APPENDIX I

EMERGENCY TELEPHONE NUMBERS
and
WORK COORDINATION

EMERGENCY TELEPHONE NUMBERS

CAMPUS EMERGENCY (24 Hours)	**x 66911**
POISON CENTER	**941-4411**

Environmental Health & Safety Office (EHSO) Resources

Laboratory Safety x 65180
Mark Burch, Chemical Hygiene Officer

Biological Safety x 63197
Hubert Olipares, Biological Safety Officer

Radiation Safety x 66475
Irene Sakimoto, Radiation Safety Officer

Industrial Hygiene x 63204
Emma Kennedy, Industrial Hygienist

Hazardous Waste Disposal x 63198
Tim O'Callaghan, Hazardous Material Management Officer

HMMP Training/Auditing x 63201
Ray Welch, Environmental and Occupational Safety Specialist

Diving Safety x 66420
Dave Pence, Diving Safety Officer

Fire Safety x 64953
Jerry Egenberger, Fire Safety Officer

Environmental Compliance x 69173
Joel Narusawa, Environmental Compliance Officer

Facilities Planning and Management Office (FPMO)

Work Coordination x 67134

APPENDIX II

LABORATORY INSPECTION CHECKLIST

LABORATORY CHECK-UP

DATE:_____ _____
BLDG/ROOM: _____
PI/LAB SUP:_____

I. GENERAL	YES	NO	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?			
n. Exit doors are unobstructed?			
o. A fire extinguisher is readily accessible? Inspection date current?			
Notes:			

II. HAZARDOUS CHEMICALS & WASTE	YES	NO	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. Peroxidizable 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 spills cleaned up?			
k. Household-type refrigerators are not used for flammable liquid storage?			
l. Fume hood has adequate airflow?			
III. CHEMICAL HYGIENE PLAN	**YES**	**NO**	**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:

rev.3/01

APPENDIX III

"HAZARDOUS CHEMICALS IN LABORATORIES"
STATE OF HAWAII OCCUPATIONAL SAFETY & HEALTH STANDARDS

HAWAII 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 which 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 elements 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 air flow 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, other

safety 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 for

contact 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, N-nitrosodiethylamine, 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 air flow 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
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
*Fluorine
*Formaldehyde
*Hydrazine and salts
Hydrofluoric acid
Hydrogen bromide
Hydrogen chloride
*Hydrogen cyanide
*Hydrogen sulfide
Mercury and compounds
*Methanol
*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 work day.

(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 work week, 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[1]

Substance	CAS No.[b]	Air Contaminant Limits** PEL-TWA* ppm[c]	PEL-TWA* mg/m³[d]	PEL-STEL[a] ppm[c]	PEL-STEL[a] mg/m³[d]	PEL-CEILING ppm[c]	PEL-CEILING designation mg/m³[d]	Skin
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								
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							
Handling and use, as Sb		-	0.5	-	-	-	-	-

TABLE 202-1 Limits for Air Contaminants[1] (Continued)

Substance	CAS No.[b]	Air Contaminant Limits** PEL-TWA* ppm[c]	PEL-TWA* mg/m[3d]	PEL-STEL[a] ppm[c]	PEL-STEL[a] mg/m[3d]	PEL-CEILING ppm[c]	PEL-CEILING desig-nation mg/m[3d]	Skin
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	-	-	-	-	-
Benzene; see §12-202-36	71-43-2	See Table 202-2 for operations excluded[e]						
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)	7440-41-7	0.002		0.005 (see Table 202-2)		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	-	-	-
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						

TABLE 202-1 Limits for Air Contaminants[1] (Continued)

Substance	CAS No.[b]	Air Contaminant Limits** PEL-TWA* ppm[c]	PEL-TWA* mg/m³[d]	PEL-STEL[a] ppm[c]	PEL-STEL[a] mg/m³[d]	PEL-CEILING ppm[c]	PEL-CEILING designation mg/m³[d]	Skin
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
tert-Butyl chromate (as CrO_3)	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	-	-	-
Vapor & Aerosol		5	20	-	40	-	-	-
Captafol (Difolatan®)	2425-06-1	-	0.1	-	-	-	-	-
Captan	133-06-2	-	5	-	15	-	-	-
Carbaryl (Sevin®)	63-25-2	-	5	-	10	-	-	-
Carbofuran (Furadan®)	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

