances through the use of gloves, coveralls, goggles, or other appropriate personal protective equipment, engineering controls, or work practices.

(b) Table 202-2.

(1) PEL-TWA. An employee's exposure to any material listed in table 202-2, in any 7- to 8-hour work shift of a 40-hour workweek,

shall not exceed the PEL-TWA given for that material in table 202-2.

(2) Acceptable ceiling concentration. An employee's exposure to a material listed in table 202-2 shall not exceed at any time during a 7- to 8-hour work shift the acceptable ceiling concentration given for that material in the table.

(c) Effective date. The effective date for the permissible exposure limits specified in the Air Contaminants Limits column of table 202-1 is six months after the effective date of this standard.

(d) Enforcement of the limits are indefinitely stayed for: aluminum alkyls; ethylidine norbornene; hexafluoroacetone; mercury (alkyl compounds); oxygen difluoride; phenylphosphine; and sulfur pentafluoride; until OSHA publishes in the Federal Register a notice that adequate sampling and analytical techniques are developed.

TABLE 202-1 Limits for Air Contaminants

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	**CAS#**	**ppmc**	**mg/m3d**	**ppmc**	**mg/m3d**	**ppmc**	**mg/m3d**	
Acetaldehyde	75-07-0	100	180	150	270	-	-	-
Acetic acid	64-19-7	10	25	15	37	-	-	-
Acetic anhydride	108-24-7	-	-	-	-	5	20	-
Acetone	67-64-1	750	1,780	1,000	2,375	-	-	-
Acetonitrile	75-05-8	40	70	60	105	-	-	X
2-Acetylaminofluorene	53-96-3	see §12-202-14.1						
Acetylene dichloride		see 1,2-Dichloroethylene						
Acetylene ttrabromide	79-27-6	1	14	1.5	20	-	-	-
Acetylsalicylic acid (Aspirin)	50-78-2	-	5	-	-	-	-	-
Acrolein	107-02-8	0.1	0.25	0.3	0.8	-	-	-
Acrylamide	79-06-1	-	0.03	-	-	-	-	X
Acrylic acid	79-10-7	2	6	-		-	-	X
Acrylonitrile	107-13-1	see §12-202-30						
Aldrin	309-00-2	-	0.25	-	0.75	-	-	X
Allyl alcohol	107-18-6	2	5	4	10	-	-	X
Allyl chloride	107-05-1	1	3	2	6	-	-	-
Allyl glycidyl ether (AGE)	106-92-3	5	22	10	44	-	-	X
Allyl propyl disulfide	2179-59-1	2	12	3	18	-	-	-
-Alumina	1344-28-1							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Aluminum (as Al)	7429-90-5							
Metal & oxide								

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	**CAS#**	**ppmc**	**mg/m3d**	**ppmc**	**mg/m3d**	**ppmc**	**mg/m3d**	
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Pyro powders		-	5	-	-	-	-	-
Welding fumes		-	5	-	-	-	-	-
Soluble salts		-	2	-	-	-	-	-
Alkyls		-	2	-	-	-	-	-
4-Aminodiphenyl	92-67-1			see §12-202-14.1				
2-Aminoethanol				see Ethanolamine				
2-Aminopyridine	504-29-0	0.5	2	2	4	-	-	-
Amitrole	61-82-5	-	0.2	-	-	-	-	-
Ammonia	7664-41-7	25	18	35	27	-	-	-
Ammonium chloride fume	12125-02-9	-	10	-	20	-	-	-
Ammonium sulfamate	7773-06-0							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
n-Amyl acetate	628-63-7	100	525	150	800	-	-	-
sec-Amyl acetate	626-38-0	125	650	150	800	-	-	-
Aniline and homologs	62-53-3	2	8	5	20	-	-	X
Anisidine (o-, p-isomers)	29191-52-4	0.1	0.5	-	-	-	-	X
Antimony and compounds (as Sb)	7440-36-0	-	0.5	-	-	-	-	-
Antimony trioxide	1309-64-4							

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Handling and use, as Sb		-	0.5	-	-	-	-	-
ANTU (Alpha Naphthyl-thiourea)	86-88-4	-	0.3	-	0.9	-	-	-
Arsenic, organic compounds (as As)	7440-38-2	-	0.2	-	-	-	-	-
Arsenic, inorganic compounds, (as As)	7440-38-2	see §12-202-31						
Arsine	7784-42-1	0.05	0.2	-	-	-	-	-
Asbestos Varies see		§12-206 and 12-145						
Asphalt (petroleum) fumes	8052-42-4	-	5	-	10	-	-	-
Atrazine	1912-24-9	-	5	-	-	-	-	-
Azinphos-methyl	86-50-0	-	0.2	-	0.6	-	-	X
Barium, soluble compounds (as Ba)	7440-39-3	-	0.5	-	-	-	-	-
Barium sulfate	7727-43-7							
Total dust		-	10	-	-	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Benomyl	17804-35-2							
Total dust		0.8	10	1.3	15	-	-	-
Respirable fraction		-	5	-	-	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Benzene; see §12-202-36	71-43-2	See Table 202-2 for operations excludede						
Benzidine	92-87-5	see §12-202-14.1						
p-Benzoquinone		see Quinone						
Benzo(a)pyrene		see Coal tar pitch volatiles						
Benzoyl peroxide	94-36-0	-	5	-	-	-	-	-
Benzyl chloride	100-44-7	1	5	-	-	-	-	-
Beryllium and beryllium compounds (as Be) (see Table 202-2)	7440-41-7	0.002		0.005		0.025		-
Biphenyl		see Diphenyl						
Bismuth telluride, Undoped	1304-82-1							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Bismuth telluride, Se-doped		-	5	-	10	-	-	-
Borates, tetra, sodium salts								
Anhydrous	1330-43-4	-	1	-	-	-	-	-
Decahydrate	1303-96-4	-	5	-	-	-	-	-
Pentahydrate	12179-04-3	-	1	-	-	-	-	-
Boron oxide	1303-86-2							
total dust		-	10	-	20	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Respirable fraction		-	-	-	-	-	-	-
Boron tribromide	10294-33-4	-	-	-	-	1	10	-
Boron trifluoride	7637-07-2	-	-	-	-	1	3	-
Bromacil	314-40-9	1	10	2	20	-	-	-
Bromine	7726-95-6	0.1	0.7	0.3	2	-	-	-
Bromine pentafluoride	7789-30-2	0.1	0.7	0.3	2	-	-	-
Bromoform	75-25-2	0.5	5	-	-	-	-	X
Butadiene (1,3-Butadiene)	106-99-0			see §12-202-40				
Butane	106-97-8	800	1,900	-	-	-	-	-
Butanethiol see Butyl mercaptan								
2-Butanone (Methyl ethyl ketone)(MEK)	78-93-3	200	590	300	885	-	-	-
2-Butoxyethanol	111-76-2	25	120	75	360	-	-	X
n-Butyl-acetate	123-86-4	150	710	200	950	-	-	-
sec-Butyl acetate	105-46-4	200	950	250	1,190	-	-	-
tert-Butyl acetate	540-88-5	200	950	250	1,190	-	-	-
Butyl acrylate	141-32-2	10	55	-	-	-	-	-
n-Butyl alcohol	71-36-3	-	-	-	-	50	150	X
sec-Butyl alcohol	78-92-2	100	305	150	455	-	-	-
tert-Butyl alcohol	75-65-0	100	300	150	450	-	-	-
Butylamine	109-73-9	-	-	-	-	5	15	X

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
tert-Butyl chromate (as CrO3)	1189-85-1	-	-	-	-	-	0.1	X
n-Butyl glycidyl ether (BGE)	2426-08-6	25	135	-	-	-	-	-
n-Butyl lactate	138-22-7	5	25	-	-	-	-	-
Butyl mercaptan	109-79-5	0.5	1.5	-	-	-	-	-
o-sec Butylphenol	89-72-5	5	30	-	-	-	-	X
p-tert-Butyltoluene	98-51-1	10	60	20	120	-	-	-
Cadmium fume (as Cd)	7440-43-9	-	-	-	-	-	0.05	-
Cadmium dust (as Cd)	7440-43-9	-	0.05	-	-	-	0.2	-
Calcium carbonate	1317-65-3							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Calcium cyanamide	156-62-7	-	0.5	-	1	-	-	-
Calcium hydroxide	1305-62-0	-	5	-	-	-	-	-
Calcium oxide	1305-78-8	-	2	-	-	-	-	-
Calcium silicate	1344-95-2							
Total dust		-	10	-	-	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Calcium sulfate	7778-18-9							
Total dust		-	10	-	-	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Camphor, synthetic	76-22-2	0.3	2	-	-	-	-	-
Caprolactam	105-60-2							
Dust		-	1	-	3	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Vapor & Aerosol		5	20	-	40	-	-	-
Captafol (DifolatanR)	2425-06-1	-	0.1	-	-	-	-	-
Captan	133-06-2	-	5	-	15	-	-	-
Carbaryl (SevinR)	63-25-2	-	5	-	10	-	-	-
Carbofuran (FuradanR)	1563-66-2	-	0.1	-	-	-	-	-
Carbon black	1333-86-4	-	3.5	-	7	-	-	-
Carbon dioxide	124-38-9	5,000	9,000	15,000	27,000	-	-	-
Carbon disulfide	75-15-0	4	12	12	36	-	-	X
Carbon monoxide	630-08-0	35	40			200	229	-
Carbon tetrabromide	558-13-4	0.1	1.4	0.3	4	-	-	X
Carbon tetrachloride	56-23-5	2	12.6	-	-	-	-	-
Carbonyl fluoride	353-50-4	2	5	5	15	-	-	-
Catechol (Pyrocatechol)	120-80-9	5	20	-	-	-	-	X
Cellulose	9004-34-6							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Cesium hydroxide	21351-79-1	-	2	-	-	-	-	-
Chlordane	57-74-9	-	0.5	-	2	-	-	X
Chlorinated camphene	8001-35-2	-	0.5	-	1	-	-	X
Chlorinated diphenyl oxide	55720-99-5	-	0.5	-	2	-	-	-
Chlorine	7782-50-5	0.5	1.5	1	3	-	-	-
Chlorine dioxide	10049-04-4	0.1	0.3	0.3	0.9	-	-	-
Chlorine trifluoride	7790-91-2	-	-	-	-	0.1	0.4	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Chloroacetaldehyde	107-20-0	-	-	-	-	1	3	-
Chloroacetone	78-95-5	-	-	-	-	1	4	X
Chloroacetophenone (Phenacyl chloride)	532-27-4	0.05	0.3	-	-	-	-	-
Chloroacetyl chloride	79-04-9	0.05	0.2	-	-	-	-	-
Chlorobenzene (monochlorobenzene)	108-90-7	75	350	-	-	-	-	-
o-Chlorobenzylidene malononitrile	2698-41-1	-	-	-	-	0.05	0.4	X
Chlorobromomethane	74-97-5	200	1,050	250	1,300	-	-	-
2-Chloro-1,3-Butadiene				see -Chloroprene				
Chlorodifluoromethane	75-45-6	1,000	3,500	1,250	4,375	-	-	-
Chlorodiphenyl (42% chlorine) (PCB)	53469-21-9	-	1	-	2	-	-	X
Chlorodiphenyl (54% Chlorine) (PCB)	11097-69-1	-	0.5	-	1	-	-	X
1-Chloro, 2,3-epoxypropane				see Epichlorohydrin				
2-Chloroethanol				see Ethylene chlorohydrin				
Chloroethylene				see Vinyl chloride				
Chloroform (Trichloromethane)	67-66-3	2	9.78	-	-	-	-	-
bis(Chloromethyl) ether	542-88-1			see §12-202-14.1				
Chloromethyl methyl ether	107-30-2			see §12-202-14.1				

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
1-Chloro-1-nitropropane	600-25-9	2	10	-	-	-	-	-
Chloropentafluoroethane	76-15-3	1,000	6,320	-	-	-	-	-
Chloropicrin	76-06-2	0.1	0.7	0.3	2	-	-	-
-Chloroprene	126-99-8	10	35	-	-	-	-	X
o-Chlorostyrene	2039-87-4	50	285	75	428	-	-	-
o-Chlorotoluene	95-49-8	50	250	75	375	-	-	X
2-Chloro-6-(trichloro-methyl) pyridine	1929-82-4							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Chlorpyrifos	2921-88-2	-	0.2	-	0.6	-	-	X
Chromic acid and chromates (as CrO3)								
	Varies with compound	-	-	-	-	-	0.1	-
(Chromate), (as Cr)		-	0.05	-	-	-	-	-
Chromium (II) compounds (as Cr)	7440-47-3	-	0.5	-	-	-	-	-
Chromium (III) compounds (as Cr)	7440-47-3	-	0.5	-	-	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	**CAS#**	**ppmc**	**mg/m3d**	**ppmc**	**mg/m3d**	**ppmc**	**mg/m3d**	
Chromium (VI) compounds (as Cr) Water soluble & insoluble		-	0.05	-	-	-	-	-
Chromium metal (as Cr)	7440-47-3	-	0.5	-	-	-	-	-
Chromyl chloride	14977-61-8	0.025	0.15	-	-	-	-	-
Chrysene		see Coal tar pitch volatiles						
Clopidol	2971-90-6							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Coal dust (less than 5% SiO2), Respirable fraction		-	2	-	-	-	-	-
Coal dust (greater than or equal to 5% SiO2), Respirable quartz fraction		-	0.1	-	-	-	-	-
Coal tar pitch volatiles (benzene soluble fraction), anthracene, BaP, phenanthrene, acridine, chrysene,								

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
pyrene	65966-93-2	-	0.2f	-	-	-	-	-
Cobalt metal, dust, and fume (as Co)	7440-48-4	-	0.05	-	-	-	-	-
Cobalt carbonyl (as Co)	10210-68-1	-	0.1	-	-	-	-	-
Cobalt hydrocarbonyl (as Co)	16842-03-8	-	0.1	-	-	-	-	-
Coke oven emissions				see §12-202-9				
Copper	7440-50-8							
Fume (as Cu)		-	0.1	-	-	-	-	-
Dusts and mists (as Cu)		-	1	-	2	-	-	-
Cotton dust (raw)				see §12-202-32				
Crag herbicide (Sesone) (Sodium 2,4-dichloro-phenoxyethyl sulfate)	136-78-7							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Cresol, all isomers	1319-77-3	5	22	-	-	-	-	X
Crotonaldehyde	123-73-9	2	6	6	18	-	-	-
	4170-30-3							
Crufomate	299-86-5	-	5	-	20	-	-	-
Cumene	98-82-8	50	245	75	365	-	-	X
Cyanamide	420-04-2	-	2	-	-	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Cyanides (as CN) Varies with compound		-	5	-	-	-	-	X
Cyanogen	460-19-5	10	20	-	-	-	-	-
Cyanogen chloride	506-77-4	-	-	-	-	0.3	0.6	-
Cyclohexane	110-82-7	300	1,050	375	1,300	-	-	-
Cyclohexanol	108-93-0	50	200	-	-	-	-	X
Cyclohexanone	108-94-1	25	100	100	400	-	-	X
Cyclohexene	110-83-8	300	1,015	-	-	-	-	-
Cyclohexylamine	108-91-8	10	40	-	-	-	-	-
Cyclonite	121-82-4	-	1.5	-	3	-	-	X
Cyclopentadiene	542-92-7	75	200	75	200	-	-	-
Cyclopentane	287-92-3	600	1,720	900	2,580	-	-	-
Cyhexatin	13121-70-5	-	5	-	10	-	-	-
2,4-D (Dichloryl-phenoxyacetic acid)	94-75-7	-	10	-	20	-	-	-
DDT (Dichlorodiphenyl-trichloroethane)	50-29-3	-	1	-	3	-	-	X
Decaborane	17702-41-9	0.05	0.3	0.15	0.9	-	-	X
Demeton (SystoxR)	8065-48-3	-	0.1	0.03	0.3	-	-	X
Diacetone alcohol (4-hydroxy-4-methyl-2-pentanone)	123-42-2	50	240	75	360	-	-	-
1,2-Diaminoethane		see Ethylenediamine						
Diazinon	333-41-5	-	0.1	-	0.3	-	-	X
Diazomethane	334-88-3	0.2	0.4	-	-	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Diborane	19287-45-7	0.1	0.1	-	-	-	-	-
1,2-Dibromo-3-chloropropane	96-12-8	see §12-202-29						
2-N-Dibutylamino-ethanol	102-81-8	2	14	4	28	-	-	X
Dibutyl phosphate	107-66-4	1	5	2	10	-	-	-
Dibutyl phthalate	84-74-2	-	5	-	10	-	-	-
Dichloroacetylene	7572-29-4	-	-	-	-	0.1	0.4	-
o-Dichlorobenzene	95-50-1	-	-	-	-	50	300	-
p-Dichlorobenzene	106-46-7	75	450	110	675	-	-	-
3,3'-Dichlorobenzidine	91-94-1	see §12-202-14.1						
Dichlorodifluoromethane	75-71-8	1,000	4,950	1,250	6,200	-	-	-
1,3-Dichloro-5,5-dimethyl hydantoin	118-52-5	-	0.2	-	0.4	-	-	-
1,1-Dichloroethane	75-34-3	100	400	250	1,010	-	-	-
1,2-Dichloroethylene	540-59-0	200	790	250	1,000	-	-	-
Dichloroethyl ether	111-44-4	5	30	10	60	-	-	X
Dichloromethane	see Methylene chloride							
Dichloromonofluoro-methane	75-43-4	10	40	-	-	-	-	-
1,1-Dichloro-1-nitro-ethane	594-72-9	2	10	10	60	-	-	-
1,2-Dichloropropane	see Propylene dichloride							
1,3-Dichloropropene	542-75-6	1	5	-	-	-	-	X

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
2,2-Dichloropropionic acid	75-99-0	1	6	-	-	-	-	-
Dichlorotetrafluoro-ethane	76-14-2	1,000	7,000	1,250	8,750	-	-	-
Dichlorvos (DDVP)	62-73-7	0.1	1	0.3	3	-	-	X
Dicrotophos	141-66-2	-	0.25	-	-	-	-	X
Dicyclopentadiene	77-73-6	5	30	-	-	-	-	-
Dicyclopentadienyl iron	102-54-5							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Dieldrin	60-57-1	-	0.25	-	0.75	-	-	X
Diethanolamine	111-42-2	3	15	-	-	-	-	-
Diethylamine	109-89-7	10	30	25	75	-	-	-
2-Diethylaminoethanol	100-37-8	10	50	-	-	-	-	X
Diethylene triamine	111-40-0	1	4	-	-	-	-	-
Diethyl ether				see Ethyl ether				
Diethyl ketone	96-22-0	200	705	-	-	-	-	-
Diethyl phthalate	84-66-2	-	5	-	10	-	-	-
Difluorodibromomethane	75-61-6	100	860	150	1,290	-	-	-
Diglycidyl ether (DGE)	2238-07-5	0.1	0.5	-	-	-	-	-
Dihydroxybenzene see Hydroquinone								
Diisobutyl ketone	108-83-8	25	150	-	-	-	-	-
Diisopropylamine	108-18-9	5	20	-	-	-	-	X
4-Dimethylaminoazo-benzene	60-11-7			see §12-202-14.1				

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Dimethoxymethane				see Methylal				
Dimethyl acetamide	127-19-5	10	35	15	50	-	-	X
Dimethylamine	124-40-3	10	18	10	50	-	-	-
Dimethylaminobenzene				see Xylidine				
Dimethylaniline (N-Dimethyl-aniline	121-69-7	5	25	10	50	-	-	X
Dimethylbenzene				see Xylene				
Dimethyl-1, 2-dibromo-2,2-dichloroethyl phosphate	300-76-5	-	3	-	-	-	-	X
Dimethylformamide	68-12-2	10	30	20	60	-	-	X
2,6-Dimethyl-4-heptanone				see Diisobutyl ketone				
1,1-Dimethylhydrazine	57-14-7	0.5	1	1	2	-	-	X
Dimethylphthalate	131-11-3	-	5	-	10	-	-	-
Dimethyl sulfate	77-78-1	0.1	0.5	-	-	-	-	X
Dinitolmide (3,5-Dinitro-o-toluamide)	148-01-6	-	5	-	10	-	-	-
Dinitrobenzene (all isomers)								
(alpha-)	528-29-0	0.15	1	0.5	1	-	-	X
(meta-)	99-65-0							
(para-)	100-25-4							
Dinitro-o-cresol	534-52-1	-	0.2	-	0.6	-	-	X

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Dinitrotoluene	25321-14-6	-	1.5	-	5	-	-	X
Dioxane (Diethylene dioxide)	123-91-1	25	90	-	-	-	-	X
Dioxathion (Delnav)	78-34-2	-	0.2	-	-	-	-	X
Diphenyl (Biphenyl)	92-52-4	0.2	1.5	0.6	4	-	-	-
Diphenylamine	122-39-4	-	10	-	20	-	-	-
Diphenylmethane diisocyanate				see Methylene bisphenyl isocyanate				
Dipropylene glycol methyl ether	34590-94-8	100	600	150	900	-	-	X
Dipropyl ketone	123-19-3	50	235	-	-	-	-	-
Diquat	85-00-7	-	0.5	-	1	-	-	-
Di-sec-octyl phthalate (Di-2-ethylhexyl-phthalate)	117-81-7	-	5	-	10	-	-	-
Disulfiram	97-77-8	-	2	-	5	-	-	-
Disulfoton	298-04-4	-	0.1	-	0.3	-	-	X
2,6-Di-tert-butyl-p-cresol	128-37-0	-	10	-	20	-	-	-
Diuron	330-54-1	-	10	-	-	-	-	-
Divinyl benzene	1321-74-0	10	50	-	-	-	-	-
Emery	112-62-9							
Total dust		-	10	-	-	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Endosulfan	115-29-7	-	0.1	-	0.3	-	-	X

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Endrin	72-20-8	-	0.1	-	0.3	-	-	X
Epichlorohydrin	106-89-8	2	8	-	-	-	-	X
EPN	2104-64-5	-	0.5	-	2	-	-	X
1,2-Epoxypropane		see Propylene oxide						
2,3-Epoxy-1-propanol		see Glycidol						
Ethanethiol		see Ethyl mercaptan						
Ethanolamine	141-43-5	3	8	6	15	-	-	-
Ethion	563-12-2	-	0.4	-	-	-	-	X
2-Ethoxyethanol	110-80-5	5	19	-	-	-	-	X
2-Ethoxyethyl acetate (Cellosolve acetate)	111-15-9	5	27	-	-	-	-	X
Ethyl acetate	141-78-6	400	1,400	-	-	-	-	-
Ethyl acrylate	140-88-5	5	20	25	100	-	-	X
Ethyl alcohol (Ethanol)	64-17-5	1,000	1,900	-	-	-	-	-
Ethylamine	75-04-7	10	18	-	-	-	-	-
Ethyl amyl ketone (5-Methyl-3-heptanone)	541-85-5	25	130	-	-	-	-	-
Ethyl benzene	100-41-4	100	435	125	545	-	-	-
Ethyl bromide	74-96-4	200	890	250	1,110	-	-	-
Ethyl butyl ketone (3-Heptanone)	106-35-4	50	230	75	345	-	-	-
Ethyl chloride	75-00-3	1,000	2,600	1,250	3,250	-	-	-
Ethyl ether	60-29-7	400	1,200	500	1,500	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Ethyl formate	109-94-4	100	300	-	-	-	-	-
Ethyl mercaptan	75-08-1	0.5	1	-	-	-	-	-
Ethyl silicate	78-10-4	10	85	-	-	-	-	-
Ethylene chlorohydrin	107-07-3	-	-	-	-	1	3	X
Ethylenediamine	107-15-3	10	25	-	-	-	-	-
Ethylene dibromide	106-93-4 20			see §12-202-34 30 X				
				See Table 202-2 for operations excluded				
Ethylene dichloride	107-06-2	1	4	2	8	-	-	-
Ethylene glycol, vapor	107-21-1	-	-	-	-	50	125	-
Ethylene glycol dinitrate (EGDN)l	628-96-6	0.05	0.3	-	0.1	-	-	X
Ethylene glycol methyl acetate				see Methyl cellosolve acetate				
Ethylene imine	151-56-4			see §12-202-14.1				
Ethylene oxide	75-21-8			see §12-202-35				
Ethylidene chloride				see 1,1-Dichloroethane				
Ethylidene norbornene	16219-75-3	-	-	-	-	5	25	-
N-Ethylmorpholine	100-74-3	5	23	-	-	-	-	X
Fenamiphos	22224-92-6	-	0.1	-	-	-	-	X
Fensulfothion (Dasanit)	115-90-2	-	0.1	-	-	-	-	-
Fenthion	55-38-9	-	0.2	-	-	-	-	X
Ferbam	14484-64-1							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	-	-	-	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Ferrovanadium dust	12604-58-9	-	1	-	3	-	-	-
Fibrous glass dust	-	-	10h	-	-	-	-	-
Fluorides (as F) Varies with compound		-	2.5	-	-	-	-	-
Fluorine	7782-41-4	0.1	0.2	-	-	-	-	-
Fluorotrichloro-methane (Trichloro-fluoromethane)	75-69-4	-	-	-	-	1,000	5,600	-
Fonofos	944-22-9	-	0.1	-	-	-	-	X
Formaldehyde	50-00-0	see §12-202-37						
Formamide	75-12-7	10	15	-	-	-	-	-
Formic acid	64-18-6	5	9	10	18	-	-	-
Furfural	98-01-1	2	8	-	-	-	-	X
Furfuryl alcohol	98-00-0	10	40	15	60	-	-	X
Gasoline	8006-61-9	300	900	-	-	-	-	-
Germanium tetrahydride	7782-65-2	0.2	0.6	0.6	1.8	-	-	-
Glutaraldehyde	111-30-8	-	-	-	-	0.2	0.7	-
Glycerin (mist)	56-81-5							
Total dust		-	10	-	-	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Glycidol	556-52-5	25	75	-	-	-	-	-
Glycol monoethyl ether		see 2-Ethoxyethanol						
Grain dust (oat, wheat, barley)		-	10	-	-	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Graphite, natural respirable dust	7782-42-5	-	2.5	-	-	-	-	-
Graphite, synthetic -								
Total dust		-	10	-	-	-	-	-
Respirable fraction		-	5	-	-	-	-	-
GuthionR				see Azinphos methyl				
Gypsum	13397-24-5							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Hafnium	7440-58-6	-	0.5	-	1.5	-	-	-
Heptachlor	76-44-8	-	0.5	-	2	-	-	X
Heptane (n-Heptane)	142-82-5	400	1,600	500	2,000	-	-	-
Hexachlorobutadiene	87-68-3	0.02	0.24	-	-	-	-	-
Hexachlorocyclo-pentadiene	77-47-4	0.01	0.1	0.03	0.3	-	-	-
Hexachloroethane	67-72-1	1	10	-	-	-	-	X
Hexachloronaphthalene	1335-87-1	-	0.2	-	0.6	-	-	X
Hexafluoroacetone	684-16-2	0.1	0.7	0.3	2	-	-	X
n-Hexane	110-54-3	50	180	-	-	-	-	-
Hexane isomers Varies with compound		500	1,800	-	-	-	-	-
2-Hexanone (Methyl n-butyl ketone)	591-78-6	5	20	-	-	-	-	-
Hexone (Methyl isobutyl ketone	108-10-1	50	205	75	300	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
sec-Hexyl acetate	108-84-9	50	300	-	-	-	-	-
Hexylene glycol	107-41-5	-	-	-	-	25	125	-
Hydrazine	302-01-2	0.1	0.1	-	-	-	-	X
Hydrogenated terphenyls	61788-32-7	0.5	5	-	-	-	-	-
Hydrogen bromide	10035-10-6	-	-	-	-	3	10	-
Hydrogen chloride	7647-01-0	-	-	-	-	5	7	-
Hydrogen cyanide	74-90-8	-	-	4.7	5	-	-	X
Hydrogen fluoride (as F)	7664-39-3	3	-	6	-	-	-	-
Hydrogen peroxide	7722-84-1	1	1.4	2	3	-	-	-
Hydrogen selenide (as Se)	7783-07-5	0.05	0.2	-	-	-	-	-
Hydrogen sulfide	7783-06-4	10	14	15	21	-	-	-
Hydroquinone	123-31-9	-	2	-	4	-	-	-
2-Hydroxypropyl acrylate	999-61-1	0.5	3	-	-	-	-	X
Indene	95-13-6	10	45	15	70	-	-	-
Indium and compounds (as In)	7440-74-6	-	0.1	-	0.3	-	-	-
Iodine	7553-56-2	-	-	-	-	0.1	1	-
Iodoform	75-47-8	0.6	10	1	20	-	-	-
Iron oxide dust and fume (as Fe)	1309-37-1							
Total particulate		-	5	-	10	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Iron pentacarbonyl (as Fe)	13463-40-6	0.1	0.8	0.2	1.6	-	-	-
Iron salts (soluble) (as Fe)	Varies with compound	-	1	-	2	-	-	-
Isoamyl acetate	123-92-2	100	525	125	655	-	-	-
Isoamyl alcohol (primary and secondary)	123-51-3	100	360	125	450	-	-	-
Isobutyl acetate	110-19-0	150	700	187	888	-	-	-
Isobutyl alcohol	78-83-1	50	150	75	225	-	-	-
Isooctyl alcohol	26952-21-6	50	270	-	-	-	-	X
Isophorone	78-59-1	4	23	-	-	5	28	-
Isophorone diiso-cyanate	4098-71-9	0.005	0.045	0.02	-	-	-	X
2-Isopropoxyethanol	109-59-1	25	105	75	320	-	-	-
Isopropyl acetate	108-21-4	250	950	310	1,185	-	-	-
Isopropyl alcohol	67-63-0	400	980	500	1,225	-	-	-
Isopropylamine	75-31-0	5	12	10	24	-	-	-
N-Isopropylaniline	768-52-5	2	10	-	-	-	-	X
Isopropyl ether	108-20-3	250	1,050	310	1,320	-	-	-
Isopropyl glycidyl ether (IGE)	4016-14-2	50	240	75	360	-	-	-
Kaolin - Total dust		-	10	-	20	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Respirable fraction		-	5	-	-	-	-	-
Ketene	463-51-4	0.5	0.9	1.5	3	-	-	-
Lead chromate, as Cr	7758-97-6	-	0.05	-	-	-	-	-
Lead inorganic (as Pb)	7439-92-1	see §12-202-33.1 and 12-148.1						
Limestone	1317-65-3							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Lindane	58-89-9	-	0.5	-	1.5	-	-	X
Lithium hydride	7580-67-8	-	0.025	-	-	-	-	-
L.P.G. (Liquefied petroleum gas)	68476-85-7	1,000	1,800	1,250	2,250	-	-	-
Magnesite	546-93-0							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Magnesium oxide fume	1309-48-4							
Total particulate		-	10	-	-	-	-	-
Malathion	121-75-5							
Total dust		-	10	-	-	-	-	X
Maleic anhydride	108-31-6	0.25	1	-	-	-	-	-
Manganese compounds (as Mn)	7439-96-5	-	-	-	-	-	5	-
Manganese fume (as Mn)	7439-96-5	-	1	-	3	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Manganese cyclopenta-dienyl tricarbonyl (as Mn)	12079-65-1	-	0.1	-	0.3	-	-	X
Manganese tetroxide (as Mn)	1317-35-7	-	1	-	-	-	-	-
Marble (Calcium carbonate)	1317-65-3							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Mercury (aryl and inorganic) (as Hg)	7439-97-6	-	-	-	-	-	0.1	X
Mercury (organo) alkyl compounds (as Hg)	7439-97-6	-	0.01	-	0.03	-	-	X
Mercury (vapor) (as Hg)	7439-97-6	-	0.05	-	-	-	-	X
Mesityl oxide	141-79-7	15	60	25	100	-	-	-
Methacrylic acid	79-41-4	20	70	-	-	-	-	X
Methanethiol				see Methyl mercaptan				
Methomyl (Lannate)	16752-77-5	-	2.5	-	-	-	-	-
Methoxychlor	72-43-5							
Total dust		-	10	-	-	-	-	-
2-Methoxyethanol	150-76-5			see Methyl cellosolve				
4-Methoxyphenol								

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Methyl acetate	79-20-9	200	610	250	760	-	-	-
Methyl acetylene (Propyne)	74-99-7	1,000	1,650	1,250	2,040	-	-	-
Methyl acetylene-propadiene mixture (MAPP) -		1,000	1,800	1,250	2,250	-	-	-
Methyl acrylate	96-33-3	10	35	-	-	-	-	X
Methylacrylonitrile	126-98-7	1	3	2	6	-	-	X
Methylal (Dimethoxy-methane)	109-87-5	1,000	3,100	1,250	3,875	-	-	-
Methyl alcohol (methanol)	67-56-1	200	260	250	325	-	-	X
Methylamine	74-89-5	10	12	-	-	-	-	-
Methyl amyl alcohol		see Methyl isobutyl carbinol						
Methyl n-amyl ketone	110-43-0	50	235	-	-	-	-	-
N-Methyl aniline	100-61-8	0.5	2	1	5	-	-	X
Methyl bromide	74-83-9	5	20	15	60	-	-	X
Methyl n-butyl ketone		see 2-Hexanone						
Methyl cellosolve (2-Methoxyethanol)	109-86-4	5	16	-	-	-	-	X
Methyl cellosolve acetate (2-Methoxyethyl acetate)	110-49-6	5	24	-	-	-	-	X
Methyl chloride	74-87-3	50	105	106	205	200	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Methyl chloroform (1,1,1-Trichloro-ethane)	71-55-6	350	900	450	2,450	-	-	-
Methyl 2-cyanoacrylate	137-05-3	2	8	4	16	-	-	-
Methylcyclohexane	108-87-2	400	1,600	500	2,000	-	-	-
Methylcyclohexanol	25639-42-3	50	235	75	350	-	-	-
o-Methylcyclohexanone	538-60-8	50	230	75	345	-	-	X
2-Methylcyclo-pentadienyl manganese tricarbonyl (as Mn)	12108-13-3	-	0.2	-	0.6	-	-	X
Methyl demeton	8022-00-2	-	0.5	-	1.5	-	-	X
4,4'-Methylene bis (2-chloroaniline) (MBOCA)	101-14-4	0.02	0.22	-	-	-	-	X
Methylene bis (4-cyclohexyliso-cyanate)	5124-30-1	-	-	-	-	0.01	0.11	-
Methylene chloride	75-09-2	see §12-202-41						
4,4'-Methylene dianiline;	101-77-9	see §12-202-38 and 12-146						
Methyl ethyl ketone (MEK)		see 2-Butanone						

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Methyl ethyl ketone peroxide (MEKP)	1338-23-4	-	-	-	-	0.2	1.5	-
Methyl formate	107-31-3	100	250	150	375	-	-	-
Methyl hydrazine (Mono-methyl hydrazine	60-34-4	-	-	-	-	0.2	0.35	X
Methyl iodide	74-88-4	2	10	-	-	-	-	X
Methyl isoamyl ketone	110-12-3	50	240	-	-	-	-	-
Methyl isobutyl carbinol	108-11-2	25	100	-	-	-	-	X
Methyl isobutyl ketone see Hexone								
Methyl isocyanate	624-83-9	0.02	0.05	-	-	-	-	X
Methyl isopropyl ketone	563-80-4	200	705	-	-	-	-	-
Methyl mercaptan	74-93-1	0.5	1	-	-	-	-	-
Methyl methacrylate	80-62-6	100	410	-	-	-	-	-
Methyl parathion	298-00-0	-	0.2	-	0.6	-	-	X
Methyl propyl ketone				see 2-Pentanone				
Methyl silicate	681-84-5	1	6	-	-	-	-	-
-Methyl styrene	98-83-9	50	240	100	485	-	-	-
Methylene bisphenyl isocyanate (MDI)	101-68-8	-	-	-	-	0.02	0.2	-
Metribuzin	21087-64-9	-	5	-	-	-	-	-
MevinphosR				see Phosdrin				

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Mica				see Silicates				
Molybdenum (as Mo)	7439-98-7							
Soluble compounds		-	5	-	10	-	-	-
Insoluble compounds								
Total dust		-	10	-	20	-	-	-
Monocrotophos (AzodrinR)	6923-22-4	-	0.25	-	-	-	-	-
Monomethyl aniline (N-Methylaniline)	100-61-8	0.5	2	-	-	-	-	X
Morpholine	110-91-8	20	70	30	105	-	-	X
Naled	300-76-5	-	3	-	6	-	-	X
Naphtha (Coal tar)	8030-30-6	100	400	-	-	-	-	-
Naphthalene	91-20-3	10	50	15	75	-	-	-
-Naphthylamine	134-32-7			see §12-202-14.1				
-naphthylamine	91-59-8			see §12-202-14.1				
Nickel carbonyl (as Ni)	13463-39-3	0.001	0.007	-	-	-	-	-
Nickel, metal and insoluble compounds (as Ni)	7440-02-0	-	1	-	-	-	-	-
Nickel, soluble compounds (as Ni)	7440-02-0	-	0.1	-	0.3	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Nickel sulfide roasting, fume & dust, (as Ni)	-	-	1	-	-	-	-	-
Nicotine	54-11-5	-	0.5	-	1.5	-	-	X
Nitrapyrin	1929-82-4	-	10	-	20	-	-	-
Nitric acid	7697-37-2	2	5	4	10	-	-	-
Nitric oxide	10102-43-9	25	30	35	45	-	-	-
p-Nitroaniline	100-01-6	-	3	-	-	-	-	X
Nitrobenzene	98-95-3	1	5	2	10	-	-	X
p-Nitrochlorobenzene	100-00-5	0.1	0.6	-	-	-	-	X
4-Nitrodiphenyl	92-93-3			see §12-202-14.1				
Nitroethane	79-24-3	100	310	150	465	-	-	-
Nitrogen dioxide	10102-44-0	3	6	5	9.4	-	-	-
Nitrogen trifuoride	7783-54-2	10	29	15	45	-	-	-
Nitroglycerin (NG)l	55-63-0	-	-	-	0.1	-	-	X
Nitromethane	75-52-5	100	250	150	375	-	-	-
1-Nitropropane	108-03-2	25	90	35	135	-	-	-
2-Nitropropane	79-46-9	10	35	-	-	-	-	-
N-Nitrosodi-methylamine	62-79-9			see §12-202-14.1				

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Nitrotoluene								
o-isomer	88-72-2	2	11	-	-	-	-	X
m-isomer	99-08-1	2	11	-	-	-	-	X
p-isomer	99-99-0	2	11	-	-	-	-	X
Nitrotrichloromethane				see Chloropicrin				
Nitrous oxide	10024-97-2	50	91	-	-	-	-	-
Nonane	111-84-2	200	1,050	250	1,300	-	-	-
Octachloronaphthalene	2234-13-1	-	0.1	-	0.3	-	-	X
Octane	111-65-9	300	1,450	375	1,800	-	-	-
Oil mist, mineral	8012-95-1	-	5i	-	10i	-	-	-
Osmium tetroxide (as Os)	20816-12-0	0.0002	0.002	0.0006	0.006	-	-	-
Oxalic acid	144-62-7	-	1	-	2	-	-	-
Oxygen difluoride	7783-41-7	-	-	-	-	0.05	0.11	-
Ozone	10028-15-6	0.1	0.2	0.3	0.6	-	-	-
Paraffin wax fume	8002-74-2	-	2	-	6	-	-	-
Paraquat, respirable dust	1910-42-5	-	0.1	-	-	-	-	X
	2074-50-2	-	0.1	-	-	-	-	X
	4685-14-7	-	0.1	-	-	-	-	X
Parathion	56-38-2	-	0.1	-	0.3	-	-	X
Particulates not other wise regulated -								
Total dust		-	10	-	-	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Respirable fraction		-	-	5	-	-	-	-
Pentaborane	19624-22-7	0.005	0.01	0.015	0.03	-	-	-
Pentachloro-naphthalene	1321-64-8	-	0.5	-	2	-	-	X
Pentachlorophenol	87-86-5	-	0.5	-	1.5	-	-	X
Pentaerythritol	115-77-5							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Pentane	109-66-0	600	1,800	750	2,250	-	-	-
2-Pentanone (Methyl propyl ketone)	107-87-9	200	700	250	875	-	-	-
Perchloroethylene (Tetrachloro-ethylene)	127-18-4	25	170	200	1,340	-	-	-
Perchloromethyl mercaptan	594-42-3	0.1	0.8	-	-	-	-	-
Perchloryl fluoride	7616-94-6	3	14	6	28	-	-	-
Perlite								
Total dust		-	10	-	-	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Petroleum distillates (Naphtha)	8002-05-9	400	1,600	-	-	-	-	-
Phenol	108-95-2	5	19	10	38	-	-	X
Phenothiazine	92-84-2	-	5	-	10	-	-	X