TABLE 202-1 Limits for Air Contaminants[1] (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STEL[a]		PEL-CEILING		Skin
Substance	CAS No.[b]	ppm[c]	mg/m[3d]	ppm[c]	mg/m[3d]	ppm[c]	desig-nation mg/m[3d]	
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	-
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						
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 CrO_3)	Varies with compound	-	-	-	-	-	0.1	-
Chromite ore processing (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[1] (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STEL[a]		PEL-CEILING		Skin
Substance	CAS No.[b]	ppm[c]	mg/m[3][d]	ppm[c]	mg/m[3][d]	ppm[c]	desig-nation mg/m[3][d]	
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% SiO_2), Respirable fraction	-		2	-	-	-	-	-
Coal dust (greater than or equal to 5% SiO_2), Respirable quartz fraction	-		0.1	-	-	-	-	-
Coal tar pitch volatiles (benzene soluble fraction), anthracene, BaP, phenanthrene, acridine, chrysene, pyrene	65966-93-2	-	0.2[f]	-	-	-	-	-
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 4170-30-3	2	6	6	18	-	-	-
Crufomate	299-86-5	-	5	-	20	-	-	-
Cumene	98-82-8	50	245	75	365	-	-	X
Cyanamide	420-04-2	-	2	-	-	-	-	-
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	-	-	-	-	-

TABLE 202-1 Limits for Air Contaminants[1] (Continued)

Substance	CAS No.[b]	Air Contaminant Limits** PEL-TWA* ppm[c]	PEL-TWA* mg/m³[d]	PEL-STEL[a] ppm[c]	PEL-STEL[a] mg/m³[d]	PEL-CEILING ppm[c]	PEL-CEILING designation mg/m³[d]	Skin
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 (Systox®)	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	-	-	-	-	-
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
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	-	-	-	-	-

TABLE 202-1 Limits for Air Contaminants[1] (Continued)

Substance	CAS No.[b]	Air Contaminant Limits** PEL-TWA* ppm[c]	PEL-TWA* mg/m³[d]	PEL-STEL[a] ppm[c]	PEL-STEL[a] mg/m³[d]	PEL-CEILING ppm[c]	PEL-CEILING designation mg/m³[d]	Skin
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						
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
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	-	-	-

TABLE 202-1 Limits for Air Contaminants[1] (Continued)

Substance	CAS No.[b]	Air Contaminant Limits** PEL-TWA* ppm[c]	PEL-TWA* mg/m[3d]	PEL-STEL[a] ppm[c]	PEL-STEL[a] mg/m[3d]	PEL-CEILING ppm[c]	PEL-CEILING designation mg/m[3d]	Skin
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
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	-	-	-
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 See Table 202-2 for operations excluded			30		X
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						

TABLE 202-1 Limits for Air Contaminants[1] (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STEL[a]		PEL-CEILING		Skin
Substance	CAS No.[b]	ppm[c]	mg/m[3d]	ppm[c]	mg/m[3d]	ppm[c]	mg/m[3d] designation	
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		-	-	-	-	-	-	-
Ferrovanadium dust	12604-58-9	-	1	-	3	-	-	-
Fibrous glass dust	-	-	10[h]	-	-	-	-	-
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	-	-	-	-	-
Graphite, natural respirable dust	7782-42-5	-	2.5	-	-	-	-	-
Graphite, synthetic	-							
Total dust		-	10	-	-	-	-	-
Respirable fraction		-	5	-	-	-	-	-
Guthion[R]	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

TABLE 202-1 Limits for Air Contaminants[1] (Continued)

		Air Contiminant Limits**						
		PEL-TWA*		PEL-STEL[a]		PEL-CEILING		Skin
Substance	CAS No.[b]	ppm[c]	mg/m[3d]	ppm[c]	mg/m[3d]	ppm[c]	desig-nation mg/m[3d]	
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	-	-	-
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	-	-	-
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	-	-	-
Respirable fraction		-	5	-	-	-	-	-

TABLE 202-1 Limits for Air Contaminants[1] (Continued)

Substance	CAS No.[b]	Air Contaminant Limits** PEL-TWA* ppm[c]	PEL-TWA* mg/m[3d]	PEL-STEL[a] ppm[c]	PEL-STEL[a] mg/m[3d]	PEL-CEILING ppm[c]	PEL-CEILING designation mg/m[3d]	Skin
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	-	-	-
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								
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

TABLE 202-1 Limits for Air Contaminants[1] (Continued)

Substance	CAS No.[b]	Air Contaminant Limits** PEL-TWA* ppm[c]	PEL-TWA* mg/m³[d]	PEL-STEL[a] ppm[c]	PEL-STEL[a] mg/m³[d]	PEL-CEILING ppm[c]	PEL-CEILING designation mg/m³[d]	Skin
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	-	-
Methyl chloroform (1,1,1-Trichloro-ethane)	71-55-6	350	1,900	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						
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	-	-	-	-	-

TABLE 202-1 Limits for Air Contaminants[1] (Continued)