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
p-Phenylene diamine	106-50-3	-	0.1	-	-	-	-	X
Phenyl ether, vapor	101-84-8	1	7	2	14	-	-	-
Phenyl ether-biphenyl mixture, vapor		1	7	-	-	-	-	-
Phenylethylene see Styrene								
Phenyl glycidyl ether (PGE)	122-60-1	1	6	-	-	-	-	-
Phenylhydrazine	100-63-0	5	20	10	45	-	-	X
Phenyl mercaptan	108-98-5	0.5	2	-	-	-	-	-
Phenylphosphine	638-21-1	-	-	-	-	0.05	0.25	-
Phorate	298-02-2	-	0.05	-	0.2	-	-	X
Phosdrin (MevinphosR)	7786-34-7	0.01	0.1	0.03	0.3	-	-	X
Phosgene (Carbonyl chloride)	75-44-5	0.1	0.4	-	-	-	-	-
Phosphine	7803-51-2	0.3	0.4	1	1.4	-	-	-
Phosphoric acid	7664-38-2	-	1	-	3	-	-	-
Phosphorus (yellow)	7723-14-0	-	0.1	-	0.3	-	-	-
Phosphorus oxychloride	10025-87-3	0.1	0.6	0.5	3	-	-	-
Phosphorus penta-chloride	10026-13-8	-	1	-	3	-	-	-
Phosphorus penta-sulfide	1314-80-3	-	1	-	3	-	-	-
Phosphorus trichloride	7719-12-2	0.2	1.5	0.5	3	-	-	-
Phthalic anhydride	85-44-9	1	6	-	-	-	-	-
m-Phthalodinitrile	626-17-5	-	5	-	-	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Picloram	1918-02-1							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Picric acid	88-89-1	-	0.1	-	0.3	-	-	X
Pindone (2-Pivalyl-1,3-indandione)	83-26-1	-	0.1	-	0.3	-	-	-
Piperazine dihydro-chloride	142-64-3	-	5	-	-	-	-	-
Plaster of Paris	26499-65-0							
Total dust		-	10	-	-	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Platinum (as Pt)	7440-06-4							
Metal		-	1	-	-	-	-	-
Soluble salts		-	0.002	-	-	-	-	-
Portland cement	65997-15-1							
Total dust		-	10	-	-	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Potassium hydroxide	1310-58-3	-	-	-	-	-	2	-
Propane	74-98-6	1,000	1,800	-	-	-	-	-
Propargyl alcohol	107-19-7	1	2	3	6	-	-	X
-Propriolactone	57-57-8				see §12-202-14.1			
Propionic acid	79-09-4	10	30	15	45	-	-	-
Propoxur (Baygon)	114-26-1	-	0.5	-	2	-	-	-
n-Propyl acetate	109-60-4	200	840	250	1,050	-	-	-
n-Propyl alcohol	71-23-8	200	500	250	625	-	-	X

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
n-Propyl Nitrate	627-13-4	25	105	40	170	-	-	-
Propylene dichloride	78-87-5	75	350	110	510	-	-	-
Propylene glycol dinitrate (PGDN)	6423-43-4	0.05	0.3	0.1	0.6	-	-	X
Propylene glycol mono-methyl ether	107-98-2	100	360	150	540	-	-	-
Propylene imine	75-55-8	2	5	-	-	-	-	X
Propylene oxide	75-56-9	20	50	-	-	-	-	-
n-Propyl nitrate	627-13-4	25	105	40	170	-	-	-
Propyne				see Methyl acetylene				
Pyrethrum	8003-34-7	-	5	-	10	-	-	-
Pyridine	110-86-1	5	15	10	30	-	-	-
Quinone	106-51-4	0.1	0.4	0.3	1	-	-	-
Resorcinol	108-46-3	10	45	20	90	-	-	-
Rhodium (as Rh), metal fume and insoluble compounds	7440-16-6	-	0.1	-	-	-	-	-
Rhodium (as Rh), soluble compounds	7440-16-6	-	0.001	-	-	-	-	-
Ronnel 299-84-3		-	10	-	-	-	-	-
Rosin core solder pyrolysis products, as formaldehyde		-	0.1	-	0.3	-	-	-
Rotenone (commercial)	83-79-4	-	5	-	10	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Rouge -								
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Rubber solvent (Naphtha)		400	1,600	-	-	-	-	-
Selenium compounds (as Se)	7782-49-2	-	0.2	-	-	-	-	-
Selenium hexafluoride (as Se)	7783-79-1	0.05	0.2	-	-	-	-	-
Sesone (Sodium 2,4-dichloro-phenoxy-ethyl sulfate)				see Crag herbicide				
Silane see Silicone tetrahydride								
Silica, amorphous, precipitated and gel		-	6	-	-	-	-	-
Silica, amorphous, diatomaceous earth containing less than 1% crystalline silica	61790-53-2	-	6	-	-	-	-	-
Silica, crystalline cristobalite (as quartz), respirable dust	14464-46-1	-	0.05	-	-	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Silica, crystalline quartz (as quartz), respirable dust	14808-60-7	-	0.1	-	-	-	-	-
Silica, crystalline tripoli (as quartz), respirable dust	1317-95-9	-	0.1	-	-	-	-	-
Silica, crystalline tridymite (as quartz), respirable dust	15468-32-3	-	0.05	-	-	-	-	-
Silica, fused, respirable dust	60676-86-0	-	0.1	-	-	-	-	-
Silicates (less than 1% crystalline silica) Mica (respirable dust)	12001-26-2	-	3	-	-	-	-	-
Soapstone, total dust		-	-	6	-	-	-	-
Soapstone, respirable dust		-	-	3	-	-	-	-
Talc (containing asbestos): use asbestos limit -				see §12-202-13				

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Talc (containing no asbestos), respirable dust	14807-96-6	-	2	-	-	-	-	-
Tremolite		see §12-202-13						
Silicon	7440-21-3							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Silicon carbide	409-21-2							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Silicon tetrahydride (Silane)	7803-62-5	5	7	-	-	-	-	-
Silver, metal and soluble compounds (as Ag)	7440-22-4	-	0.01	-	-	-	-	-
Soapstone see Silicates								
Sodium azide	26628-22-8							
(as HN3)		-	-	-	-	0.1	-	X
(as NaN3)		-	-	-	-	-	0.3	X
Sodium bisulfite	7631-90-5	-	5	-	-	-	-	-
Sodium 2,4-dichloro-phenoxyethyl sulfate		see Crag herbicide (see sessone)						
Sodium fluoroacetate	62-74-8	-	0.05	-	0.15	-	-	X
Sodium hydroxide	1310-73-2	-	-	-	-	-	2	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Sodium metabisulfite	7681-57-4	-	5	-	-	-	-	-
Starch	9005-25-8							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Stibine	7803-52-3	0.1	0.5	0.3	1.5	-	-	-
Stoddard solvent	8052-41-3	100	525	-	-	-	-	-
Strychnine	57-24-9	-	0.15	-	0.45	-	-	-
Styrene, monomer	100-42-5	50	215	100	425	-	-	-
Subtilisins (Proteolytic enzymes) (60 min)j	9014-01-1	-	-	-	0.00006	-	-	-
Sucrose	57-50-1							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Sulfotep;				see TEDP				
Sulfur dioxide	7446-09-5	2	5	5	10	-	-	-
Sulfur hexafluoride	2551-62-4	1,000	6,000	1,250	7,500	-	-	-
Sulfuric acid	7664-93-9	-	1	-	3	-	-	-
Sulfur monochloride	10025-67-9	-	-	3	18	1	6	-
Sulfur pentafluoride	5714-22-7	-	-	0.075	0.75	0.01	0.1	-
Sulfur tetrafluoride	7783-60-0	-	-	0.3	1	0.1	0.4	-
Sulfuryl fluoride	2699-79-8	5	20	10	40	-	-	-
Sulprofos	35400-43-2	-	1	-	-	-	-	-
SystoxR				see Demeton				
2,4,5-T								

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Talc				see Silicates				
Tantalum, metal and oxide dust	7440-25-7	-	5	-	10	-	-	-
TEDP (Sulfotep)	3689-24-5	-	0.2	-	0.6	-	-	X
Tellurium and compounds (as Te)	13494-80-9	-	0.1	-	-	-	-	-
Tellurium hexafluoride (as Te)	7783-80-4	0.02	0.2	-	-	-	-	-
Temephos	3383-96-8							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
TEPP	107-49-3	0.004	0.05	0.01	0.2	-	-	X
Terphenyls	26140-60-3	-	-	-	-	0.5	5	-
1,1,1,2-Tetrachloro-2,2-difluoroethane	76-11-9	500	4,170	625	5,210	-	-	-
1,1,2,2-Tetrachloro-1,2-difluoroethane	76-12-0	500	4,170	625	5,210	-	-	-
1,1,2,2-Tetrachloro-ethane	79-34-5	1	7	-	-	-	-	X
Tetrachoroethylene				see Perchloroethylene				
Tetrachloromethane				see Carbon tetrachloride				
Tetrachloro-naphthalene								
Tetraethyl lead	1335-88-2	-	2	-	4	-	-	X

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
(as Pb)	78-00-2	-	0.075k	-	0.3k	-	-	X
Tetrahydrofuran	109-99-9	200	590	250	735	-	-	-
Tetramethyl lead, (as Pb)	75-74-1	-	0.075k	-	0.5k	-	-	X
Tetramethyl succino-nitrile	3333-52-6	0.5	3	2	9	-	-	X
Tetranitromethane	509-14-8	1	8	-	-	-	-	-
Tetrasodium pyro-phosphate	7722-88-5	-	5	-	-	-	-	-
Tetryl (2,4,6-Trinitrophenyl-methyl-nitramine)	479-45-8	-	1.5	-	-	-	-	X
Thallium, soluble compounds (as Tl)	7440-28-0	-	0.1	-	-	-	-	X
4,4'-Thiobis (6-tert, butyl-m-cresol)	96-69-5							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Thioglycolic acid	68-11-1	1	4	-	-	-	-	X
Thionyl chloride	7719-09-7	-	-	-	-	1	5	-
Thiram	137-26-8	-	1	-	-	-	-	-
Tin, inorganic compounds (except oxides) (as Sn)	7440-31-5	-	2	-	4	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Tin, organic compounds (as Sn)	7440-31-5	-	0.1	-	0.2	-	-	X
Tin oxide (as Sn)	21651-19-4	-	2	-	4	-	-	-
Titanium dioxide	13463-67-7							
Total dust		-	10	-	20	-	-	-
Toluene (Toluol)	108-88-3	100	375	150	560	-	-	X
Toluene di-isocyanate (TDI)	584-84-9	0.005	0.04	0.02	0.15	-	-	-
m-Toluidine	108-44-1	2	9	-	-	-	-	X
o-Toluidine	95-53-4	5	22	-	-	-	-	X
p-Toluidine	106-49-0	2	9	-	-	-	-	X
Toxaphene				see Chlorinated camphene				
Tremolite				see Silicates				
Tributyl phosphate	126-73-8	0.2	2.5	0.4	5	-	-	-
Trichloroacetic acid	76-03-9	1	5	-	-	-	-	-
1,2,4-Trichlorobenzene	120-82-1	-	-	-	-	5	40	-
1,1,1-Trichloroethane				see Methyl chloroform				
1,1,2-Trichloroethane	79-00-5	10	45	20	90	-	-	X
Trichloroethylene	79-01-6	50	270	200	1,080	-	-	-
Trichloromethane				see Chloroform				
Trichloronaphthalene	1321-65-9	-	5	-	10	-	-	X
1,2,3-Trichloropropane	96-18-4	10	60	75	450	-	-	X
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	1,000	7,600	1,250	9,500	-	-	-
Triethylamine	121-44-8	10	40	15	60	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Trifluorobromomethane	75-63-8	1,000	6,100	1,200	7,300	-	-	-
Trimellitic anhydride	552-30-7	0.005	0.04	-	-	-	-	-
Trimethylamine	75-50-3	10	24	15	36	-	-	-
Trimethyl benzene	25551-13-7	25	125	35	170	-	-	-
Trimethyl phosphite	121-45-9	2	10	5	25	-	-	-
2,4,6-Trinitrophenyl				see Picric acid				
2,4,6-Trinitrophenyl-methyl nitramine				see Tetryl				
2,4,6-Trinitrotoluene (TNT) 118-96-7		-	0.5	-	-	-	-	X
Triorthocresyl phosphate	78-30-8	-	0.1	-	-	-	-	X
Triphenyl amine	603-34-9	-	5	-	-	-	-	-
Triphenyl phosphate	115-86-6	-	3	-	6	-	-	X
Tungsten (as W)	7440-33-7							
Insoluble compounds		-	5	-	10	-	-	-
Soluble compounds		-	1	-	3	-	-	-
Turpentine	8006-64-2	100	560	150	840	-	-	-
Uranium (as U)	7440-61-1							
Soluble compounds		-	0.05	-	-	-	-	-
Insoluble compounds		-	0.2	-	0.6	-	-	-
n-Valeraldehyde	110-62-3	50	175	-	-	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
Vanadium	1314-62-1							
Respirable dust (as V2O5)		-	0.05	-	-	-	-	-
Fume (as V2O5)		-	0.05	-	-	-	-	-
Vegetable oil mist -								
Total dust		-	10	-	-	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Vinyl acetate 108-05-4		10	30	20	60	-	-	-
Vinyl benzene					see Styrene			
Vinyl bromide	593-60-2	5	20	-	-	-	-	-
Vinyl chloride	75-01-4				see §12-202-28			
Vinylcyanide					see Acrylonitrile			
Vinyl cyclohexene dioxide	106-87-6	10	60	-	-	-	-	X
Vinylidene chloride (1,1-Dichloro-ethylene)	75-35-4	1	4	-	-	-	-	-
Vinyl toluene	25013-15-4	50	240	100	485	-	-	-
VM & P Naphtha	8032-32-4	300	1,350	400	1,800	-	-	-
Warfarin	81-81-2	-	0.1	-	0.3	-	-	-
Welding fumes (total particulate)		-	5	-	-	-	-	-
Wood dust:								
Certain hardwoods as beech & oak		-	-	1	-	-	-	-

TABLE 202-1 Limits for Air Contaminants (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STELa		PEL-CEILING		Skin
Substance	CAS#	ppmc	mg/m3d	ppmc	mg/m3d	ppmc	mg/m3d	
All soft woods, (except Western red cedar)		-	5	-	10	-	-	-
Wood dust, Western red cedar		-	-	2.5	-	-	-	-
Xylenes (o-, m-, p-isomers	1330-20-7	100	435	150	655	-	-	X
m-Xylene , '-diamine	1477-55-0	-	-	-	-	-	0.1	X
Xylidine	1300-73-8	0.5	2.5	-		-	-	X
Yttrium	7440-65-5	-	1	-	3	-	-	-
Zinc chloride fume	7646-85-7	-	1	-	2	-	-	-
Zinc chromate (as CrO3) Varies with Compound		-	0.01	-	-	-	0.1	-
Zinc oxide fume	1314-13-2	-	5	-	10	-	-	-
Zinc oxide	1314-13-2							
Total dust		-	10	-	-	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Zinc stearate	557-05-1							
Total dust		-	10	-	20	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Zirconium compounds (as Zr)	7440-67-2	-	5	-	10	-	-	-

Footnotes to Table 202-1:

Air Contaminant Rule Limits are the most restrictive of the federal limits, ACGIH limits and existing DOSH limits.

* The PEL-TWA's are 7- to 8-hour TWA's, unless otherwise noted.

** Unless otherwise noted, employers in General Industry (i.e., those covered by Part 2 of the DOSH standards) may use any combination of controls to achieve these limits, until December 31, 1992.

a. STEL duration is for 15 minutes, unless otherwise noted.

b. The CAS number is for information only. Enforcement is based on the substance name. For an entry covering more than one metal compound measured as the metal, the CAS number for the metal is given--not the CAS numbers for the individual compounds.

c. Ppm are in parts of vapor or gas per million parts of contaminated air by volume at 25oC and 760 torr.

d. Mg/m3 is approximate milligrams of substance per cubic meter of air.

e. The final benzene standard in section 12-202-36 applies to all occupational exposures to benzene except some subsegments of industry where exposures are consistently under the action level (e.g., distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures); for the excepted subsegments, the benzene limits in Table 202-2 apply.

f. Coal tar pitch volatiles mean the fused polycyclic hydrocarbons which volatilize from the distillation residues of coal, petroleum, (excluding asphalt, CAS 8052-42-4 and CAS 64742-93-4), wood, and other organic matter.

g. Cotton dust refers to lint-free dust as measured by the vertical elutriator, cotton-dust sampler described in the Transactions of the National Conference on Dust, p. 33 by J.R. Lynch, (May 2, 1970). The PELTWA in the table applies to respirable dust as measured by a vertical elutriator cotton dust sampler or equivalent instrument. The time-weighted average applies to the cotton waste processing operations of waste cycling (sorting, blending, cleaning, and willowing) and garreting. See also section 12-202-32.

h. Fibrous glass dust means particles <7 m in diameter.

i. Oil mist as sampled by a method that does not collect vapor.

j. Compliance with the Subtilisins PEL-TWA is assessed by sampling with a high volume sampler (600-800 liters per minute) for at least 60 minutes.

k. For control of tetraethyl lead and tetramethyl lead in general room air, biologic monitoring is essential for personnel monitoring.

l. Most Occupational exposures to EGDN actually involve mixtures of EGDN and nitroglycerin (NG). This EGDN:NG mixture has a PEL-STEL of 0.1 mg/m3.

TABLE 202-2

Material Segments	Industry	Skin Design-nation	8-hour time-weighted average	Ceiling concentra-tion
Benzene	(Z37.40-1969)[1]	-	10 ppm	25 ppm
Beryllium and Beryllium compounds	(Z37.29-1970)	-	2 g/m^3	5 g/m^3
Ethylene dibromide	(Z37.31-1970)	X	20 ppm	30 ppm
Methyl chloride	(Z37.18-1969)	-	100 ppm	200 ppm

[1]This standard applies to the industry segments exempt from the 1 ppm 8-hour TWA and 5 ppm STEL of the benzene standard at section 12-202-36. This standard also applies to any industry for which section 12-202-36 is stayed or otherwise not in effect. [Eff 3/22/91; am 6/8/92; am 5/2/97; am 4/11/98] (Auth: HRS §396-4) (Imp: HRS §396-4)

§12-202-5 Exposure for less than 7-8 hours. REPEALED. [Eff. 7/12/82; am 6/16/84; am 8/5/88; R 3/22/91] (Auth: HRS §396-4) (Imp: HRS §396-4)

§12-202-6 Exposure for more than 8 hours.

(a) The permissible exposure limit to hazardous substances described or listed in this chapter for shifts greater than 8 hours shall be the PEL for greater-than-8-hour exposure.

(b) This formula shall be used to compute the TWA for greater-than-8-hour exposure:

TWA = ppm-hours/total hours exposed.

For example, suppose an employee was exposed to 9.3 ppm-hours of chlorine over a 10-hour span. Then:

TWA = 9.3 ppm-hours/lO.O hours = 0.93 ppm.

However, this TWA cannot be compared to the PEL-TWA in table 202-1 to determine whether the PEL-TWA has been exceeded.

(c) A substance greater-than-8-hours-exposure PEL shall be computed from the following general formula:

substance >8 hour PEL = maximum concentration-hours/total hours exposure.

(1) Since the maximum concentration-hours (in either ppm-hours or mg/m3-hours) is calculated from the appropriate substance PEL-TWA of table 202-1 multiplied by 8 hours, the above formula is equivalent to the following formula:

substance >8 hour PEL = PEL-TWA (table 202-1) x 8 hours/total hours exposure.

(2) In the chlorine example above, therefore, where the chlorine PEL-TWA in table 202-1 is 0.5 ppm, the chlorine 10-hour exposure PEL is calculated in ppm as follows:

chlorine 10-hour PEL = 0.5 ppm x 8 hours/10.0 hours = 4 ppm-hours/10.0 hours = 0.4 ppm;

similarly, for example, note that (in ppm) the:

chlorine 12-hour PEL = 0.33 ppm; and chlorine 20-hour PEL = 0.2 ppm.