Substance	CAS No.[b]	Air Contaminant Limits** PEL-TWA* ppm[c]	PEL-TWA* mg/m[3d]	PEL-STEL[a] ppm[c]	PEL-STEL[a] mg/m[3d]	PEL-CEILING ppm[c]	PEL-CEILING designation mg/m[3d]	Skin
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	-	-	-	-	-
Mevinphos[R]		see Phosdrin						
Mica		see Silicates						
Molybdenum (as Mo)	7439-98-7							
Soluble compounds		-	5	-	10	-	-	-
Insoluble compounds Total dust		-	10	-	20	-	-	-
Monocrotophos (Azodrin[R])	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	-	-	-
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[1] (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STEL[a]		PEL-CEILING		Skin
Substance	CAS No.[b]	ppm[c]	mg/m[3d]	ppm[c]	mg/m[3d]	ppm[c]	desig-nation mg/m[3d]	
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	-	5[i]	-	10[i]	-	-	-
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	-	-	-	-	-
Respirable fraction	-	-	5	-	-	-	-	-
Pentaborane	19624-22-7	0.005	0.01	0.015	0.03	-	-	-
Pentachloronaphthalene	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
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	-	-	-	-	-

TABLE 202-1 Limits for Air Contaminants[1] (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STEL[a]		PEL-CEILING		Skin
Substance	CAS No.[b]	ppm[c]	mg/m[3d]	ppm[c]	mg/m[3d]	ppm[c]	desig-nation mg/m[3d]	
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 (Mevinphos[R])	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	-	-	-	-	-
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
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	-	-	-

TABLE 202-1 Limits for Air Contaminants[1] (Continued)

Substance	CAS No.[b]	Air Contaminant Limits** PEL-TWA* ppm[c]	PEL-TWA* mg/m[3d]	PEL-STEL[a] ppm[c]	PEL-STEL[a] mg/m[3d]	PEL-CEILING ppm[c]	PEL-CEILING mg/m[3d]	Skin designation
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	-	-	-
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	-	-	-	-	-
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	-	-	-	-	-

TABLE 202-1 Limits for Air Contaminants[1] (Continued)

		Air Contaminant Limits**						
		PEL-TWA*		PEL-STEL[a]		PEL-CEILING		Skin
Substance	CAS No.[b]	ppm[c]	mg/m[3d]	ppm[c]	mg/m[3d]	ppm[c]	desig-nation mg/m[3d]	
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						
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 HN_3)		-	-	-	-	0.1	-	X
(as NaN_3)		-	-	-	-	-	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	-
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)	9014-01-1	-	-	-	0.00006 (60 min)[j]	-	-	
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	-	-	-

TABLE 202-1 Limits for Air Contaminants[1] (Continued)

Substance	CAS No.[b]	Air Contaminant Limits** PEL-TWA* ppm[c]	PEL-TWA* mg/m³[d]	PEL-STEL[a] ppm[c]	PEL-STEL[a] mg/m³[d]	PEL-CEILING ppm[c]	PEL-CEILING desig-nation mg/m³[d]	Skin
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	-	-	-	-	-
Systox[R]		see Demeton						
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						
Tetrachloronaphthalene	1335-88-2	-	2	-	4	-	-	X
Tetraethyl lead (as Pb)	78-00-2	-	0.075[k]	-	0.3[k]	-	-	X
Tetrahydrofuran	109-99-9	200	590	250	735	-	-	-
Tetramethyl lead, (as Pb)	75-74-1	-	0.075[k]	-	0.5[k]	-	-	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	-	-	-	-	-

TABLE 202-1 Limits for Air Contaminants[1] (Continued)

Substance	CAS No.[b]	Air Contaminant Limits** PEL-TWA* ppm[c]	PEL-TWA* mg/m³[d]	PEL-STEL[a] ppm[c]	PEL-STEL[a] mg/m³[d]	PEL-CEILING ppm[c]	PEL-CEILING designation mg/m³[d]	Skin
Tin, inorganic compounds (except oxides) (as Sn)	7440-31-5	-	2	-	4	-	-	-
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	-	-	-
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[1] (Continued)

Substance	CAS No.[b]	Air Contaminant Limits** PEL-TWA* ppm[c]	PEL-TWA* mg/m[3d]	PEL-STEL[a] ppm[c]	PEL-STEL[a] mg/m[3d]	PEL-CEILING ppm[c]	PEL-CEILING designation mg/m[3d]	Skin
Vanadium	1314-62-1							
Respirable dust (as V_2O_5)		-	0.05	-	-	-	-	-
Fume (as V_2O_5)		-	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	-	-	-	-	-
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 CrO_3)	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 25^{o}C and 760 torr.

d. Mg/m^{3} are 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 PEL-TWA 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/m^3.

TABLE 202-2

Material	Industry Segments	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/m^3-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)

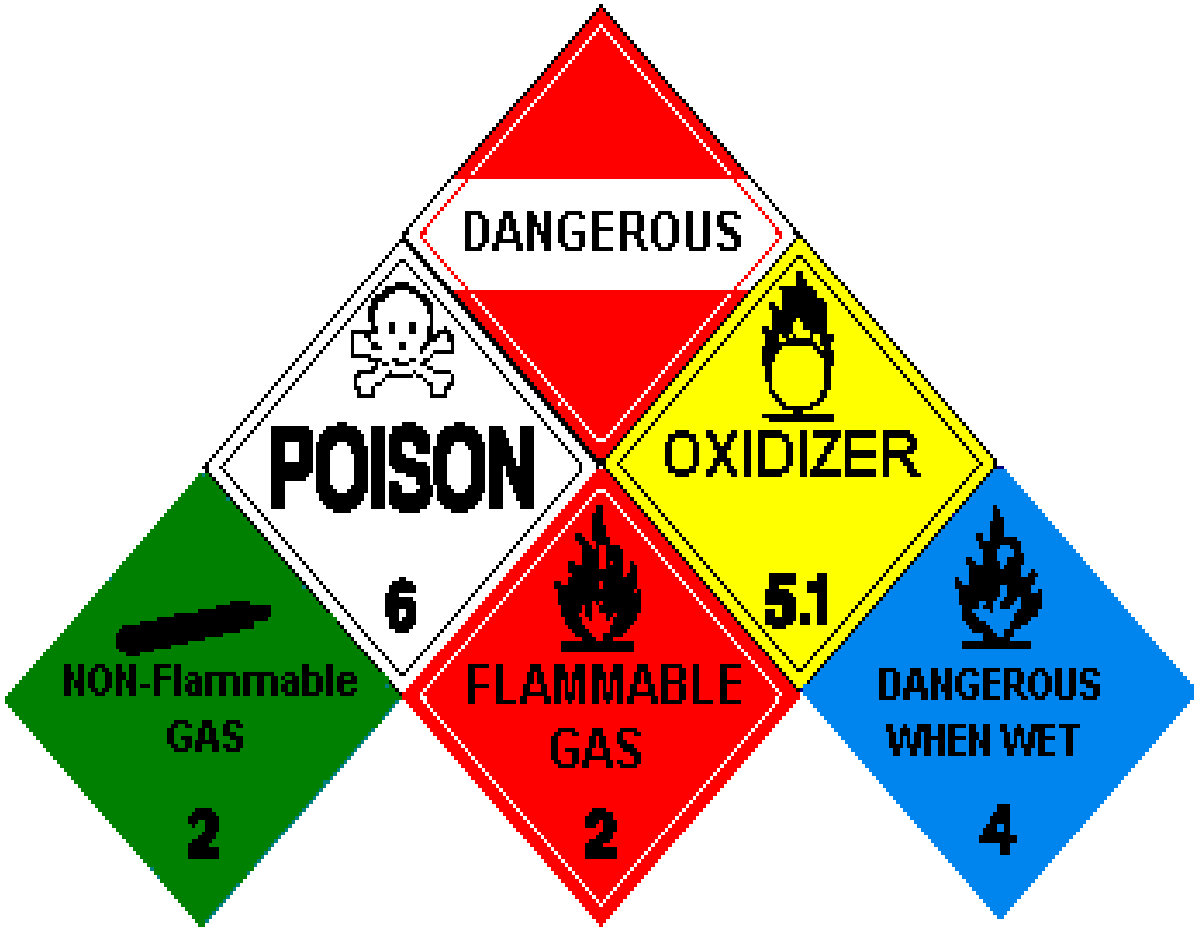
§12-202-11 REPEALED. [Eff. 7/12/82; am 6/16/84; am 8/5/88; am 3/22/91; R 12/29/00] (Auth: HRS §396-4) (Imp: HRS §396-4)

§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 HAWAII AT MANOA



Hazardous Material Management Program

October 2002

UNIVERSITY OF HAWAI'I AT MĀNOA

OFFICE OF THE CHANCELLOR

October 25, 2002

Dear Colleagues:

Providing a safe and healthy environment in which faculty, staff and students work and study is a matter of the highest priority on the Mānoa campus. Our students and employees should be able to go about their daily activities knowing that hazardous materials in our laboratories managed and are handled safely, with competence, and with utmost concern for our health and a commitment to protect our environment.

We are obligated to comply with applicable federal, state and local regulations that govern the use of hazardous materials and the disposal of hazardous wastes. To facilitate that we are following all applicable rules, and the manual detailing the Mānoa campus Hazardous Material Management Program (HMMP) has been revised and is being distributed for immediate implementation.

The manual is a definitive guide to handling hazardous materials and disposing of hazardous wastes. This is not only a matter of complying with the law-it is a matter of ensuring the personal health and safety of everyone on campus and making sure that we do whatever is necessary to maintain a safe and secure workplace and protect our environment.

We all need to be aware of our responsibilities in this area, and the HMMP has been prepared with everyone's safety in mind.