The chlorine 10-hour TWA (i.e., 0.93 ppm, computed in subsection (b) above) is greater than the chlorine 10-hour PEL of 0.4 ppm; therefore, the employee was exposed to an unacceptable level of chlorine. [Eff. 7/12/82; am 6/16/84; am 3/22/91] (Auth: HRS §396-4) (Imp: HRS §396-4)

§12-202-7 Short-term limits (STLs). REPEALED. [Eff. 7/12/82; R 6/16/84] (Auth: HRS §396-4) (Imp: HRS §396-4)

§12-202-7.01 Short-term exposure levels (STELs). REPEALED. [Eff. 7/12/82; am 6/16/84; am 8/5/88; R 3/22/91] (Auth: HRS §396-4) (Imp: HRS §396-4)

§12-202-8 REPEALED. [Eff 7/12/82; am 6/16/84; am 3/22/91; am 6/8/92; am 7/6/99; R 12/29/00] (Auth: HRS §396-4) (Imp: HRS §396-4)

§12-202-9 REPEALED. [Eff. 7/12/82; am 5/28/83; am 6/16/84; am 8/5/88; am 3/22/91; am 4/11/98; R 12/29/00] (Auth: HRS §396-4) (Imp: HRS §396-4)

§12-202-10 REPEALED. [Eff. 7/12/82; am 6/16/84; am 8/5/88; am 3/22/91; R 12/29/00] (Auth: HRS §396-4) (Imp: HRS §396-4)

§12-202-11 REPEALED. [Eff. 7/12/82; am 6/16/84; am 8/5/88; am 3/22/91; R 12/29/00] (Auth: HRS §396-4) (Imp: HRS §396-4)

§12-202-12 Achieving compliance. To achieve compliance within the limits prescribed in this chapter, administrative or engineering controls must first be determined and implemented whenever feasible. When those controls are not feasible to achieve full compliance, protective equipment or any other protective measures shall be used to keep the exposure of employees to air contaminants within the limits prescribed in this chapter. Any equipment and technical measure used for this purpose must be approved for each particular use by a competent industrial hygienist or another technically qualified person. Whenever respirators are used, their use shall comply with chapter 12-64. [Eff. 7/12/82] (Auth: HRS §396-4) (Imp: HRS §396-4)

APPENDIX V

HAZARDOUS MATERIAL MANAGEMENT PROGRAM

UNIVERSITY OF HAWAI‘I

John A. Burns School of Medicine at Kaka‘ako

Hazardous Material and Hazardous Waste Management Program

JUNE 2005

TABLE OF CONTENTS

ATTACHMENTS

I. INTRODUCTION

This program outlines requirements for the management of hazardous materials and the disposal of hazardous waste at the University of Hawai‘i John A. Burns School of Medicine at Kaka‘ako, hereafter called JABSOM Kaka‘ako. These requirements are based on federal, state and county regulations. Failure to comply with these requirements may subject JABSOM Kaka‘ako and/or individuals to fines and civil or criminal prosecution. Additionally, proper management of hazardous materials reduces disposal costs. Revisions to this program require University of Hawai‘i Environmental Health and Safety Office (EHSO) approval, except for revisions that only change the names of designated individuals. These only require EHSO notification and can be accomplished by memorandum.

A. RESPONSIBLE PERSONNEL

1. All personnel must

- **Become familiar with the hazardous materials in their area and with this hazardous material and hazardous waste management program.**
- **Use authorization to purchase form (*Attachment 1*) to obtain approval for the purchase of hazardous materials.**
- **Submit an authorization to use hazardous materials form (*Attachment 2*) for grant approval.**
- **Provide an annual inventory of hazardous materials (*Attachment 3*) and a monthly inventory of hazardous wastes (*Attachment 4*).**
- **Store and label waste properly.**
- **Contact the John A. Burns School of Medicine (JABSOM) Health and Safety Coordinator (808-692-1855) if you have any questions about this "*Hazardous Waste and Hazardous Material Program*".**

2. Designated program coordinator

The JABSOM Health and Safety Coordinator is responsible for overall coordination of the Hazardous Material and Hazardous Waste Management Program at JABSOM Kaka‘ako.
In addition, all hazardous waste generating personnel are required to attend initial and annual refresher hazardous waste generator training given by the JABSOM Health and Safety Coordinator. Hazardous waste generators are to contact the JABSOM Health and Safety Coordinator (808-692-1855) to register for this training.

I. HAZARDOUS MATERIAL MANAGEMENT

A. **Training certificates.** Individuals required to attend hazardous waste generator training will receive a certificate of completion for this training. This certificate is to be kept in the waste generator's working area with other training records. The JABSOM Health and Safety Coordinator will also have a record of attendance for this training on file and provide a copy to the EHSO Hazardous Materials Management Officer.

B. **Authorization to purchase hazardous materials.** Approval from the JABSOM Health and Safety Coordinator is required for the purchase or requisition of all hazardous materials. The "Authorization to Purchase Hazardous Materials Form" (*Attachment 1*), must be submitted to the JABSOM Health and Safety Coordinator before any purchase of hazardous materials is initiated. If approved, a copy of the form will be provided to you for attachment to your purchase order or requisition. The purpose of this approval is to ensure the safe storage, handling and eventual disposal of the material while minimizing cost.

C. **Approval to use hazardous materials.** As part of the grant approval process (ORS Form 5, item 4 under PI certification) a specific form for the use of certain highly hazardous materials has been developed (*Attachment 2*). This form is similar to those already in place for the use of radioactive and biohazard materials. This form must be submitted to the EHSO Hazardous Materials Management Officer prior to the completion of the grant process. (phone: 808-956-3198, fax: 808-956-3205).

D. **Inventory Control Procedures.**

1. **Annual Inventory of Hazardous Materials**. JABSOM Kaka'ako programs that store hazardous materials are required to submit annual inventories to the JABSOM Health and Safety Coordinator. The annual inventory form, *Attachment 3*, will help manage existing hazardous materials, monitor on-going usage, and prevent unnecessary accumulation. As part of the inventory procedure, the JABSOM Health and Safety Coordinator will inspect the condition of all hazardous material containers to ensure that hazardous materials are stored in containers which are in good condition and which are properly labeled.

2. **Monthly Inventory of Hazardous Wastes.** Hazardous waste generators are required to submit monthly waste inventories to the JABSOM Health and Safety Coordinator. Waste inventory forms (*Attachment 4*) shall be submitted to the JABSOM Health and Safety Coordinator on or before the first Friday of every month. The JABSOM

Health and Safety Coordinator will forward a copy of the form(s) to EHSO for completion of the DOT hazard class and EPA Waste Code information. The completed form(s) will be returned to the JABSOM Health and Safety Coordinator so that it will be readily available to any requesting state or federal compliance officers conducting inspections. The waste inventories help us ensure that we do not exceed our accumulation limits, thus subjecting JABSOM Kaka'ako to more stringent regulations. In addition, the completed forms document the hazardous waste determination required by federal regulations as discussed in *Attachment 4*. As part of the inventory procedure, the JABSOM Health and Safety Coordinator is required to inspect the condition of all hazardous wastes containers to ensure that hazardous wastes are stored in containers which are in good condition, compatible with the material being stored, and properly labeled.

3. **Inventory of Special (non-regulated) Wastes.** While certain wastes are not regulated hazardous wastes, they also cannot be disposed of in a sanitary landfill or down the drain, and may necessitate special disposal procedures (ex: gels with ethidium bromide). These non-regulated wastes should be included on the Waste Inventory Form for proper disposal.

E. **<u>Audit Program</u>.** The audit program will assist in maintaining a safe working and academic environment. The JABSOM Health and Safety Coordinator and/or the Environmental Health and Safety Office (EHSO) will conduct periodic audits of the campus to review the current operations with respect to all-applicable safety, health and environmental policies and regulations. The following issues will be reviewed: hazardous material storage, hazardous and acutely hazardous waste accumulation, Material Safety Data Sheet availability, hazardous waste accumulation areas, and emergency plans. A report indicating any corrective actions that are necessary and suggesting any improvements will be provided to the waste generator by EHSO or the JABSOM Health and Safety Coordinator.

II. HAZARDOUS WASTE MANAGEMENT

A. **<u>Waste Identification and Classification</u>.** All wastes must be identified and then classified as hazardous or non-hazardous according to specific federal and state definitions summarized in *Attachment 5*. The Environmental Health and Safety Office (808-956-3198) will assist you in making a determination of whether a waste is hazardous

1. **What is a waste?** A waste is:

   - **A useless by-product of an operation**

- **A material which is to be disposed**
- **Any material which can no longer be used**
- **A manufacturing *or process* by-product**

2. How do I determine if a waste is hazardous?

Contact the Environmental Health and Safety Office (EHSO). The EHSO (808-956-3198) will assist you in making a determination of whether a waste is hazardous.

B. Accumulation of Wastes.

1. Limits on Waste Generation. To maintain the status of conditionally exempt small quantity generator, JABSOM Kakaʻako **may not** generate more than 100 kilograms (approximately one half of a 55-gallon drum, 27 gallons, or 220 pounds) of hazardous waste in one month. JABSOM Kakaʻako also may not generate more than 1 kilogram (2.2 pounds) of acute hazardous ("P" coded) waste in one month (see *Attachment 6* for a list of these chemicals).

2. Limits on Waste Accumulation. To maintain the status of conditionally exempt small quantity generator, JABSOM Kakaʻako **may not** store more than 1000 kilograms (approximately five 55-gallon drums, or 275 gallons, or 2200 pounds) of total accumulated hazardous waste and no more than 1 kilogram (2.2 pounds) of accumulated acute hazardous ("P" coded) waste **at any time** (see *Attachment 6* for a list of these chemicals)**.**

3. Designation of Waste Management Area. All programs generating hazardous waste should establish a safe area near the point of generation for temporary storage of waste while awaiting disposal. The JABSOM Health and Safety Coordinator will bi-annually, or more frequently if necessary, hire a licensed hazardous waste contractor to transport the waste to an EPA permitted hazardous waste treatment, storage and disposal facility.

C. Storage of Hazardous Chemical Waste

1. Waste Containers

a. Labeling. All hazardous waste containers must be labeled with the following:

- **The words "Waste _____." (examples: Waste Acetone, Waste Hydrochloric Acid, Waste methyl alcohol or Waste ethidium bromide, etc).**

- The **Chemical Name** of the Waste or an accurate description of the contents of the container. The manufacturer's label or a label giving the chemical name and specific hazards (e.g., flammable, corrosive or poison) is acceptable.

- The accumulation start date.

b. **Closed Containers.** All hazardous waste containers must remain closed except when waste is being added to them.

c. **Containers in Good Condition.** Containers used for waste must be in good condition (i.e. not rusting, no cracks or structural defects). If a container is broken or begins to leak, the material must be transferred to a container in good condition. The container's composition must be compatible with the material to be stored in it and incompatible materials must not be stored in proximity to one another. Package materials in sturdy cardboard boxes or plastic waste containers. Cushion the material in the containers to prevent breakage. If cardboard boxes are used which originally held other chemicals, the name of the chemical must be covered over or defaced. Failure to do so constitutes improper marking as to contents and is an EPA and OSHA regulation violation.

d. **Containment.** Secondary containment is required for containers of liquid waste under the following circumstances:

1. When stored in 55-gallon drums.

2. When stored on the floor.

3. When stored in a hood which has a drain.

4. When stored within four (4) feet of a sink.

5. When necessary to separate incompatible or high hazard wastes.

Consult with the Environmental Health and Safety Office at the UH Manoa campus (808-956-3198) regarding appropriate containment when a 55-gallon drum is used to collect waste.

e. **Separate Incompatible Materials/Waste.** Incompatible materials shall be segregated by hazard class (e.g. Toxic-Reactive-Ignitable-Corrosive). Examples of incompatible materials are: acids/bases, organics/oxidizers, and flammable

liquids/oxidizers. Unknowns and high hazard materials such as cyanides, organic peroxides, pyrophorics, water reactives and explosives shall be segregated separately regardless of quantity. If there are any questions, please call the EHSO for assistance (808-956-3198).

f. **Housekeeping.** The waste storage area should be neat and orderly, containers should not be stacked upon one another or containers of liquids should not be stored on their sides.

D. **Hazardous Waste Disposal.**

The disposal of hazardous wastes requires that a licensed hazardous waste contractor be hired to dispose of the waste. As stated previously, the JABSOM Health and Safety Coordinator will annually, or more frequently if necessary, hire a licensed hazardous waste contractor to transport the waste to an EPA permitted hazardous waste treatment, storage and disposal facility.

E. **Drain disposal prohibited.** Consult with the Environmental Health and Safety Office at the UH Manoa campus (808-956-3198) if you are unsure about whether a material can be disposed of via drain. No hazardous materials/waste may be disposed of down any drain. All liquids (except known clean water) shall be reviewed prior to any drain disposal to ensure that the liquid is permitted to be discharged down the drain. In addition, applicable County ordinances need to be consulted prior to disposing of items down the drain. They may prohibit drain disposal of items such as:

- Fats and greases, if their concentration and physical dispersion results in separation and adherence to sewer structures.
- Storm water, surface water, groundwater, roof runoff, subsurface drainage, cooling water, swimming pool water or other unpolluted drainage.
- Liquid or vapor having a temperature of >150 degrees Fahrenheit.
- Any water or waste containing >100 ppm, by weight, of fat, oil or grease.
- Gasoline, benzene, naphtha, fuel oil, or other flammable or explosive liquid, solid or gas.
- Garbage that has not been properly shredded. Garbage from commercial food establishments is prohibited.

- Ashes, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, plastics, wood, paunch manure or any other solid or viscous substance capable of causing obstruction to the flow in sewers.

- Water or wastes having a pH lower than 5.5, higher than 12.5, or having any other corrosive property capable of causing damage to the sewage works or its personnel.

- Water or wastes containing a toxic or poisonous substance of sufficient quantity to injure or interfere with any sewage treatment process or cause a hazard to humans or animals.

- Noxious or malodorous gas or explosive liquids or substance capable of endangering public property and safety, or creating a public nuisance.

- Dyes for tissue/slide staining (concentrated dyes need to be disposed of as hazardous liquid waste, however, diluted dye rinse solutions may be disposed of via drain with copious amounts of water before, during, and after disposal.)

IV. EMERGENCY SPILL PROCEDURES

You must have a specific spill emergency plan in place and provide information and training to individuals working in your area regarding the plan. It is a requirement to post the emergency procedures and emergency phone numbers in the work area. All personnel working with hazardous chemicals should be able to answer the question:

"What would they do if this material spilled?"

Spill kits with instructions, absorbents, reactants, and protective equipment are required to be available to clean up minor spills. A **minor spill** is one that does not spread rapidly, does not endanger people or property except by direct contact, does not endanger the environment, and the workers in the area are capable of handling safely without the assistance of safety and emergency personnel. **All other chemical spills are considered major.**

The following are general procedures for the handling of all spills.

1. In the event of a spill, attend to anyone who may have been contaminated or hurt, if it can be done without endangering yourself.

2. Turn on the fume hood(s) and open windows where this can be done without endangering yourself.

3. If flammable materials are spilled, de-energize electrical devices if it can be done without endangering yourself.

A. Minor Spills

If you have any questions regarding spill clean up requirements, please contact the JABSOM Health and Safety Coordinator (808-956-7937) or the Environmental Health and Safety Office at the UH Manoa campus (808-956-8660).

- Take the time to put on the proper personal protective equipment for the job and ensure that is resistant to the spilled material.

- Neutralize acids and bases, if possible using neutralizing agents such as sodium carbonate or sodium bisulfate.

- Control the spread of liquids by containing the spill. Absorb liquids by adding appropriate absorbent materials, such as vermiculite or sand, from the spill's outer edges toward the center. Paper towels and sponges may also be used as absorbent material, but this should be done cautiously considering the character of the spilled material. Paper towels and sponges should never be used to clean up a flammable liquid or acid spill.

- Collect and contain the cleanup residue and all materials used to clean up the spill by placing it into a plastic bucket or other appropriate container. Properly label the container as "spill residue" with the chemical name of the spilled materials. Dispose of the spill residue as hazardous waste.

- Decontaminate the area and affected equipment. Ventilating the spill area may be necessary.

- Document what happened, why, what was done, and what was learned. Such documentation can be used to avoid similar instances in the future. Major incidents are almost always preceded by numerous near misses.

B. Major Spills

If the spill is major, contact the JABSOM Health and Safety Coordinator (808-956-7937), the Environmental Health and Safety Office at the UH Manoa Campus (808-956-8660), or the Fire Department (911). If the spill is after normal work hour (8 am to 4:30 pm) contact the Fire Department (911).

C. Reporting Requirements

After the initial spill response, contact the JABSOM Health and Safety Coordinator (808-956-7937) and/or the Environmental Health and Safety Office at the UH Manoa campus (808-956-8660) to determine whether there are any federal or state reporting requirements. Some reporting obligations are immediate, and must be made within 24 hours.

V. SPECIFIC INFORMATION ON THE DISPOSAL OF VARIOUS MATERIALS/WASTE

The individual possessing or generating the material/waste retains the primary responsibility for the material/waste. The JABSOM Health and Safety Coordinator (808-692-1855) and the Environmental Health and Safety Office at the UH Manoa campus (808-956-8660) provide information on requirements and assistance in handling the materials. Specific information on various types of materials is given below.

BATTERIES: Lithium, nickel/cadmium or mercury batteries shall be stored at the hazardous waste accumulation site for contract disposal. Vehicle batteries are recyclable and arrangements with local vendors can be made. Operations and Maintenance handle disposal of batteries from State vehicles.

BIOLOGICAL MATERIALS: For biohazardous wastes, refer to the "Biohazardous Waste Disposal Guidelines for JABSOM Kakaʻako" (*Attachment 7*) or contact the EHSO Biological Safety Officer (808-956-3197) for information concerning the handling and disposal of biological materials.

COMPRESSED GASES: Compressed gas cylinders should be returned to the vendor. A return agreement with the vendor should be included in the contract. Without such an agreement the return or disposal of the cylinders is difficult and very costly. Contact the JABSOM Health and Safety Coordinator (808-692-1855) or the Environmental Health and Safety Office at the UH Manoa campus (808-956-8660) for assistance.

CONTROLLED SUBSTANCES: The handling and disposal of controlled substances (i.e. drugs and other substances listed in 21 CFR 1308) are the responsibility of the permit holder. The JABSOM Health and Safety Coordinator and EHSO cannot accept controlled substances for disposal.

FLUORESCENT LIGHT BALLASTS: The Facilities Management Office (808-692-0913) removes non-leaking ballast. Ballast may contain PCBs, contact the Environmental Health and Safety Office at the UH Manoa campus (808-956-

8660) for assistance concerning leaking ballast or any ballast known to contain PCBs.

FLUORESCENT LIGHT TUBES: The Facilities Management Office (808-692-0913) removes and disposes of fluorescent light tubes.

HAZARDOUS CHEMICALS AND HAZARDOUS WASTE: The JABSOM Health and Safety Coordinator will annually hire a contractor to dispose of hazardous wastes. Efforts should be made to determine if others could use excess hazardous chemicals in the department or facility prior to submitting for contract disposal. Chemicals considered non-hazardous waste (see "Non-hazardous Waste" below) could be disposed of in the municipal sanitary landfill or sanitary sewer.

MERCURY: Items containing functional mercury (e.g. light switches, barometers and thermometers) shall be stored at a hazardous waste accumulation site for contract disposal.

MIXED WASTE: Mixed waste is defined as materials that possess a radioactive or biological hazard as well as an unrelated chemical hazard (e.g. potassium dichromate solution contaminated with Carbon-14). Contact the Environmental Health and Safety Office at the UH Manoa campus (808-956-8660) as applicable for assistance in the proper disposal of these materials.

NON-HAZARDOUS WASTE: Listed in Table 1 below are typical laboratory chemicals that are not considered hazardous wastes by the U.S. Environmental Protection Agency. If the facility's refuse contractor permits the disposal of the solid chemicals listed in Table 1 then they may be disposed of as ordinary trash. The container must have the chemical name on it and it should be marked "non-hazardous" to mitigate any concern by the refuse collectors. Alternatively, non-hazardous solid chemicals can be collected for disposal with the periodic hazardous waste disposal. Liquid chemicals or chemical solutions can only be disposed of to the sanitary sewer (i.e. "down the drain") if the requirements of the applicable County ordinances or the facility's Industrial Wastewater Discharge Permit are met. Contact EHSO (808-956-3198) if you have chemicals that you believe may be non-hazardous for a determination as to whether they may be disposed of as ordinary trash or in the sanitary sewer in small amounts.

TABLE 1: Non-Hazardous Waste

Sugars (e.g., sucrose, glucose, mannose)	Silica Gel
Starch	Alumina (aluminum oxide)
Naturally occurring Amino Acids	Calcium Fluoride
Citric Acid and its Sodium, Potassium, Magnesium, Calcium and Ammonium Salts.	Lactic Acid and its Sodium, Potassium, Magnesium, Calcium and Ammonium, Salts
Sodium, Potassium, Calcium, Strontium, and Ammonium Sulfates	Sodium, Potassium, Calcium, Magnesium, Strontium and Ammonium Phosphates
Sodium, Potassium, Magnesium and Ammonium Chlorides	Sodium, Potassium, Magnesium, and Calcium Borates
Silicon Dioxide	Sodium, Potassium, Ammonium Acetates
Boron, Magnesium, Copper Oxides	Sodium, Potassium, Magnesium, Calcium , and Ammonium Carbonates

OILS AND TRANSFORMER FLUID: Facilities Management Office (808-692-0913) will assist with disposal of *used* pump oil. Used motor oil is recyclable through local vendors. Operations and Maintenance handle used motor oil from University vehicles.