Sincerely,

Peter Englert
Chancellor
University of Hawai'i at Mānoa

2444 DOLE STREET . BACHMAN HALL . HONOLULU, HAWAI'I 96822 ▪ TEL (808) 956-7651 ▪ FAX (808) 956-275'

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ATTACHMENTS

HAZARDOUS MATERIAL MANAGEMENT PROGRAM

I. INTRODUCTION.

The following manual provides information on requirements for the management of hazardous materials, including the disposal of hazardous waste. These requirements are based on Federal and State of Hawaii regulations. Failure to comply with these requirements may subject the University and/or individuals to fines, and civil or criminal prosecution. In addition, the proper management of hazardous materials is necessary to reduce disposal costs. While the disposal of all material as hazardous waste is expensive, there are certain materials that require special attention to minimize the difficulty and expense of their disposal. A copy of this Hazardous Material Management Program along with other useful information is available online at the University's web-site (http://www.hawaii.edu/ehso/hazmat).

II. MANAGEMENT OF HAZARDOUS MATERIAL.

Compliance with the following requirements will assist the University's Environmental Health and Safety Office (EHSO) in ensuring the proper management of certain types of hazardous chemicals. Our hazardous material management strategy is divided into four parts: Approval to purchase, approval to use, inventory control, and audits.

A. Approval to Purchase Certain Hazardous Chemicals. EHSO approval is required for the purchase or requisition of the specific chemicals on the list provided on the Procurement Authorization for Hazardous Material Form, Attachment (1). This form must be filled out and submitted to EHSO for approval prior to initiating a purchase order for any of the materials on the list. If approved, a copy of the form will be provided to you for attachment to your purchase order or requisition. The purpose of EHSO approval is to enable us to assist you in ensuring the safe storage, handling and disposal of the material while minimizing cost to the University.

B. 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 hazardous materials has been developed, Attachment (2). This form is similar to those already in place for the use of radioactive and biohazardous materials.

C. Inventory of Hazardous Material. The previous hazardous material inventory form, Attachment (3), is no longer required. The requirement for this form has been deleted because of the new requirement for a total chemical inventory mandated by the Chancellor's memorandum of October 17, 2001 that is being incorporated into the University Chemical Hygiene Plan (CHP). The CHP chemical inventory will be used to provide EHSO with the information previously provided by Attachment (3). A copy of the inventory must be available at the laboratory/facility for review, but a copy does not have to be submitted to EHSO unless specifically requested. A new Attachment 3 "Sample Chemical Inventory Format" has been added and can be used to document the required chemical inventory.

D. Audit Program. EHSO has established an audit program to assist in maintaining laboratories and facilities that are safe and protective of the environment. EHSO personnel will periodically visit laboratories and facilities to review the implementation of applicable safety, health and environmental policies and requirements. Specifically, the following items will normally be covered: Use of personal protective equipment, emergency eyewashes and showers, vent hoods, hazardous material storage, survey for highly hazardous materials or acutely hazardous waste, 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.

III. HAZARDOUS WASTE DISPOSAL REQUIREMENTS. The following requirements apply to all generators of hazardous waste.

A. Mandatory Training: Initial and annual refresher training is required for hazardous waste generators. The purpose of the training is to familiarize waste generators with EPA requirements and University policies and procedures. The EHSO Environmental Training Specialist can be contacted at 956-3201 to schedule training. Principal Investigators have the primary responsibility for the storage and disposal of excess hazardous material and waste in the laboratories. They can choose to train all of the workers in the laboratory as hazardous waste generators or they can designate an individual or individuals as the trained hazardous waste generator(s) for the laboratory. At least one person in each laboratory must have current hazardous waste generator training. In addition all persons who generate waste in the laboratory must know who the designated trained hazardous waste generator is and the basic requirements for waste disposal (i.e. hazardous waste must be labeled and stored in the satellite accumulation area in a closed container and non-hazardous waste must be appropriately disposed). The Principal Investigator has the responsibility to ensure that all persons who generate waste know the basic requirements for waste disposal and that the satellite accumulation area is periodically monitored to verify that requirements are met. **EHSO will NOT pick up any hazardous material or hazardous waste unless the person who signs the material/waste turn-in form has been trained.**

B. Waste Generator Responsibilities: The following outlines waste generator responsibilities.

1. Become familiar with the hazardous materials you use and the University policies on hazardous materials and hazardous waste management.

2. Comply with waste requirements. Store and label waste properly, complete the waste turn-in form correctly.

3. Attend annual waste generator training.

4. Contact EHSO, if in doubt about the requirements or how to properly dispose of waste.

C. Establishment of a Satellite Accumulation Area: Each generator shall establish an identifiable area for the collection of waste. The area must be at or near the point of generation of the waste (i.e., in the same room or in a connecting room where the waste is being generated). Up to 55 gallons of ordinary waste or one quart of Acutely Hazardous (P-coded) Waste may be accumulated over an indefinite period of time. A list of Acutely Hazardous Wastes is provided in Attachment (4). The containers must be labeled and must be closed except when waste is being added to them. If the 55 gallon or one quart limit is reached, you must contact EHSO immediately. The satellite accumulation area should be neat and orderly, containers should not be stacked upon one another or containers of liquid should not be stored on their side.