Transformer fluid will be handled on a case-by-case basis, contact the Environmental Health and Safety Office at the UH Manoa campus (808-956-8660) for assistance. The following requirements apply to used oil:

Used oil may only be stored in containers that are in good condition and not leaking. Containers, aboveground storage tanks, and fill pipes must be labeled or marked clearly with the words **"Used Oil."** Upon detection of a release of used oil, a generator must stop the release, contain the used oil, clean up and manage properly the used oil and other materials, and if necessary, repair or replace any leaking used oil storage containers. If a release of used oil occurs, contact the JABSOM Health and Safety Coordinator (808-692-1855) and/or the Environmental Health and Safety Office at the UH Manoa campus (808-956-8660) for information regarding cleanup, and special *regulatory* reporting requirements which may apply.

PHOTOGRAPHIC CHEMICALS: Photographic fixer will must be stored in capped container and labeled, “Fixer for Recycling”. Photographic fixer solution may contain silver salts after use. Silver is an EPA toxic characteristic waste and must be recycled or disposed of as a hazardous waste. If your facility has a silver recovery unit, it should be used to process the used fixer in accordance with the manufacturing instructions. This would include ensuring that the effluent from the unit meets the requirements for safe drain disposal and that the unit filter, when full, is sent for recycling. If your facility does not have a silver recovery unit, there are contractors who will furnish one for a fee or for the value of the silver recovered. Alternatively, the used fixer solution can be handled and disposed of as a hazardous waste.

RADIOACTIVE MATERIALS: Contact the EHSO Radiation Safety Officer (808-956-6475) for information concerning the proper handling and disposal of radioactive material.

SHARPS AND GLASSWARE: See *Attachment 7* for proper handling and disposal of sharps and glassware.

UNKNOWNS: To dispose of any “unknown” hazardous (or potentially hazardous) material, please contact the JABSOM Health and Safety Coordinator (808-692-1855) or the UH Manoa Environmental Health and Safety Office (808-956-3198) for assistance. “Unknown” potentially hazardous materials require testing to identify the material’s hazardous properties so that it may be disposed of properly. Principle Investigator’s will be charged $70 to test an “unknown” potentially hazardous material.

VI. HAZARDOUS WASTE MINIMIZATION

A. Buying Chemicals in Smaller Amounts

The "large economy size" may cost less to buy, but costs to dispose of any unused or excess materials, in most cases, are several times the initial cost of the material. In many cases containers of excess or waste chemicals sent for disposal are full or 3/4 full. All chemical users should accurately estimate the amount of chemical they expect to use to complete the job and only purchase what they will need in a relatively short time frame. For example purchasing large amounts of chemicals that may be used over a ten to twenty year time frame is not recommended. Chemicals can deteriorate and become dangerous over time as well as incur substantial costs to be disposed of. EHSO recommends that chemical users only store a one to two year supply of chemicals.

B. Recycling and Redistribution

Efforts should be made to find someone in the laboratory or department who can use the hazardous material before it is submitted to the JABSOM Health and Safety Coordinator as waste for contract disposal. Subsequently, unopened chemicals that still have a two year or more shelf life, and are in their original container with the original label can be submitted the UH Electronic Swap Meet (http://dbserver.its.hawaii.edu/swapmeet/index.html) for recycling.

C. Use of Less Hazardous or Non-hazardous Materials

The following provides some examples of the use of less hazardous or nonhazardous materials. Each person is encouraged to think of some others that may be applicable to their research or instructional materials.

1. **Cleaning Solutions**: Chromerge, chromic acid and dichromate cleaning solutions are not desirable from a waste disposal prospective, as they cannot be made non-hazardous and are expensive to dispose of. There are many non-toxic biodegradable cleaning solutions that can be used instead of chromic acid. For extremely dirty glassware a product called Nochromix, which uses sulfuric acid and an organic oxidizer in place of chromium can be used. While this requires neutralization of the acid for ordinary disposal, it is far less costly to dispose of than chromium solutions. A number of alternative cleaning solutions are listed below. These are all available from Fisher Scientific, who has the University contract for laboratory supplies. NoChromix, Alconox, Liquinox liquid detergent, Citranox, Fisherbrand sparkleen, and FL-70 Concentrate.

2. **Drying Agents**: The safest common drying agents are calcium chloride, silica gel, molecular sieves and calcium sulfate (Drierite). These are recommended because of their low toxicity and stability. Drying agents that pose varying degrees of hazard and disposal problems include:

    - Phosphorus pentoxide, which generates highly corrosive phosphoric acid and heat on contact with water. This material also has to be disposed of as a hazardous.

    - Magnesium perchlorate (Dehydrite), which is a strong oxidizer and may cause fires or explosions on contact with organic materials. This material has to be disposed of as a hazardous waste.

3. **Thermometers**: Mercury Thermometers should be replaced with non-mercury thermometers whenever possible. Broken mercury thermometers create spills that are a potential hazard, time consuming to clean up, and are one of the most expensive hazardous wastes to dispose. Non-mercury thermometers with equivalent accuracy are available for temperature ranges of 0º to 250º Centigrade. Contact the JABSOM Health and Safety Coordinator (808-956-7937) or check your laboratory supply catalog for more information. If mercury-containing equipment is used, then a mercury spill kit and personnel knowledgeable in its use is required in the laboratory or facility.

ATTACHMENT 1

PROCUREMENT AUTHORIZATION FOR HAZARDOUS MATERIALS

An approved (signed) copy of this form must accompany any *request*, purchase order or requisition for the procurement of all hazardous materials.

NAME: _____
(Instructor/Program Coordinator)

DEPARTMENT: _____ **PHONE NO., EXT.:** _____
LOCATION: _____

Chemical Name	Solid/Liquid/ Gas	Amount (gallon, lbs)	Usage Plan	Estimated Usage Period

Program Coordinator_____ **DATE:** _____
(Signature)

Dean/Director approval_____ **DATE**: _____
(Signature)

PLEASE SEND THE COMPLETED FORM TO: JABSOM Health and Safety Coordinator (phone: 808-692-1855, fax: 808-692-1957)

FOR overall program coordinator USE ONLY

APPROVAL: _____ DATE: _____
(*Program Coordinator*)

APPROVAL NO.: _____

ATTACHMENT 2

UNIVERSITY OF HAWAII
ENVIRONMENTAL HEALTH & SAFETY OFFICE
HAZARDOUS MATERIAL MANAGEMENT PROGRAM
APPROVAL FOR THE USE OF HAZARDOUS MATERIAL

1. **Principal Investigator**:_____

2. **Project Title**:_____

3. If your project will involve any of the types of hazardous materials listed below, please provide a list of the chemical name(s) and approximate amounts of the materials to be used, information on how the material will be used and stored, also information on any special safety measures that will be taken. The information is needed to ensure the materials are stored, used and disposed of in accordance with the applicable Federal and State regulations.

    a) **Explosive materials** (e.g., ammonium perchlorate, picric acid or picrates, azides, acetylides or fulminates of heavy metals, aromatic di or tri nitro compounds such as dinitrophenol or trinitrotoluene, nitroglycerine, RDX and tetrazene).

    b) **Water reactive chemicals** (e.g., alkali metals such as sodium, potassium or lithium; metal hydrides such as lithium aluminum hydride, sodium borohydride or lithium hydride; calcium carbide, ethyldichlorosilane and phosphides).

    c) **Flammable or poison gases** (e.g. methane, ethylene, chlorine, phosgene and hydrogen sulfide).

    d) **Organic peroxides** (e.g., methyl ethyl ketone peroxide or peracetic acid).

    e) **Highly toxic materials** (e.g., cyanides, osmium tetroxide, phosphorus, strychnine, pentaborane, or any material with a LD_{50} [oral rat] of 50mg/kg or less).

    f) **Flammable liquids** (i.e., materials with a flash point of 140 degrees Fahrenheit or less) in quantities of 60 gallons or more at any one time.

4. If your project will involve the use of controlled substances (i.e., materials listed in 21 CFR 1308 by the U.S. Drug Enforcement Agency such as cocaine, chloral hydrate, morphine, and sodium barbital), provide the number of the required Federal or State permit for possession and use of these materials.

5. I agree to: (1) comply with the University of Hawaii at Manoa Hazardous Material Management Program (HMMP) requirements and any additional requirements provided by the Environmental Health and Safety Office that are necessary to ensure compliance with Federal and State regulations, (2) inform the Environmental Health and Safety Office if there are any amendments to the project which affect the types of hazardous material listed above, and (3) transfer or properly dispose of all my hazardous material as specified in the HMMP prior to leaving the University or transferring to a different laboratory. I believe the above information is accurate and complete.

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PRINCIPAL INVESTIGATOR **DATE**

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DEPARTMENT CHAIRPERSON **DATE**

PLEASE SEND THE COMPLETED FORM TO: EHSO 2040 East-West Road Attention: Hazardous Materials Management Officer. The Hazardous Materials Management Officer may be contacted at 956-3198 or Fax 956-3205, if you have questions.

6. The use of the hazardous materials listed above is approved subject to the special requirements listed below.

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HAZARDOUS MATERIALS MANAGEMENT OFFICER **DATE**

SPECIAL REQUIREMENTS:

ATTACHMENT 3

HAZARDOUS CHEMICAL INVENTORY FORM (ANNUAL)

This form assists JABSOM Kaka'ako with proper management of our hazardous material and hazardous waste and to ensure that materials are safely stored and handled. You should provide a complete inventory of all stored hazardous materials. If additional space is needed, you may use an attached sheet using the same format. If at a later date you obtain materials not previously listed, please submit an amended form.

Chemical Name	Physical State (solid, liquid, gas)	Amount (gallons, lbs)

PROGRAM COORDINATOR:

_____ **Phone No.:**_____
(Print Name)

_____ **Date:**_____
(Signature)

LOCATION: _____

PLEASE SEND THE COMPLETED FORM TO: JABSOM Health and Safety Coordinator (phone: 808-692-1855, fax: 808-692-1957)

ATTACHMENT 4

HAZARDOUS WASTE INVENTORY FORM (MONTHLY)

This form assists JABSOM Kakaʻako with proper management of our hazardous waste. If you have any hazardous or non-hazardous waste being stored for disposal, please provide the information requested. If additional space is needed, you may use an attached sheet using the same format. **EHSO will complete columns 4 and 5, DOT Class and EPA Waste Code.**

Chemical Name	**Physical State (solid, liquid, gas)**	**Amount left & container size (liters or grams)**	**DOT Class (EHSO only)**	**EPA Waste Code (EHSO only)**

Waste Generator:

_____ **Phone No.:**_____
(Print Name)

_____ **Date:** _____
(Signature)

LOCATION: _____

PLEASE SEND THE COMPLETED FORM TO: JABSOM Health and Safety Coordinator (phone: 808-692-1855, fax: 808-692-1957)

ATTACHMENT 5

Procedure for Making Hazardous Waste Determinations

All wastes must be screened to determine whether they are hazardous. A hazardous waste is one which because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed. The EPA has determined that the following meet the definition of a hazardous waste:

a) A waste which is listed as hazardous in the regulations (40 CFR 261);*
b) A mixture that includes a listed hazardous waste; or
c) A waste which exhibits any of the four following characteristics; ignitability, corrosivity, reactivity, or toxicity.

*NOTE: the complete text of the hazardous waste regulations is available online at www.epa.gov/epahome/cfr40.htm

The following procedures must be used to determine if a waste is hazardous. If it is, the procedures will identify the appropriate EPA hazardous waste number for each waste, which will in turn determine disposal requirements:

(i.) Determine the proper name of the waste and its specific source.

(ii.) Check the EPA's hazardous waste lists in the following order:

(a.) "U" list of toxic wastes (40 CFR 261.33f).

(b.) "P" List of acutely hazardous waste (40 CFR 261.33e).

(c.) "K" List of hazardous wastes from specific sources (40 CFR 261.32).

(d.) "F" List (40 CFR 261.31) for a non-specific source of waste.

(iii.) If the waste is not one the "U" List, the "P" List, the "K" List or the "F" List, you must determine whether the waste exhibits any of following four characteristics:

(a.) Ignitability. A waste that exhibits the characteristic of ignitability has the EPA hazardous waste number of D001. See 40 CFR §261.20.

(b.) Corrosivity. A waste that exhibits the characteristic of corrosivity has the EPA hazardous waste number of D002. See 40 CFR §261.22.

(c.) Reactivity. A waste that exhibits the characteristic of reactivity has the EPA hazardous waste number of D003. See 40 CFR §261.23.

(d.) Toxicity. A waste that exhibits the characteristic of reactivity will have and the EPA hazardous waste number of D004 through D043. See 40 CFR §261.24.

ATTACHMENT 6

LIST OF ACUTELY HAZARDOUS WASTE (P-CODED WASTE)

The following materials are hazardous wastes if and when they are intended to be discarded (40 CFR 261.33):

1. Any commercial chemical product, or manufacturing chemical intermediate having the generic name listed below.

2. Any off-specification commercial chemical product or chemical intermediate having the generic name listed below.

3. Any residue remaining in a container that is not empty. P-coded containers must have their contents removed and be triple rinsed with an appropriate solvent before they are legally empty and no longer regulated.

4. Any residue resulting from the clean-up of a spill of a P-coded waste.

5. The phrase "commercial chemical product or manufacturing chemical intermediate having a generic name listed below" refers to a chemical substance which is manufactured or formulated for commercial or manufacturing use which consists of the commercially pure grade of the chemical, any technical grades of the chemical that are produced or marketed, and all formulations in which the chemical is the sole active ingredient.

Hazardous No.	Chemical waste abstracts No. (CAS)	Substance
P023	107-20-0	Acetaldehyde, chloro-
P002	591-08-2	Acetamide, N-(aminothioxomethyl)-
P057	640-19-7	Acetamide, 2-fluoro-
P058	62-74-8	Acetic acid, fluoro-, sodium salt
P002	591-08-2	1-Acetyl-2-thiourea
P003	107-02-8	Acrolein
P070	116-06-3	Aldicarb
P203	1646-88-4	Aldicarb sulfone.
P004	309-00-2	Aldrin
P005	107-18-6	Allyl alcohol
P006	20859-73-8	Aluminum phosphide (R,T)
P007	2763-96-4	5-(Aminomethyl)-3-isoxazolol
P008	504-24-5	4-Aminopyridine
P009	131-74-8	Ammonium picrate (R)
P119	7803-55-6	Ammonium vanadate

Hazardous No.	Chemical waste abstracts No. (CAS)	Substance
P099	506-61-6	Argentate(1-), bis(cyano-C)-, potassium
P010	7778-39-4	Arsenic acid H[INF]3[/INF] AsO[INF]4[/INF]
P012	1327-53-3	Arsenic oxide As[INF]2[/INF] O[INF]3[/INF]
P011	1303-28-2	Arsenic oxide As[INF]2[/INF] O[INF]5[/INF]
P011	1303-28-2	Arsenic pentoxide
P012	1327-53-3	Arsenic trioxide
P038	692-42-2	Arsine, diethyl-
P036	696-28-6	Arsonous dichloride, phenyl-
P054	151-56-4	Aziridine
P067	75-55-8	Aziridine, 2-methyl-
P013	542-62-1	Benzenamine, 4-chloro-
P077	100-01-6	Benzenamine, 4-nitro-
P028	100-44-7	Benzene, (chloromethyl)-
P042	51-43-4	1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-, (R)-
P046	122-09-8	Benzeneethanamine, alpha,alpha-dimethyl-
P014	108-98-5	Benzenethiol
P127	1563-66-2	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-, methylcarbamate.
P188	57-64-7	Benzoic acid, 2-hydroxy-, compd. with (3aS-cis)-1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethylpyrrolo[2,3-b]indol-5-yl methylcarbamate ester (1:1).
P001	81-81-2	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)-, & salts, when present at concentrations greater than 0.3%
P028	100-44-7	Benzyl chloride
P015	7440-41-7	Beryllium powder
P017	598-31-2	Bromoacetone
P018	357-57-3	Brucine
P045	39196-18-4	2-Butanone, 3,3-dimethyl-1-(methylthio)-, O-[methylamino)carbonyl] oxime
P021	592-01-8	Calcium cyanide
P021	592-01-8	Calcium cyanide Ca(CN)[INF]2[/INF]
P189	55285-14-8	Carbamic acid, [(dibutylamino)-thio]methyl-, 2,3-dihydro-2,2-dimethyl- 7-benzofuranyl ester

Hazardous No.	Chemical waste abstracts No. (CAS)	Substance
P191	644-64-4	Carbamic acid, dimethyl-, 1-[(dimethyl-amino)carbonyl]- 5-methyl-1H- pyrazol-3-yl ester.
P192	119-38-0	Carbamic acid, dimethyl-, 3-methyl-1-(1-methylethyl)-1H- pyrazol-5-yl ester.
P190	1129-41-5	Carbamic acid, methyl-, 3-methylphenyl ester.
P127	1563-66-2	Carbofuran.
P022	75-15-0	Carbon disulfide
P095	75-44-5	Carbonic dichloride
P189	55285-14-8	Carbosulfan.
P023	107-20-0	Chloroacetaldehyde
P024	106-47-8	p-Chloroaniline
P026	5344-82-1	1-(o-Chlorophenyl)thiourea
P027	542-76-7	3-Chloropropionitrile
P029	544-92-3	Copper cyanide
P029	544-92-3	Copper cyanide Cu(CN)
P202	64-00-6	m-Cumenyl methylcarbamate.
P030	.....	Cyanides (soluble cyanide salts), not otherwise specified
P031	460-19-5	Cyanogen
P033	506-77-4	Cyanogen chloride
P033	506-77-4	Cyanogen chloride (CN)Cl
P034	131-89-5	2-Cyclohexyl-4,6-dinitrophenol
P016	542-88-1	Dichloromethyl ether
P036	696-28-6	Dichlorophenylarsine
P037	60-57-1	Dieldrin
P038	692-42-2	Diethylarsine
P041	311-45-5	Diethyl-p-nitrophenyl phosphate
P040	297-97-2	O,O-Diethyl O-pyrazinyl phosphorothioate
P043	55-91-4	Diisopropylfluorophosphate (DFP)
P004	309-00-2	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa- chloro-1,4,4a,5,8,8a,-hexahydro-, (1alpha,4alpha,4abeta,5alpha,8alpha,8abeta)-1 1 1
P060	465-73-6	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa- chloro-1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha,4abeta,5beta,8beta,8abeta)-

Hazardous No.	Chemical waste abstracts No. (CAS)	Substance
P037	60-57-1	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2aalpha,3beta,6beta,6a alpha,7beta, 7aalpha)-
P051	72-20-8	2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2abeta,3alpha,6alpha,6 abeta,7beta, 7aalpha)-, & metabolites
P044	60-51-5	Dimethoate
P046	122-09-8	alpha,alpha-Dimethylphenethylamine
P191	644-64-4	Dimetilan.
P047	534-52-1	4,6-Dinitro-o-cresol, & salts
P048	51-28-5	2,4-Dinitrophenol
P020	88-85-7	Dinoseb
P085	152-16-9	Diphosphoramide, octamethyl-
P111	107-49-3	Diphosphoric acid, tetraethyl ester
P039	298-04-4	Disulfoton
P049	541-53-7	Dithiobiuret
P185	26419-73-8	1,3-Dithiolane-2-carboxaldehyde, 2,4-dimethyl-, O- [(methylamino)-carbonyl]oxime.
P050	115-29-7	Endosulfan
P088	145-73-3	Endothall
P051	72-20-8	Endrin
P051	72-20-8	Endrin, & metabolites
P042	51-43-4	Epinephrine
P031	460-19-5	Ethanedinitrile
P194	23135-22-0	Ethanimidothioc acid, 2-(dimethylamino)-N-[[(methylamino) carbonyl]oxy]-2-oxo-, methyl ester.
P066	16752-77-5	Ethanimidothioic acid, N-[[(methylamino)carbonyl]oxy]-, methyl ester
P101	107-12-0	Ethyl cyanide
P054	151-56-4	Ethyleneimine
P097	52-85-7	Famphur
P056	7782-41-4	Fluorine
P057	640-19-7	Fluoroacetamide
P058	62-74-8	Fluoroacetic acid, sodium salt
P198	23422-53-9	Formetanate hydrochloride.
P197	17702-57-7	Formparanate.
P065	628-86-4	Fulminic acid, mercury(2+) salt (R,T)