D. Waste Containers: Containers used for wastes must be in good condition (i.e. not rusting, without 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 material composition must be compatible with the material to be stored and incompatible materials must not be stored in the same container.

E. Labeling: All waste material shall be labeled with the word "waste" and the chemical name(s) of the waste (e.g., "waste methyl alcohol" or "waste ethidium bromide"). Generic names can be used if a separate list is maintained to indicate the chemical names and the approximate amounts (e.g., "waste chlorinated solvent bottle no 1" with a separate list "Bottle no. 1 Chloroform 50%, Methyl Chloroform 40%, Methylene Chloride 10%"). Chemicals which are unused or only partially used, in original containers and which cannot be used by others in the department, do not have to be labeled as waste: the manufacturers label or a label giving the chemical name and specific hazards (e.g., flammable, corrosive or poison) is acceptable. The name of the chemical and other required data are entered on the Hazardous Material and Hazardous Waste Turn-in Form.

F. Secondary Containments. Secondary containments are required for containers of liquid waste under the following circumstances:

1. When the waste is stored in 55-gallon drums.

2. When the waste is stored on the floor.

3. When the waste is stored in a hood which has a drain.

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

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

Plastic tubs can be used as secondary containments. EHSO should be consulted about secondary containments for 55-gallon drums.

G. Hazardous Material and Hazardous Waste Turn In Form. This form, Attachment (5), is necessary to comply with EPA regulations. It will provide the University with a permanent auditable record of the excess material and hazardous waste generated. Instructions for completing the form and an explanation of the entries are also provided in Attachment (5).

H. Hazardous Waste Disposal Costs. The cost of hazardous waste disposal for the Manoa Campus is borne by the Environmental Health and Safety Office with no charge to the generator of the waste, except for the following:

1. **Unknown Waste**. A charge of $70 for each container of unknown waste is made to cover the cost of analysis. Waste cannot be legally disposed of unless it has been identified.

2. **Radioactive Mixed Waste**. Wastes which are both naturally radioactive (e.g., Uranium or Thorium compounds) and a regulated waste (e.g., nitrates or flammable solvents), are very expensive to dispose. In the past the cost of 10 pounds of radioactive mixed waste was $30,000. Reimbursement of EHSO disposal costs will be charged to the department generating the waste.

3. **Compressed Gas Cylinders**. Compressed gas cylinders that are not empty or which contain unknown gases present difficult and expensive disposal problems. One lecture bottle sized cylinder can cost $500 to dispose and cylinders whose contents are unknown can cost as much as $5,000 for disposal. Reimbursement of EHSO disposal costs will be charged to the department generating the waste.

4. **Dioxin or Dioxin Contaminated Materials**. Materials containing Dioxin (dibenzodioxins or dibenzofurans) must be disposed at one approved site on the Mainland which is only infrequently open or exported to a disposal site in Canada. This involves substantial cost, approximately $1,000 per pound and special permits. Reimbursement of EHSO disposal costs will be charged to the department generating the waste.

I. Emergency Plans for Spills. A specific plan and training in the plan is needed for the chemicals you will be using. It is a good idea to post the emergency procedures and emergency phone numbers in the work area. Personnel working with hazardous chemicals should be able to answer the question: **"What would I do if this material spilled?"** Spill kits with instructions, adsorbents, reactants, and protective equipment should 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 spills.

1. Attend to anyone who may have been contaminated or hurt, if it can be done without endangering yourself.

2. Ensure that the fume hood(s) is on and open windows where it can be done without endangering yourself. If flammable materials are spilled, de-energize electrical devices if it can be done without endangering yourself.

3. If the spill is major, contact Campus Security (x66911) and the EHSO (x63201 or x63198). If the spill is minor, clean up can be performed as follows:

    a. Ensure protective apparel is resistant to the spilled material. Neutralize acids and bases, if possible using neutralizing agents such as sodium carbonate or sodium bisulfate.

    b. Control the spread of liquids by containing the spill.

    c. 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. If you have any questions regarding spill clean up requirements, please contact EHSO at x63201 or x63198.

    d. Collect and contain the cleanup residues by scooping it into a plastic bucket or other appropriate container and properly dispose of the waste as hazardous waste.

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

    f. 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.

J. Specific Information on the Disposal of Various Materials. The individual possessing or generating the material retains the primary legal responsibility for the material. EHSO provides information on requirements and assistance in handling the materials. Specific information on various types of materials is given below.