Hazardous No.	Chemical waste abstracts No. (CAS)	Substance
P059	76-44-8	Heptachlor
P062	757-58-4	Hexaethyl tetraphosphate
P116	79-19-6	Hydrazinecarbothioamide
P068	60-34-4	Hydrazine, methyl-
P063	74-90-8	Hydrocyanic acid
P063	74-90-8	Hydrogen cyanide
P096	7803-51-2	Hydrogen phosphide
P060	465-73-6	Isodrin
P192	119-38-0	Isolan.
P202	64-00-6	3-Isopropylphenyl N-methylcarbamate.
P007	2763-96-4	3(2H)-Isoxazolone, 5-(aminomethyl)-
P196	15339-36-3	Manganese, bis(dimethylcarbamodithioato-S,S[prime])-,
P196	15339-36-3	Manganese dimethyldithiocarbamate.
P092	62-38-4	Mercury, (acetato-O)phenyl-
P065	628-86-4	Mercury fulminate (R,T)
P082	62-75-9	Methanamine, N-methyl-N-nitroso-
P064	624-83-9	Methane, isocyanato-
P016	542-88-1	Methane, oxybis[chloro-
P112	509-14-8	Methane, tetranitro- (R)
P118	75-70-7	Methanethiol, trichloro-
P198	23422-53-9	Methanimidamide, N,N-dimethylN[prime]-[3-[[(methylamino)-carbonyl]oxy]phenyl]-monohydrochloride.
P197	17702-57-7	Methanimidamide, N,N-dimethyl-N[prime]-[2-methyl-4-[[(methylamino)carbonyl]oxy]phenyl]-
P050	115-29-7	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-,3-oxide3
P059	76-44-8	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-
P199	2032-65-7	Methiocarb.
P066	16752-77-5	Methomyl
P068	60-34-4	Methyl hydrazine
P064	624-83-9	Methyl isocyanate
P069	75-86-5	2-Methyllactonitrile
P071	298-00-0	Methyl parathion
P190	1129-41-5	Metolcarb.
P128	315-8-4	Mexacarbate.
P072	86-88-4	alpha-Naphthylthiourea

Hazardous No.	Chemical waste abstracts No. (CAS)	Substance
P073	13463-39-3	Nickel carbonyl
P073	13463-39-3	Nickel carbonyl Ni(CO)[INF]4[/INF], (T-4)-
P074	557-19-7	Nickel cyanide
P074	557-19-7	Nickel cynaide Ni(CN)[INF]2[/INF]
P075	54-11-5	Nicotine, & salts
P076	10102-43-9	Nitric oxide
P077	100-01-6	p-Nitroaniline
P078	10102-44-0	Nitrogen dioxide
P076	10102-43-9	Nitrogen oxide NO
P078	10102-44-0	Nitrogen oxide NO[INF]2[/INF]
P081	55-63-0	Nitroglycerine (R)
P082	62-75-9	N-Nitrosodimethylamine
P084	4549-40-0	N-Nitrosomethylvinylamine
P085	152-16-9	Octamethylpyrophosphoramide
P087	20816-12-0	Osmium oxide OsO[INF]4[/INF], (T-4)-
P087	20816-12-0	Osmium tetroxide
P088	145-73-3	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid
P194	23135-22-0	Oxamyl.
P089	56-38-2	Parathion
P034	131-89-5	Phenol, 2-cyclohexyl-4,6-dinitro-
P048	51-28-5	Phenol, 2,4-dinitro-
P047	534-52-1	Phenol, 2-methyl-4,6-dinitro-, & salts
P020	88-85-7	Phenol, 2-(1-methylpropyl)-4,6-dinitro-
P009	131-74-8	Phenol, 2,4,6-trinitro-, ammonium salt (R)
P128	315-18-4	Phenol, 4-(dimethylamino)-3,5-dimethyl-, methylcarbamate (ester).
P199	2032-65-7	Phenol, (3,5-dimethyl-4-(methylthio)-, methylcarbamate
P202	64-00-6	Phenol, 3-(1-methylethyl)-, methyl carbamate.
P201	2631-37-0	Phenol, 3-methyl-5-(1-methylethyl)-, methyl carbamate.
P092	62-38-4	Phenylmercury acetate
P093	103-85-5	Phenylthiourea
P094	298-02-2	Phorate
P095	75-44-5	Phosgene
P096	7803-51-2	Phosphine
P041	311-45-5	Phosphoric acid, diethyl 4-nitrophenyl ester
P039	298-04-4	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester

Hazardous No.	Chemical waste abstracts No. (CAS)	Substance
P094	298-02-2	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester
P044	60-51-5	Phosphorodithioic acid, O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] ester
P043	55-91-4	Phosphorofluoridic acid, bis(1-methylethyl) ester
P089	56-38-2	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester
P040	297-97-2	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester
P097	52-85-7	Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester
P071	298-00-0	Phosphorothioic acid, O,O,-dimethyl O-(4-nitrophenyl) ester
P204	57-47-6	Physostigmine.
P188	57-64-7	Physostigmine salicylate.
P110	78-00-2	Plumbane, tetraethyl-
P098	151-50-8	Potassium cyanide
P098	151-50-8	Potassium cyanide K(CN)
P099	506-61-6	Potassium silver cyanide
P201	2631-37-0	Promecarb
P070	116-06-3	Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime
P203	1646-88-4	Propanal, 2-methyl-2-(methyl-sulfonyl)-, O-[(methylamino)carbonyl] oxime.
P101	107-12-0	Propanenitrile
P027	542-76-7	Propanenitrile, 3-chloro-
P069	75-86-5	Propanenitrile, 2-hydroxy-2-methyl-
P081	55-63-0	1,2,3-Propanetriol, trinitrate (R)
P017	598-31-2	2-Propanone, 1-bromo-
P102	107-19-7	Propargyl alcohol
P003	107-02-8	2-Propenal
P005	107-18-6	2-Propen-1-ol
P067	75-55-8	1,2-Propylenimine
P102	107-19-7	2-Propyn-1-ol
P008	504-24-5	4-Pyridinamine
P075	54-11-5	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S)-, & salts
P204	57-47-6	Pyrrolo[2,3-b]indol-5-ol, 1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethyl-,methylcarbamate (ester), (3aS-cis)-.
P114	12039-52-0	Selenious acid, dithallium(1+) salt

Hazardous No.	Chemical waste abstracts No. (CAS)	Substance
P103	630-10-4	Selenourea
P104	506-64-9	Silver cyanide
P104	506-64-9	Silver cyanide Ag(CN)
P105	26628-22-8	Sodium azide
P106	143-33-9	Sodium cyanide
P106	143-33-9	Sodium cyanide Na(CN)
P108	57-24-9	Strychnidin-10-one, & salts
P018	357-57-3	Strychnidin-10-one, 2,3-dimethoxy-
P108	57-24-9	Strychnine, & salts
P115	7446-18-6	Sulfuric acid, dithallium(1+) salt
P109	3689-24-5	Tetraethyldithiopyrophosphate
P110	78-00-2	Tetraethyl lead
P111	107-49-3	Tetraethyl pyrophosphate
P112	509-14-8	Tetranitromethane (R)
P062	757-58-4	Tetraphosphoric acid, hexaethyl ester
P113	1314-32-5	Thallic oxide
P113	1314-32-5	Thallium oxide Tl[INF]2[/INF] O[INF]3[/INF]
P114	12039-52-0	Thallium(I) selenite
P115	7446-18-6	Thallium(I) sulfate
P109	3689-24-5	Thiodiphosphoric acid, tetraethyl ester
P045	39196-18-4	Thiofanox
P049	541-53-7	Thioimidodicarbonic diamide [(H[INF]2[/INF] N)C(S)][INF]2[/INF] NH
P014	108-98-5	Thiophenol
P116	79-19-6	Thiosemicarbazide
P026	5344-82-1	Thiourea, (2-chlorophenyl)-
P072	86-88-4	Thiourea, 1-naphthalenyl-
P093	103-85-5	Thiourea, phenyl-
P185	26419-73-8	Tirpate.
P123	8001-35-2	Toxaphene
P118	75-70-7	Trichloromethanethiol
P119	7803-55-6	Vanadic acid, ammonium salt
P120	1314-62-1	Vanadium oxide V[INF]2[/INF] O[INF]5[/INF]
P120	1314-62-1	Vanadium pentoxide
P084	4549-40-0	Vinylamine, N-methyl-N-nitroso-
P001	81-81-2	Warfarin, & salts, when present at concentrations greater than 0.3%
P205	137-30-4	Zinc, bis(dimethylcarbamodithioato-S,S[prime])-,
P121	557-21-1	Zinc cyanide

P121	557-21-1	Zinc cyanide Zn(CN)[INF]2[/INF]

Hazardous No.	Chemical waste abstracts No. (CAS)	Substance
P122	1314-84-7	Zinc phosphide Zn[INF]3[/INF] P[INF]2[/INF], when present at concentrations greater than 10% (R,T)
P205	137-30-4	Ziram

ATTACHMENT 7

Biohazardous Waste Disposal Guidelines for JABSOM Kaka‘ako

These guidelines will assist you with determining how to properly dispose of biohazardous waste at JABSOM Kaka‘ako. If you have any questions, please contact the JABSOM Health and Safety Coordinator (808-956-7937) or the UH EHSO Biological Safety Officer (808-956-3197).

SHARPS

Non-contaminated broken glass

- Place in a plastic bag lined puncture resistant (ex: cardboard) box→When box is full, tape box closed→write “BROKEN GLASS” on the outside of the box→Put the box next to the dumpster outside of the building.

Biological contaminated sharps *(ex: hypodermic needles with syringes/tubing, blades, scalpels, razors, lancets, microscope slides, etc)*

- Place in RED BIOHAZARDOUS SHARPS CONTAINER→When container is full, strap lid with filament tape→Label with P.I. name, location, and contact phone number→Autoclave→Place item in Biohazard Waste Collection container in the autoclave room.

Chemical contaminated sharps *(ex: hypodermic needles with syringes/tubing, blades, scalpels, razors, lancets, microscope slides, etc)*

- Rinse with water and collect this contaminated liquid (this liquid is hazardous, follow procedure for disposal→Place the sharp into YELLOW/OPAQUE sharps container→When container is full, label with P.I. name, location, and contact phone number→ Place item in Biohazard Waste Collection container in the autoclave room.

Mixed (biological & chemical) contaminated sharps

- Place in RED BIOHAZARDOUS SHARPS CONTAINER→When container is full, strap lid with filament tape→Label with P.I. name, location, and contact phone number→Autoclave→ Place item in Biohazard Waste Collection container in the autoclave room.

Radioactive contaminated sharps

- Contact JABSOM Health and Safety Coordinator (692-1855) for pick up.

PIPETS

Biological contaminated pipets (plastic or glass)

- Place in autoclavable puncture resistant container (ex: RED SHARPS CONTAINER)→ When container is full, strap lid with autoclave tape→Label with P.I. name, location, and contact phone number→Autoclave Place item in Biohazard Waste Collection container in the autoclave room.

Biological contaminated PASTEUR pipets (plastic or glass)

- Treat as "Chemical Contaminated Sharp", and follow that procedure for proper disposal.

Chemical contaminated pipet tips (plastic)

- Rinse with water and collect this contaminated liquid (this liquid is hazardous, follow procedure on for disposal→Place the sharp into YELLOW/OPAQUE SHARPS CONTAINER→When container is full, label with P.I. name, location, and contact phone number→ Place item in Biohazard Waste Collection container in the autoclave room.

Mixed (biological & chemical) contaminated pipets/pipet tips

- Contact JABSOM Health and Safety Coordinator (692-1855) for pick up.

Radioactive contaminated pipets/pipet tips

- Contact JABSOM Health and Safety Coordinator (692-1855) for pick up.

LIQUIDS

Biological contaminated liquids *(ex: liquid tissue culture media, animal or human blood and blood elements, animal or human body fluids, etc*)

- Autoclave→Screen particulate→Treat particulate as "Solid" biological waste, and follow that procedure for proper disposal→Flush remaining liquid down the drain with copious amounts water.

Mixed (biological & chemical) contaminated liquids *(ex: Cyclohexamide, Cyanides, etc)*

- Screen particulate (should be rendered sterile from chemical)→Treat particulate as "Solid" biological waste, and follow that procedure for proper disposal→Treat liquid as hazardous chemical and follow procedure for proper disposal.

Radioactive contaminated liquids

- Contact JABSOM Health and Safety Coordinator (692-1855) for pick up.

SOLIDS

Biological contaminated supplies *(gloves, petri dishes, Kim wipes, tissue culture flasks, etc)*

- Place in RED autoclavable bag→Autoclave→Label with P.I name, location, contact phone number, and autoclave tape → Place item in Biohazard Waste Collection container in the autoclave room.

Chemical preserved tissue specimens *(animal and plant)*

- *Contact JABSOM Health & Safety Coordinator for assistance (808-692-1855)*

Unpreserved tissues, whole body, and body parts

- *Contact JABSOM Health & Safety Coordinator for assistance (808-692-1855)*

Human body parts and organs (recognizable)

- If the human body part or organ HAS a death certificate→Call Anatomy and Reproductive Biology at 808-956-3171 for assistance.
- If the human body part or organ DOES NOT HAVE a death certificate→You will need to call a Department of Health approved medical waste disposal service (one such service is Hawaii Medical Vitrification: 808-532-0512).

Mixed (biological & chemotoxic) contaminated solids *(neoplastic, genotoxic, pharmaceutical experimental drugs)*

- Contact JABSOM Health and Safety Coordinator (692-1855) for pick up.

Radioactive contaminated solids

- Contact JABSOM Health and Safety Coordinator (692-1855) for pick up.

NOTE: To dispose of any "unknown" hazardous (or potentially hazardous) material, please contact the JABSOM Health and Safety Coordinator (808-692-1855) or the UH Manoa Environmental Health and Safety Office (808-956-3198) for assistance.

APPENDIX VI

EMERGENCY PROCEDURES DURING POWER OUTAGES

EMERGENCY PROCEDURES FOR LABORATORIES DURING POWER OUTAGES

It is important to remember that some equipment cannot be turned off and certain other pieces of equipment do not shut themselves off when there is a power outage. Pre-plan specific procedures for your laboratory while adhering to the following:

- Close chemical fume hood sashes. No work is allowed in fume hoods during a power outage.
- Ensure that all chemical containers are secured with caps, parafilm, etc.,
- All non-essential electrical devices should be turned off. Keep the doors of refrigerators and freezers closed. Check to ensure large lasers, radio frequency generators, etc. have been turned off.
- Turn off all gas cylinders at the tank valves. If a low flow of an inert gas is being used to "blanket" a reactive compound or mixture, it may be appropriate to leave the flow of gas on. The decision to do this should be part of the written SOP specific for each lab and included in this CHP.
- Check all cryogenic vacuum traps (N_2, CO_2 + solvent). The evaporation of trapped materials may cause dangerous conditions.
- Check all pressure, temperature, air, or moisture sensitive materials and equipment. This includes vacuum work, distillations, glove boxes used for airless/moistureless reactions, etc.

APPENDIX VII

REQUIREMENTS FOR STORAGE AND HANDLING OF FLAMMABLE AND COMBUSTIBLE LIQUIDS

REQUIREMENTS FOR STORAGE AND HANDLING OF FLAMMABLE AND COMBUSTIBLE LIQUIDS

STORAGE REQUIREMENTS

1. Flammable and/or combustible liquids stored in the open in a laboratory work area or inside any building shall be kept to the minimum necessary for the work being done.

2. Maximum quantity permitted in labs and other areas of use is limited to a total of 10 gallons, all classifications combined, outside of a flammable storage cabinet or approved flammable storage room. Please refer to Table 1.

3. Quantities stored in flammable storage cabinets shall be limited to 60 gallons of class I or II liquids and the total of all liquids shall not exceed 120 gallons. Please refer to Table 1 for maximum allowable container size for each class. Not more than three cabinets shall be located in the same fire area.

4. Quantities exceeding the above must be stored in an approved flammable storage room meeting the requirements of the Uniform Building and Fire Codes.

5. Flammable and combustible liquids shall not be stored near exit doorways, stairways, in exit corridors, or in a location that would impede egress from the building.

6. Flammable aerosols and unstable liquids shall be treated as class I-A liquids. Please refer to Table 1.

7. Materials which will react with water or other liquids to produce a hazard shall be segregated from flammable and/or combustible liquids.

HANDLING AND DISPENSING

1. Class I liquids shall not be transferred from one vessel to another in any exit passageway.

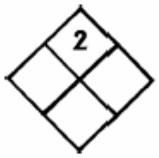
2. Transfer of flammable liquids from 5 gallon containers (or less) to smaller containers shall be done in a laboratory fume hood or in an approved flammable liquid storage room.

3. Empty containers shall be treated in the following manner:

    a) For water soluble solvents→rinse, deface label, and dispose with normal trash.

    b) For non-water soluble solvents→allow to evaporate to dryness in a hood, rinse, deface label, and dispose with normal trash.

TABLE 1

CLASS	IA	IB	IC	II
Flash point	less than 73°F	less than 73°F	73° - 100° F	100° - 140°F
Boiling point	less than 100°F	greater than 100°F		
Flammability Potential	Extremely High	Very High	High	Moderate
EXAMPLES OF COMMONLY USED MATERIALS	acetaldehyde benzoyl peroxide ethyl ether pentane methyl formate	acetone ethanol butylamine gasoline methanol isopropanol	amyl acetate butanol chlorobenzene turpentine xylene	formaldehyde hydrazine kerosene
NFPA 704 HAZARD RATINGS* 				
MAXIMUM CONTAINER SIZE Glass	1 pint (*500 ml*)	1 quart (*1 liter*)	1 gallon (*4 liter*)	1 gallon (*4 liter*)
Metal or approved plastic	1 gallon	5 gallon	5 gallon	5 gallon
Safety cans	2 gallon	5 gallon	5 gallon	5 gallon
Metal drums (DOT)	N/A	5 gallon	5 gallon	60 gallon

* NFPA is the acronym for the National Fire Protection Association. NFPA 704, *Standard System for the Identification of the Fire Hazards of Materials*, provides planning guidance to fire departments for safe tactical procedures in emergency operations, and gives on-the-spot information to safeguard the lives of fire fighting personnel and the others who may be exposed. The Hazard Identification System is not intended to identify the nonemergency health hazards of chemicals.

APPENDIX VIII

SELECT CARCINOGENS

APPENDIX VIII
SELECT CARCINOGENS

Substances regulated as select carcinogens by OSHA include:

--Compounds regulated by Title 29, Code of Federal Regulations, Part 1910, Subpart Z - Toxic and Hazardous Substances(1).

--Compounds considered to be "Known Carcinogens" by the National Toxicology Program, (NTP)(2).

--Compounds designated as carcinogens and suspect carcinogens by the International Agency for Research on Cancer, (IARC)(3).

Those compounds included in the IARC lists are shown with their IARC Group; those from Subpart Z and the NTP lists are shown with the appropriate footnote. This list does not include industrial processes that have been identified to cause cancer.

Substance	IARC Group(4)
A-alpha-C(2-Amino-9H-pyrido(2,3,b)indole)	2B
Acetaldehyde	2B
Acetamide	2B
2-Acetylaminofluorene(1)	--
Acrylamide	2B
Acrylonitrile(1)	2A
Adriamycin	2A
AF-2(2-(2-Furyl)-3-(5-nitro-2-furyl)acrylamide)	2B
Aflatoxins	1
para-Aminoazobenzene	2B
ortho-Aminoazotoluene	2B
4-Aminobiphenyl(1,2)	1
2-Amino-5-(5-nitro-2-furyl)-1,3,4-thiadiazole	2B
Amitrole	2B
Analgesic mixtures containing phenacetin2	1
Androgenic steroids	2A
ortho-Anisidine	2B
AramiteTM	2B
Arsenic and arsenic compounds(1,2)	1
Asbestos(1,2)	1
Auramine, technical-grade	2B
Azaserine	2B
Azathioprine(2)	1
Benzene(1,2)	1
Benzidine(1,2)	1

Substance	IARC Group(4)
Benzidine-based dyes	2A
Benzo(a)pyrene	2A
Benzo(b)fluoranthene	2B
Benzo(f)fluoranthene	2B
Benzo(k)fluoranthene	2B
Benzyl violet 4B	2B
Beryllium compounds	2A
Betel quid with tobacco	1
Bis(chloroethylnaphthyl)amine	1
Bis(chloroethyl) nitrosourea (BCNU)	2A
Bis(chloromethyl) ether(1,2)	1
Bitumens, extracts of steam-refined & air-refined	2B
Bleomycins	2B
Bracken fern: Toxic Component is shikimic acid	2B
1,3-Butadiene	2B
1,4-Butanediol dimethanesulfonate ("Myleran")(2)	1
Butylated hydroxyanisole (BHA)	2B
-Butyrolactone	2B
Cadmium compounds	2A
Carbon-black extracts	2B
Carbon tetrachloride	2B
Carrageenan, degraded	2B
Chlorambucil(2)	1
Chloramphenicol	2B
Chlordecone ("Kepone")	2B
alpha-Chlorinated toluenes	2B
1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea (CCNU)	2A
1-(2-Chloroethyl)-3-(methylcyclohexyl)-1-nitrosourea(Methyl-CCNU)	1
Chloroform	2B
Chlorophenols	2B
Chlorophenoxy herbicides	2B
4-Chloro-ortho-phenylenediamine	2B
para-Chloro-ortho-toluidine	2B
Chromium (VI) compounds(2)	1
Cisplatin	2A
Citrus Red No. 2	2B
Coal tar pitches1	1
Coal tars(1)	1
Cotton dusts(1)	--
Creosotes	2A
para-Cresidine	2B
Cycasin	2B
Cyclophosphamide(2)	1
Dacarbazine	2B
Daunomycin	2B
DDT	2B
N,N'-Diacetylbenzidine	2B
2,4-Diaminoanisole	2B
4,4'-Diaminodiphenyl ether	2B
2,4-Diaminotoluene	2B
Dibenz(a,h)acridine	2B
Dibenz(a,f)acridine	2B
7H-Dibenzo(c,g)carbazole	2B
Dibenz(a,h)anthracene	2A

Substance	IARC Group(4)
Dibenzo(a,e)pyrene	2B
Dibenzo(a,h)pyrene	2B
Dibenzo(a,i)pyrene	2B
Dibenzo(a,l)pyrene	2B
1,2-Dibromo-3-chloropropane(1)	2B
para-Dichlorobenzene	2B
3,3'-Dichlorobenzidine(1)	2B
3,3'-Dichloro-4,4'-diaminodiphenyl ether	2B
1,2-Dichloroethane	2B
Dichloromethane	2B
1,3-Dichloropropene (technical-grade)	2B
Diepoxybutane	2B
Di(2-ethylhexyl)phthalate	2B
1,2-Diethylhydrazine	2B
Diethylstilbestrol(2)	1
Diethyl sulphate	2A
Diglycidyl resorcinol ether	2B
Dihydrosafrole	2B
3,3'-Dimethoxybenzidine (ortho-Dianisidine)	2B
para-Dimethylaminoazobenzene(1)	2B
trans-2((Dimethylamino)methylimino) -5-(2-(5-nitro-2-furyl)vinyl-1,3,4-oxadiazole	2B
3,3'-Dimethylbenzidine (ortho-Tolidine)	2B
1,1-Dimethylhydrazine	2B
1,2-Dimethylhydrazine	2B
Dimethylcarbamoyl chloride	2A
Dimethyl sulphate	2A
1,4-Dioxane	2B
Epichlorohydrin	2A
Erionite	1
Ethyl acrylate	2B
Ethylene dibromide	2A
Ethyleneimine1(aziridine)	--
Ethylene oxide1	2A
Ethylene thiourea	2B
Ethyl methanesulphonate	2B
N-Ethyl-N-nitrosourea	2A
Formaldehyde1	2A
2-(2-Formylhydrazino)-4-(5-nitro-2-furyl)thiazole	2B
Glu-P-1 (2-Amino-6-methyldipyrido(1,2-alpha:3',2'-d)imidazole)	2B
Glu-P-2 (2-Aminodipyrido(1,2-alpha:3',2'-d)imidazole)	2B
Glycidaldehyde	2B
Griseofulvin	2B
Hexachlorobenzene	2B
Hexachlorocyclohexanes	2B
Hexamethylphosphoramide	2B
Hydrazine	2B
Indeno(1,2,3-cd)pyrene	2B
IQ (2-Amino-3-methylimidazo(4,5-f)quinoline)	2B
Iron-dextran complex	2B
Iron and steel founding	1
Isopropyl alcohol manufacture, strong-acid process	1
Lasiocarpine	2B
Lead compounds (inorganic)(1)	2B

Substance	IARC Group(4)
Magenta, manufacture of	1
MeA-alpha-C(2-Amino-3-methyl-9H-pyrido(2,3-b)indole)	2B
Methoxyprogesterone acetate	2B
Melphalan(2)	1
Merphalan	2B
5-Methoxypsoralen	2A
8-Methoxypsoralen & UV light(2)	1
2-Methylaziridine	2B
Methylazoxymethanol and its acetate	2B
Methyl chloromethyl ether(1)	1
5-Methylchrysene	2B
4,4'-Methylene bis(2-chloroaniline) (MOCA)	2A
4,4'-Methylene bis(2-methylaniline)	2B
4,4'-Methylenedianiline	2B
Methyl methanesulphonate	2B
2-Methyl-1-nitroanthraquinone	2B
N-Methyl-N-nitrosourethane	2B
N-Methyl-N'-nitro-N-nitrosoguanidine (MNNG)	2A
N-Methyl-N-nitrosourea	2A
Methylthiouracil	2B
Metronidazole	2B
Mineral oils	1
Mirex	2B
Mitomycin C	2B
Monocrotaline	2B
5-(Morpholinomethyl)-3-((5-nitrofurfurylidene)amino)-2-oxazolinone	2B
Mustard gas(2)	1
Nafenopin	2B
1-Naphthylamine(1)	3
2-Naphthylamine(1,2)	1
Nickel compounds	1
Niridazole	2B
5-Nitroacenaphthene	2B
4-Nitrobiphenyl(1)	3
Nitrofen (technical-grade)	2B
1-((5-Nitrofurfurylidene)amino)-2-imidazolidonone	2B
N-(4-(5-Nitro-2-furyl)-2-thiazolyl)acetamide	2B
Nitrogen mustard	2A
Nitrogen mustard N-oxide	2B
2-Nitropropane	2B
N-Nitrosodiethylamine	2A
N-Nitrosodimethylamine(1)	2A
N-Nitrosodi-n-butylamine	2B
N-Nitrosodi-ethanolamine	2B
N-Nitrosodi-n-propylamine	2B
3-(N-Nitrosomethylamino)propionitrile	2B
4-(N-Nitrosomethylamino)-1-(3-pyridyl)-1-butanone (NNK)	2B
N-Nitrosomethylethylamine	2B
N-Nitrosomethylvinylamine	2B
N-Nitrosomorpholine	2B
N-Nitrosonornicotine	2B
N-Nitrosopiperidine	2B
N-Nitrosopyrrolidine	2B

Substance	IARC Group(4)
N-Nitrososarcosine	2B
Oestrogens, non-steroidal	1
Oestrogens, steroidal	1
Oil Orange SS	2B
Oral contraceptives, combined	1
Oral contraceptives, sequential	1
Panfuran S (containing dihydroxymethylfuratrizine)	2B
Phenacetin & analgesics	2A
Phenazopyridine hydrochloride	2B
Phenobarbital	2B
Phenoxybenzamine hydrochloride	2B
Phenytoin	2B
Polybrominated biphenyls	2B
Polychlorinated biphenyls	2A
Ponceau MX	2B
Ponceau 3R	2B
Potassium bromate	2B
Procarbazine hydrochloride	2A
Progestins	2B
1,3-Propane sultone	2B
-Propiolactone(1)	2B
Propylene oxide	2A
Propylthiouracil	2B
Saccharin	2B
Safrole	2B
Shale oils	1
Silica, crystalline	2A
Sodium ortho-phenylphenate	2B
Soots	1
Sterigmatocystin	2B
Streptozotocin	2B
Styrene	2B
Styrene oxide	2A
Sulfallate	2B
Talc containing asbestiform fibers	1
2,3,7,8-Tetrachlorodibenzo-para-dioxin (TCDD)	2B
Tetrachloroethylene	2B
Thioacetamide	2B
4,4'-Thiodianiline	2B
Thiourea	2B
Thorium dioxide(2)	--
Tobacco products, smokeless	1
Tobacco smoke	1
Toluene diisocyanates	2B
ortho-Toluidine	2B
Toxaphene (polychlorinated camphenes)	2B
Treosulphan	1
Tris(1-aziridinyl)phosphine sulphide (Thiotepa)	2A
Tris(2,3-dibromopropyl) phosphate	2A
Trp-P-1 (3-Amino-1,4-dimethyl-5H-pyrido(4,3-b)indole)	2B
Trp-P-2 (3-Amino-1-methyl-5H-pyrido(4,3-b)indole)	2B
Trypan blue	2B
Uracil mustard	2B
Urethane	2B

Substance	IARC Group(4)
Vinyl bromide	2A
Vinyl chloride(1,2)	1

REFERENCES:

1. Occupational Safety and Health Administration Standards, Title 29, Code of Federal Regulations, Part 1910, Subpart Z – Toxic and Hazardous Substances as of 19 January 1989.

2. Fifth Annual Report on Carcinogens, Substances "Known to be Carcinogenic," National Toxicology Program, Report NTP 89-239, 1989 (latest edition).

3. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans: Overall Evaluations of Carcinogenicity, Supplement 7, International Agency for Research on Cancer (IARC), Lyons, France, 1987.

4. IARC Carcinogen Groups:
   - 1 = known carcinogenicity;
   - 2A = probable;
   - 2B = possible;
   - 3 = not classifiable due to insufficient or conflicting data.

APPENDIX IX

REPRODUCTIVE TOXICANTS

REPRODUCTIVE TOXICANTS
CHEMICAL NAME and CAS NUMBER

Acetohydroxamic acid	(546-88-3)
Actinomycin D	(50-76-0)
All-trans retinoic acid	(302-79-4)
Alprazolamm	(8981-97-7)
Amikacin sulfate	(3983-55-5)
Aminoglutethimide	(125-84-8)
Aminoglyosides	(-----)
Aminopterin	(54-62-6)
Angiotensin converting enzyme (ACE inhibitors)	(-----)
Anisindione	(117-37-3)
Aspirin	(50-78-2)
Barbiturates	(-----)
Benomyl	(17804-35-2)
Benzphetamine hydorchloride	(5411-22-3)
Benzodiazepines	(-----)
Bischloroethyl nitrosurea (BCNU) (carmustine)	(154-93-8)
Bromoxynil	(1689-84-5)
Butabarbital sodium	(143-81-7)
1,4-Butanediol dimethylsulfonate (busulfan)	(55-98-1)
Carbon disulfide	(75-15-0)
Carbon monoxide	(630-08-0)
Carboplatin	(41575-94-4)
Chenodiol	(474-25-9)
Chlorcyclizine hydrochloride	(1620-21-9)
Clorambucil	(305-03-3)
Chlordecone (kepone)	(143-50-0)
Chlordiazepoxide	(58-25-3)
Chlordiazepoxide hydorchloride	(438-41-5)
1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea (CCNU)	(13010-47-4)
Clomiphene citrate	(50-41-9)
Chlorazepate dipotassium	(57109-90-7)
Cocaine	(50-36-2)
Colchicine	(64-86-8)
Conjugated estrogens	(-----)
Cyanazine	(21715-46-2)
Cycloheximide	(66-81-9)
Cyclophosphamide (anhydrous)	(50-18-0)

Cyclophosphamide (hydrated)	(6055-19-2)
Cyhexatin	(13121-70-5)
Cytarabine	(147-94-4)
Danazol	(17230-88-5)
Daunorubicin hydrochloride	(23541-50-6)
Demeclocycline hydrochloride (internal use)	(64-73-3)
Diazepam	(439-14-5)
Dicumarol	(66-76-2)
Diethylstilbestrol (DES)	(56-53-1)
Dinocap	(39300-45-3)
Dinoseb	(88-85-7)
Diphenylhydantoin (phenytoin)	(57-41-0)
Doxycycline (internal use)	(564-25-0)
Doxycycline calcium (internal use)	(94088-85-4)
Doxycycline hyclate (internal use)	(24390-14-5)
Doxycycline monohydrate (internal use)	(17086-28-1)
Ergotamine tartrate	(379-79-3)
Ethylene glycol monoethyl ether	(110-80-5)
Ethylene glycol monomethyl ether	(109-86-4)
Ethylene glycol monoethyl ether acetate	(111-15-9)
Ethylene glycol monomethyl ether acetate	(110-49-6)
Ethylene thiourea	(96-45-7)
Etoposide	(33419-42-0)
Etratinate	(54350-48-0)
Fluorouracil	(51-21-8)
Fluoxymesterone	(76-43-7)
Flurazepam hydorchloride	(1172-18-5)
Flutamide	(13311-84-7)
Halazepam	(23093-17-3)
Hexachlorobenzene	(118-74-1)
Ifosfamide	(3778-73-2)
Iodine-131	(24267-56-9)
Isotretinoin	(4759-48-2)
Lead	(-----)
Lithium carbonate	(554-13-2)
Lithium citrate	(919-16-4)
Lorazapam	(846-49-1)
Lovastatin	(75330-75-5)
Medroxyprogesterone acetate	(71-58-9)
Megestrol acetate	(595-33-5)
Melphalan	(148-82-3)
Menotropins	(9002-68-0)
Meprobamate	(57-53-4)
Mercaptopurine	(6112-76-1)
Methacycline hydorchloride	(3963-95-9)
Methimazole	(60-56-0)

Methotrexate	(59-05-2)
Tethotrexate sodium	(15475-56-6)
Methyl bromide	(74-83-9)
Methyl mercury	(-----)
Methyltestosterone	(58-18-4)
Midazolam hydrochlorid	(59467-96-8)
Minocycline hydrochloride (internal use)	(13614-98-7)
Misoprostol	(62015-39-8)
Mitoxantrone hydrochloride	(70476-82-3)
Nafgarelin acetate	(86220-42-0)
Neomycon sulfate (internal use)	(1405-10-3)
Netilmicin sulfate	(56391-57-2)
Nicotine	(54-11-5)
Nitrogen mustard (mechlorethamine)	(51-75-2)
Nitrogen mustard hydorchloride	(55-86-7)
Norethisterone (norethindrone)	(68-22-4)
Norethisterone acetate (norethindrone acetate)	(51-98-9)
Norethisterone (norethindrone)/ethinyl estradiol	(68224/57-63-6)
Norethisterone (norethindrone)/mestranol	(68224/72-33-3)
Norgrestrel	(6533-00-2)
Oxazepam	(604-75-1)
Oxytetracycline (internal use)	(79-57-2)
Oxytetracycline hydrochloride (internal use)	(2058-46-0)
Paramethadione	(115-67-1)
Penicillamine	(52-67-5)
Phenacemide	(63-98-9)
Phenprocoumon	(435-97-2)
Pipobroman	(54-91-1)
Plicamycin	(18378-89-7)
Polychlorinated biphenyls	(-----)
Procarbazine hydrochloride	(366-70-1)
Propylthiouracil	(51-52-5)
Ribarvirin	(36791-04-5)
Secobarbital sodium	(309-43-3)
Streptomycin sulfate	(3810-74-0)
Tamoxifen citrate	(54965-24-1)
Temazepam	(846-50-4)
Testosterone cyoionate	(846-50-4)
Testosterone enanthate	(315-37-7)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	(1746-01-6)
Tetracycline (internal use)	(-----)
Thalidomide	(50-35-1)
Thioguanine	(154-42-7)
Tobacco smoke (primary)	(-----)
Tobramycin sulfate	(49842-07-1)

Toluene	(108-88-3)
Triazolam	(28911-01-5)
Trilostane	(13647-35-3)
Uracil mustard	(66-75-1)
Urofollitropin	(26995-91-5)
Valproate (valproic acid)	(99-66-1)

FEMALE REPRODUCTIVE TOXICITY

Anabolic steroids	(-----)
Carbon disulfide	(75-15-0)
Cocaine	(50-36-2)
Cyclophosphamide (anhydrous)	(50-18-0)
Cyclophosphamide (hydrated)	(6055-19-2)
Ethylene oxide	(75-21-8)
Lead	(-----)
Tobacco smoke (primary)	(-----)
Uracil mustard	(66-75-1)

MALE REPRODUCTIVE TOXICITY

Benomyl	(17804-35-2)
Cardon disulfide	(75-15-0)
Colchicine	(64-86-8)
Cyclophosphamide (anyhdrous)	(50-18-0)
Cyclophosphamide (hydrated)	(6055-19-2)
1,2-Dibromo-3-chloropropane (DBCP)	(96-12-8)
m-Dintrobenzene	(99-65-0)
o-Dintrobenzene	(528-29-0)
p-Dintrobenzene	(100-25-4)
Dinoseb	(88-85-7)
Ethylene glycol monoethyl ether	(110-80-5)
Ethylene glycol monomethyl ether	(109-86-4)
Lead	(-----)
Nitrofurantoin	(67-20-9)
Tobacco smoke (primary)	(-----)
Uracil mustard	(66-75-1)

*CRC Handbook of Laboratory Safety, Keith A. Furr, 1995.

APPENDIX X

GLOVE SELECTION GUIDE

GLOVE SELECTION GUIDANCE

Resistance to Chemicals of Common Glove Materials
(E=Excellent, G=Good, F=Fair, P=Poor)

Chemical	Natural Rubber	Neoprene	Nitrile	Vinyl	Chemical	Natural Rubber	Neoprene	Nitrile	Vinyl
Acetaldehyde	G	G	E	G	Formic Acid	G	E	E	E
Acetic Acid	E	E	E	E	Glycerol	G	G	E	E
Acetone	G	G	G	F	Hexane	P	E	-	P
Acrylonitrile	P	G	-	F	Hydrobromic acid (40%)	G	E	-	E
Ammonium Hydroxide	G	E	E	E	Hydrochloric acid (conc)	G	G	G	E
Aniline	F	G	E	G	Hydrofluoric acid (30%)	G	G	G	E
Benzaldehyde	F	F	E	G	Hydrogen Peroxide	G	G	G	E
Benzene	P	F	G	F	Iodine	G	G	-	G
Benzyl Chloride	F	P	G	P	Methylamine	G	G	E	E
Bromine	G	G	-	G	Methyl Cellosolve	F	E	-	P
Butane	P	E	-	P	Methyl Chloride	P	E	-	P
Calcium Hypochlorite	P	G	G	G	Methyl Ethyl Ketone	F	G	G	P
Carbon Disulfide	P	P	G	F	Methylene Chloride	F	F	G	F
Carbon Tetrachloride	P	F	G	F	Monoethanolamine	F	E	-	E
Chlorine	G	G	-	G	Morpholine	F	E	-	E
Chloroacetone	F	E	-	P	Naphthalene	G	G	E	G
Chloroform	P	F	G	P	Nitric Acid (conc)	P	P	P	G
Chromic Acid	P	F	F	E	Perchloric Acid	F	G	F	E
Cyclohexane	F	E	-	P	Phenol	G	E	-	E
Dibenzylether	F	G	-	P	Phosphoric Acid	G	E	-	E
Dibutyl Phthalate	F	G	-	P	Potassium Hydroxide (sat)	G	G	G	E
Diethanolamine	F	E	-	E	Propylene Dichloride	P	F	-	P
Diethyl Ether	F	G	E	P	Sodium Hydroxide	G	G	G	E
Dimethyl Sulfoxide	-	-	-	-	Sodium Hypochlorite	G	P	F	G
Ethyl Acetate	F	G	G	F	Sulfuric Acid (conc)	G	G	F	G
Ethylene Dichloride	P	F	G	P	Toluene	P	F	G	F
Ethylene Glycol	G	G	E	E	Trichloroethylene	P	F	G	F
Ethylene Trichloride	P	P	-	P	Tricresyl Phosphate	P	F	-	F
Flucrine	G	G	-	G	Triethanolamine	F	E	E	E
Formaldehyde	G	E	E	E	Trinitrotoluene	P	E	-	P

Aromatic and halogenated hydrocarbons will attack all types of natural and synthetic glove materials.