1. **BATTERIES:** EHSO will accept for disposal lithium, nickel/cadmium or mercury batteries. EHSO will NOT accept vehicle (lead/acid) or alkaline/carbon-zinc (flashlight, "C", "D", "AA") batteries for disposal. Vehicle batteries are recyclable and arrangements with local vendors can be made. Interstate Battery Systems of Hawaii, 94-110 Leokane St. (676-6000) accepts up to 20 car or other lead acid batteries for disposal/recycling free. Disposal of batteries from University vehicles is handled by Transportation Services. Under current Honolulu City and County

regulations Alkaline or Carbon-Zinc batteries can be disposed of as ordinary trash.

2. **BIOLOGICAL MATERIALS**: For biohazardous wastes, refer to the published University biohazardous waste disposal guidelines or contact the EHSO Biological Safety Officer (x63197) for information concerning the handling and disposal of biological materials.

3. **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.

4. **CONTROLLED SUBSTANCE**S: 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. EHSO cannot accept controlled substances for disposal.

5. **FLUORESCENT LIGHT BALLASTS**: The Facilities Planning and Management Office (FPMO) removes non-leaking ballasts. Ballasts that contained PCBs are believed to have already been removed from University light fixtures. Contact EHSO (x63198) for assistance concerning leaking ballasts or any known to contain PCBs.

6. **FLUORESCENT LIGHT TUBES**: FPMO removes and disposes of fluorescent light tubes. Contact Work Coordination (x67134) for assistance.

7. **HAZARDOUS CHEMICALS AND HAZARDOUS WASTE**: EHSO (x63202) will pick- up excess hazardous chemicals and hazardous chemical waste. Efforts should be made to determine if excess hazardous chemicals can be used by others in the department or facility prior to contacting EHSO for pickup. Chemicals considered non-hazardous waste can be disposed of in the municipal sanitary landfill or sanitary sewer under certain conditions (see "Non-Hazardous Waste" below). The completion of a hazardous material and hazardous waste turn in form is required for material/waste pickup by EHSO. A copy of this form is included as Attachment (5). It can be duplicated or additional copies can be obtained by contacting EHSO. The following rules must be complied with for us to pickup your material.

    a. YOU MUST HAVE ATTENDED THE HAZARDOUS WASTE GENERATOR CLASS (initial and annual refresher). We cannot pickup waste from persons who do not have current training.

    b. YOU MUST HAVE SUBMITTED A COPY OF A HAZARDOUS MATERIAL & HAZARDOUS WASTE TURN-IN FORM IN ADVANCE TO EHSO FOR OUR REVIEW AND APPROVAL (fax 956-3205 attn: Hazardous Material Management Officer). Upon approval, a mutually convenient time for pickup

will be arranged.

c. BE SURE EACH CHEMICAL CONTAINER IS PROPERLY LABELED Labels should clearly identify contents with a chemical name (i.e. no abbreviations or chemical formulas).

d. PACKAGE MATERIALS IN STURDY CARDBOARD BOXES OR PLASTIC WASTE CONTAINERS, AVAILABLE FROM EHSO. ORIGINAL CONTAINERS FOR QUANTITIES GREATER THAN 5 GALLONS OR 55-GALLON WASTE DRUMS ARE ACCEPTABLE. Cushion the material in the containers to prevent breakage. If cardboard boxes are used which originally held 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 regulation violation.

e. REPACKAGE BROKEN OR LEAKING CONTAINERS INTO NON-LEAKING CONTAINERS PRIOR TO PICKUP.

f. SEPARATE INCOMPATIBLE MATERIALS. Incompatible materials shall be segregated in separate boxes. 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 packaged separately regardless of quantity.

If you have any questions on the proper disposal of hazardous materials or wastes, contact EHSO at (x63201 or x63198).

8. **MERCURY**: EHSO will accept for disposal items containing functional mercury (e.g. light switches, barometers and thermometers).

9. **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 Radiation Safety Officer (x66475) or Biological Safety Officer (x63197) as applicable for assistance in the proper disposal of these materials.

10. **NON-HAZARDOUS WASTE**: Listed in Table 1 below are typical laboratory chemicals which are not considered hazardous wastes by the U.S. Environmental Protection Agency. If solid and in plastic containers, 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. If solid and in glass or metal containers the material would have to be transferred to plastic containers, labeled and marked "non-hazardous". This is necessary as the refuse contract does not permit the collection of metal or glass containers unless they are empty. As an alternative, all non-hazardous solid

chemicals can be turned in to EHSO for disposal using the turn-in form. If liquid chemicals or chemical solutions can only be disposed of to the sanitary sewer (i.e. "down the drain") if they are within the scope of the University's Industrial Wastewater Discharge Permit. The paragraph below provides general requirements and Table 2 below provides a list of materials that can be disposed of to the sanitary sewer. Contact EHSO (X63198) if you have chemicals that you believe may be non-hazardous for a determination as to whether they must be turned in to EHSO for disposal or 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

The following general requirements must be met for all waste to be disposed of in the sanitary sewer. The waste must meet both the general requirements and be listed in Table 2 or have specific written permission from EHSO (Hazardous Material Management Officer). The solution must have a pH between 5.5 and 9.5. No viscous solutions or solutions containing oil are permitted. No solutions at a temperature of greater than 40 degrees Centigrade are permitted. No solutions containing ashes, cinders, sand, mud, straw, shavings, metal powder, glass, rags, feathers, tar, plastics, wood, or paper are permitted.