APPENDIX XI

INVENTORY AND CHEMICAL STORAGE GUIDELINES

Chemical Inventory

Principal Investigator:____________________
Department:_____________________________
Laboratory room #s:_______________________
Updated/revised:_________________________

Chemical Name	Amount	Physical state	Location	Hazard Class

SUGGESTED SHELF STORAGE PATTERN - ORGANIC

Organic #2 Alcohols, Glycols, Amines, Amides, Imines, Imides (Store flammables in a dedicated cabinet.)		**Organic #8** Phenol, Cresols
Organic #3 Hydrocarbons, Esters, Aldehydes (Store flammables in a dedicated cabinet.)		**Organic #6** Peroxides, Azides, Hydroperoxides
Organic #4 Ethers, Ketones, Ketenes, Halogenated Hydrocarbons, Ethylene Oxide (Store flammables in a dedicated cabinet.)		**Organic #1** Acids, Anhydrides, Peracids (Store certain organic acids in acid cabinet.)
Organic #5 Epoxy Compounds, Isocyanates		**Organic #9** Dyes, Stains, Indicators (Store alcohol-based solutions in flammables cabinet.)
Organic #7 Sulfides, Polysulfides, etc.		**MISCELLANEOUS**

SUGGESTED SHELF STORAGE PATTERN - INORGANIC

Inorganic #10 Sulfur, Phosphorus, Arsenic, Phosphorus Pentoxide		**Inorganic #7** Arsenates, Cyanides, Cyanates (Store away from water)
Inorganic #2 Halides, Sulfates, Sulfites, Thiosulfates, Phosphates, Halogens, Acetates		**Inorganic #5** Sulfides, Selenides, Phosphides, Carbides, Nitrides
Inorganic #3 Amides, Nitrates (not Ammonium Nitrate), Nitrites, Azides (Store Ammonium nitrate away from all other substances-ISOLATE IT!)		**Inorganic #8** Borates, Chromates, Manganates, Permanganates
Inorganic #1 Metals & Hydrides (Store away from any water.) (Store flammable solids in flammables cabinet.		**Inorganic #9** Acids, except Nitric (Acids are best stored in dedicated cabinets.) (Store Nitric Acid away from other acids unless your acid cabinet provides a separate compartment for Nitric Acid.)
Inorganic #4 Hydroxides, Oxides, Silicates, Carbonates, Carbon		**Inorganic #6** Chlorates, Bromates, Iodates, Chlorites, Hypochlorites, Perchlorates, Perchloric Acid, Peroxides, Hydrogen Peroxide

COMMON LABORATORY CORROSIVES

ORGANIC ACIDS	ORGANIC BASES
Acetic Acid (Glacial)	Ethylenediamine
Acetic Anhydride	Ethylimine
Acetyl Bromide	Hexamethylenediamine
Acetyl Chloride	Hydroxylamine
Benzoyl Bromide	Phenylhydrazine
Benzoyl Chloride	Piperazine
Benzyl Bromide	Tetramethylammonium Hydroxide
Benzyl Chloride	Tetramethylethylenediamine
Butyric Acid	Triethylamine
Chloroacetic Acid	Trimethylamine (aqueous solution)
Chloroacetyl Chloride	
Chlorotrimethylsilane	INORGANIC BASES
Dichlorodimethylsilane	Ammonium Hydroxide
Dimethyl Sulfate	Ammonium Sulfide
Formic Acid	Calcium Hydride
Methyl Chloroformate	Calcium Hydroxide
Oxalic Acid	Calcium Oxide
Phenol	Hydrazine
Propionic Acid	Potassium Hydroxide
Propionyl Bromide	Sodium Hydride
Propionyl Chloride	Sodium Hydroxide
Salicylic Acid	
Trichloroacetic Acid	OTHERS
	Aluminum Trichloride
INORGANIC ACIDS	Ammonium Bifluoride
Bromine Pentafluoride	Antimony Trichloride
Chlorosulfonic Acid	Bromine (liquid)
Hydriodic Acid	Calcium Fluoride
Hydrobromic Acid	Chlorine (gas)
Hydrochloric Acid	Ferric Chloride
Hydrofluoric Acid	Fluorine (gas)
Nitric Acid	Iodine
Perchloric Acid	Phosphorus
Phosphoric Acid	Sodium Bisulfate
Phosphorus Pentachloride	Sodium Fluoride
Phosphorus Pentoxide	
Phosphorus Tribromide	
Phosphorus Trichloride	
Sulfuric Acid	
Sulfuryl Chloride	
Thionyl Chloride	
Tin Chloride	
Titanium Tetrachloride	

COMMON LABORATORY OXIDIZERS

Oxidizers react with other chemicals by giving off electrons and undergoing reduction. Uncontrolled reactions of oxidizers may result in a fire or an explosion, causing severe property damage or personal injury. Use oxidizers with extreme care and caution and follow all safe-handling guidelines specified in the MSDS.

Bleach
Bromates
Bromine
Butadiene
Chlorates
Chloric Acid
Chlorine
Chlorite
Chromates
Chromic Acid
Dichromates
Fluorine
Haloate
Halogens
Hydrogen Peroxide
Hypochlorites
Iodates
Mineral Acid
Nitrates
Nitric Acid
Nitrites
Nitrites
Nitrous oxide
Ozanates
Oxides
Oxygen
Oxygen Difluoride
Ozone
Perhaloate
Perborates
Percarbonates
Perchlorates
Perchloric Acid
Permanganates
Peroxides
Persulfate
Sodium Borate Perhydrate
Sulfuric Acid

APPENDIX XII

CLOSEOUT PROCEDURES AND CHECKLIST

CLOSEOUT PROCEDURES FOR DEPARTING/RETIRING FACULTY AND STAFF

Proper disposition of all hazardous materials used in the workplace is the responsibility of the chemical user or supervisor/Principal Investigator (PI) to whom a chemical use room/laboratory is assigned. Enforcement of this policy is the responsibility of the supervisor/PI. Proper disposition of hazardous materials is required whenever a chemical user leaves the University or transfers to a different laboratory/chemical use room. This process should be started at least a month before departure from the chemical use room/laboratory to allow ample time to properly dispose all materials. Hazardous waste pickup should be completed before the chemical use room/laboratory is vacated. The disposal must be in compliance with the University's Hazardous Materials Management Plan. The following checklist should be completed prior to the chemical user's departure. Once completed, the checklist should be signed and submitted to the user's Dean or Director and to the Environmental Health and Safety Office (EHSO). If periodic inspections by the EHSO reveal that proper closeout procedures have not been followed, the EHSO will oversee correction/remediation of any problems created by failure to follow those procedures, and the cost of correcting those problems will be charged to the budget of the level V unit within which the problems were identified by the EHSO.

CHEMICAL USER CLOSE-OUT CHECKLIST

DATE:_____ SUPV/PI:_____
BLDG:_____ DEPT:_____
ROOM(S):_____

REQUIREMENT	YES	NO	COMMENTS
1. Have shared storage units such as refrigerators, freezers, cold rooms, stock rooms, etc. been properly surveyed in order to locate and appropriately dispose/designate remaining chemicals?			
2. Are all chemical containers labeled and/or listed in a logbook or inventory with the name and hazard?			
3. Are all containers securely closed and in good condition?			
4. Have beakers, flasks, vials, evaporating dishes, etc. been emptied and the contents properly disposed? Remember to check refrigerators, freezers, cold rooms, fume hoods, biological safety cabinets, bench tops, storage cabinets, stock rooms, etc.			
5. Have you determined which chemicals and compressed gas cylinders are usable and transferred responsibility for those materials to another party who is willing to take charge of them? If a new user cannot be found, the materials must be disposed.			
6. Were controlled substances disposed of as specified by the Drug Enforcement Agency (DEA) permit under which they were held? Abandonment of a controlled substance is a violation of the DEA requirements.			
7. Was permission received from the DEA to transfer ownership of a controlled substance to another individual?			
8. Were non-transferable compressed gas cylinder connections removed, cylinder caps replaced, and cylinders returned to suppliers? If cylinders are non-returnable, contact the Hazardous Material Management Program at x63198.			
9. Has all laboratory equipment been cleaned or decontaminated? Were fume hood surfaces and bench tops washed?			

10. If laboratory equipment will be discarded, have the following items been removed prior to disposal: capacitors? transformers? mercury switches and thermometers? refrigerant fluids containing chlorofluorocarbons? radioactive sources and chemicals? Contact the Environmental Health and Safety office (EHSO) for assistance.	___ ___ ___ ___ ___	___ ___ ___ ___ ___	
11. Were chemicals targeted for hazardous waste disposal prepared by following procedures in the Hazardous Materials Management Program?			
12. Did you leave a copy of your lab notebook in the lab? Its care has been transferred to _____.			
13. Have you submitted the completed checklist to your Dean or Director and the EHSO? **EHSO Fax:** 63205 **Email:** labsafe@hawaii.edu			

NOTE: If any radioactive material or biological commodities were used in the lab, please contact the Radiation Safety Officer (66475) and/or the Biological Safety Officer (63197) at the EHSO.

REQUIRED SIGNATURES:

_____	_____	_____
Chemical User	Supervisor/PI	Department Head*

*By signing this checklist, you as Department Head are declaring that items 1 through 13 have been addressed. No signature would mean that the lab has not been closed-out properly. Therefore, the transfer of lab equipment to departing staff will be delayed.

APPENDIX XIII

WORKPLACE SAFETY COMMITTEE

INSPECTION AND ENFORCEMENT PROCEDURES

WORKPLACE SAFETY COMMITTEE
INSPECTION AND ENFORCEMENT PROCEDURES

In order to ensure that University facilities are operating in as safe a manner as possible, the University's Environmental Health and Safety Office (EHSO) under the auspices of the Workplace Safety Committee (WSC) will conduct periodic inspections of work sites. The procedures that will be followed are described below and on the attached flowchart.

Initially, the supervisor in charge of the work area will be given prior notice that an inspection will be conducted. On the appointed day, a member of the EHSO will conduct an inspection of the facility. The supervisor is strongly encouraged to accompany the EHSO representative. At the conclusion of the inspection, a report will be issued to the supervisor and copies will be sent to the Department Chairperson and the appropriate Dean/Director. If deficiencies were observed during the inspection, the report will list a response date by which the supervisor must reply to the EHSO indicating when and how all the deficiencies will be corrected.

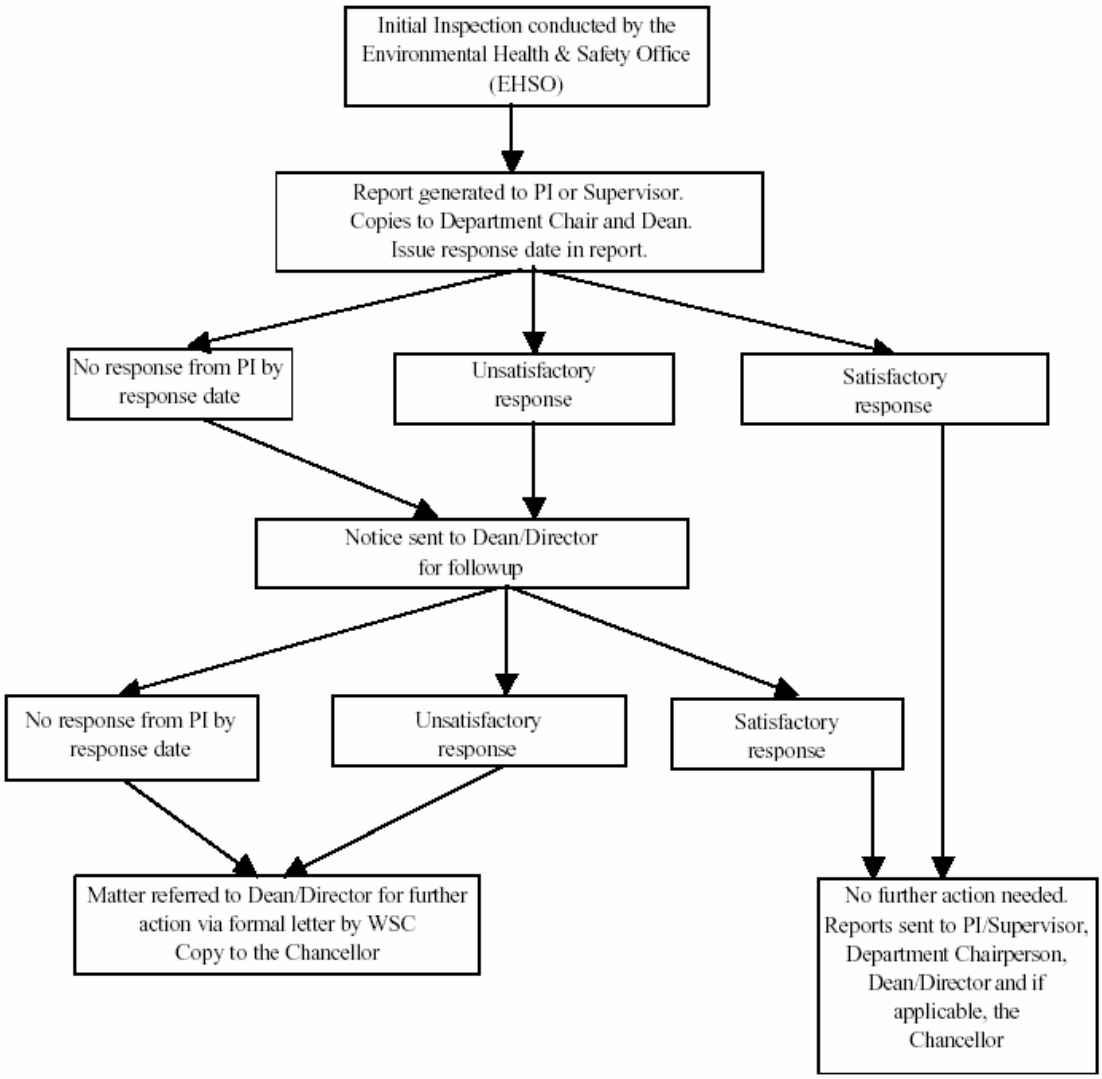
Once the response from the supervisor has been received and reviewed by the EHSO, a compliance date will be established. If the supervisor does not respond to the report, the EHSO will establish the compliance date. In either case, the supervisor will be informed about the compliance date. Once the compliance date has been reached, the EHSO will conduct a follow-up inspection to ensure the deficiencies have been corrected. If all the deficiencies have been corrected, then no further action will be taken and the supervisor, Department Chairperson and the Dean/Director will be informed. If only minor deficiencies (as defined by the EHSO) remain after the follow-up inspection, then the EHSO and the supervisor will establish a new compliance date.

If major deficiencies (as defined by the EHSO) remain, a second report will be generated and sent to the original report's recipients and the President's office. A meeting will be scheduled between the supervisor, the EHSO and a member of the WSC. The participants at this meeting will discuss how the deficiencies can be corrected. A new compliance date will be scheduled at this meeting.

The EHSO will conduct the second follow-up inspection on the new compliance date. If all deficiencies are corrected, then no further action will occur and the supervisor, Department Chairperson, the Dean/Director and the President's office will be informed. However, if any deficiencies still remain, then the WSC will formally send the matter to the appropriate Dean/Director for further action. The Dean/Director may take appropriate action including disciplinary action in accordance with applicable collective bargaining agreements. The Dean/Director will inform the WSC of all activities taken to correct the situation in a timely manner.

INSPECTION/COMPLIANCE FLOW CHART FOR WORKPLACE SAFETY COMMITTEE

Revised 10/20/00



APPENDIX XIV

LABORATORY PERSONNEL SAFETY CHECKLIST

Laboratory Personnel Safety Check List

Employee/Student Name_____ Date_____
Print

Department_____ Bldg._____ Rm.#_____

Principal Investigator _____ OR
Print

Lab Supervisor_____
Print

The following procedures have been reviewed with this employee/student.

1. _____ Has the PI/Lab Supervisor discussed the nature of the research being conducted in the laboratory?

2. _____ Has the PI/Lab Supervisor discussed all hazardous components of the research?

   a._____ chemical
   b._____ biological
   c._____ physical
   d._____ radioactive

3. _____ Has the employee/student received instruction on known symptoms associated with exposure to highly toxic chemicals or biological commodities used in the laboratory?

4. _____ Has the PI/Lab Supervisor discussed the need for the employee/student to inform health care providers of the hazardous substances (chemical, biological, radioactive) used in the laboratory during each medical visit?

5. _____ Has the PI/Lab Supervisor reviewed the laboratory Chemical Hygiene Plan and all Standard Operating Procedures with the employee/student?

6. _____ Has the PI/Lab Supervisor identified the location of Material Safety Data Sheets to the employee/student and demonstrated methods of access? (e.g., EHSO website, hardcopy, etc.).

7. _____ Has hazard assessment information concerning Personal Protective Equipment required in laboratory been reviewed, and has the supervisor and employee signed off?

8. _____ Does the employee/student need a respirator? If yes, arrange for exposure evaluation, training and fit testing through the Environmental Health & Safety Office at x6-3204.

9. _____ Have the Emergency Response Procedures been identified to the employee/student and pertinent procedures reviewed for:

a._____ spills
b._____ fire
c._____ personal injury

10. _____ Have all Emergency Equipment locations/procedures been identified to the employee/student?

a._____ Emergency Shower
b._____ Emergency Eyewash
c._____ Fire Alarm Pull Station
d._____ Fire Extinguisher
e._____ Spill Kit
f._____ Telephone (x9-911)

11. _____ Have the locations of the Satellite Accumulation Area and Hazardous Material Management Plan been identified to the employee/student and waste procedures explained for:

a._____ solvents?
b._____ acids/bases?
c._____ radioactive material?
d._____ sharps/broken glass?
e._____ biological material?

12. _____ Has the PI/Lab Supervisor reviewed with the employee/student, the laboratory signage system as indicated on the door?

13. _____ Have basic laboratory safety requirements been explained & reinforced?

14. _____ Training (refer to website www.hawaii.edu/ehso for schedule):

_____ a. If new employee/student, has the employee student signed up for Chemical Hygiene/Laboratory Safety training at x6-5180.

_____ b. If biological commodity user, has the employee/student signed up for training with the Biological Safety Office at x6-3197.

_____ c. If radioactive material user, has the employee/student signed up for training with the Radiation Safety Office at x6-6475.

All laboratory personnel must: **know** the hazards
understand the hazards
have **skills** to execute safe practices

Employee/Student Name_____ _____
Signature Date

Principal Investigator/ Lab Supervisor _____ _____
Signature Date

Keep the completed form with employee records

APPENDIX XV

SAFE HANDLING PRACTICES FOR

MOVING CHEMICALS

UH Environmental Health and Safety Office
Fact Sheet

Safe Handling Practices For Moving Chemicals

Moving chemicals from one laboratory or area to another can be a very dangerous activity when safe handling precautions are not practiced. This fact sheet will explain the basic chemical handling and storage precautions to practice when moving chemicals between labs and buildings.

1. First, perform a pre-move visual inspection and inventory of the chemicals that will be moved

   → Make a list of the chemicals and note of the type (e.g. Acid, Base, Reactive, Toxic), and amounts of the chemicals to be moved.

   → Make sure that each container is correctly labeled as to its contents.

   → Observe the general condition of each chemical container.

   → Observe each containers cap or closure seal for the formation of crystals. CAUTION DO NOT TIGHTEN, OPEN OR MOVE CONTAINERS THAT HAVE CRYSTALS FORMING ON THE CAPS AND SEALS.

   → Observe whether crystals, which could be the signs of decomposition, have formed INSIDE the container. Ethers and other classes of organic peroxides can decompose and produce potentially dangerous and explosive crystals.

2. Locate the Materials Safety Data Sheet (MSDS) for each chemical to be moved. Each MSDS has chemical specific handling and safety information that must be properly followed in order to move the chemical safely.

3. Plan the move. Chose the best route to take from point A to point B. Do not to take containers up and down stairs if possible.

4. Prepare the chemicals for the move.

   → Remember to use the proper goggles, gloves and other personal protective equipment before handling any chemicals.

- → Group the containers for the move by Hazard Class. Do not move acids with toxics, or oxidizers with organic solvents. Make a separate move for each Hazard Class.

- → Transfer salvageable chemicals from deteriorating or contaminated containers to new containers with new labels. Properly dispose of unsalvageable and excess chemicals as Hazardous Waste.

- → Box chemical containers if possible, using the correct packing materials (e.g. Vermiculite, original packaging boxes).

- → If you use a cart to move containers make sure it has rails so the containers don't slip off. Place heavy containers on the bottom rack of the cart. Do not over load the cart. Make several trips if necessary.

- → Take a chemical spill kit with you in the event you have a spill along the move. This can be a coffee can filled with Vermiculite or the Acid/Base neutralizer kits found in many labs.

5. Compressed cylinder handling.

   - → Always remove regulators from the cylinders before moving.

   - → Always replace the metal valve cover on the cylinder before moving.

   - → Move the cylinder with a cylinder dolly made especially for moving cylinders. Make sure the cylinder is securely chained or strapped to the dolly.

   - → DO NOT lay cylinders on their sides. Laying a cylinder on its side can cause condensed liquids in the cylinder to enter the valve. When the valve is opened the liquid can rapidly volatilize and expand. This can produce potentially explosive conditions.

6. Before the move, rethink the storage system where you're moving to. The best way to store reactive chemicals is by family groups, making sure that you don't put certain groups right next to each other. For example, store phenols and amines well away from acid chlorides. Inorganics should be separated from organics. The inert or low-reactive materials can still stored in alphabetical order. This "mixed" system can work well and will help you comply with chemical storage requirements.

7. During the move. Be prepared for unexpected events during the move.

- → Stay with the containers. Do not let them out of you sight while you are moving them between points “A” and “B.”

- → Be aware of the surroundings. Watch for doors opening in your way. Warn people of the hazard before they get close to you.

- → If it begins to rain while you are out side of a building you will need to find safe cover for the containers.

- → Have your spill kit available as well as the phone numbers to call in the event you have a spill along the move. Familiarize yourself with UH chemical hygiene plan “Spill Clean-Up Procedures.” The emergency contact numbers are;

JABSOM Health & Safety Coordinator (692-1855)
UH Manoa Environmental Health & Safety Office (956-8660)
Honolulu Fire Department (911)

By following these basic chemical-handling practices during your move, you can ensure your safety, as well as the safety of other people around you.