TABLE 2: Drain Disposal Restrictions

Ethidium Bromide Solutions: <0.01% by weight and < 2 quarts per day per laboratory.
Phosphate Buffer Solutions: <10% by weight and < 1 quart per day per laboratory
Salt Solutions: <10% by weight (sodium, potassium, lithium, ammonium: chlorides, carbonates, phosphates, sulfates, or acetates) < 2 quarts per day per laboratory.
Dyes or Stains: Small amounts of from slides as part of laboratory experiments.
Alcohol Solutions (methyl, ethyl, isopropyl only): < 10% by volume and < 1 quart per day per laboratory.
Dilute formaldehyde Solutions: < 3% by weight and < 1 quart per day per laboratory.
Sugar Solutions: < 10% by weight and <2 quarts per day per laboratory
Amino Acids and their Salts in solution: <10% by weight and <2 quarts per day per laboratory.
Citric and Lactic Acids and their Salts in solution: <10% by weight and <1 quart per day per laboratory.

NOTE: The percentage by weight or volume refers to a total of the items in any category. For example a solution of 5 % sodium chloride and 5 % potassium chloride would meet the limit while a solution of 10% sodium chloride and 5 % potassium chloride would not. Similarly, a solution of 10% ethyl alcohol and 5% methyl alcohol would not meet the criteria for drain disposal. A solution of 10% ethyl alcohol and 10% sodium chloride would meet the criteria as they are in different categories, but the volume permitted per day would be the lower of the two.

11. **OILS AND TRANSFORMER FLUID**: EHSO will accept waste pump oil. EHSO will NOT accept used motor oil. Used motor oil is recyclable through local vendors. Used motor oil from University vehicles is handled by Transportation Services. Transformer fluid will be handled on a case by case basis, contact EHSO (x63198) for assistance.

12. **RADIOACTIVE MATERIALS**: Refer to the University Radiation Safety Manual or contact the EHSO Radiation Safety Officer (x66475) for information concerning the proper handling and disposal of radioactive material.

13. **SHARPS AND GLASSWARE**: Glassware not contaminated with radiological,

biological or hazardous chemical material shall be placed in a puncture resistant container labeled "glass" or "broken glass". It will be picked up by the custodial staff and disposed of. Refer to the published University biohazardous waste disposal guidelines or contact the EHSO Biological Safety Officer (x63197) for information on the handling and disposal of sharps or glassware contaminated with biological or infectious material. Refer to the University Radiation Safety Manual or contact the EHSO Radiation Safety Officer (x66475) for information on the proper handling and disposal of sharps or glassware contaminated with radioactive material. Glassware or sharps contaminated with hazardous chemicals should be rinsed to decontaminate them and then disposed of as non-contaminated glassware or sharps (i.e. placed in a sharps container). Broken glassware contaminated with hazardous chemicals should be placed in a puncture resistant container (e.g. bottle, plastic container or can overpack), labeled with the name of the chemical and disposed of as hazardous chemical waste.

K. Abandoned Waste. Abandoned waste should not occur, as the abandonment of waste is a violation of the HMMP. In the event that abandoned waste is discovered, the following policy will be implemented.

1. If the waste material is in a building or adjacent to a building such that it can be assumed that the waste came from the building, then the Department/School/College occupying the building is responsible for the disposal of the waste material in accordance with the HMMP.

2. If the waste material is in an area such that it is not easily identifiable as having come from a building (e.g., the material is in a dumpster or parking lot), or if a chemical spill is involved, then EHSO will respond and dispose of the material as abandoned waste in accordance with the HMMP.

IV. HAZARDOUS WASTE MINIMIZATION

A. Buying Chemicals in Smaller Amounts. The "large economy size" may cost less to buy, but disposal costs, in most cases, are several times the initial cost of the material. Many of the bottles of excess or waste chemicals turned in are full or 3/4 full. Everyone needs to accurately estimate the amount of chemicals they expect to use.

B. Recycling and Redistribution. As described in the hazardous material control and hazardous waste program above, efforts are to be made to find someone in the laboratory or department who could use the hazardous material before it is turned in to EHSO as excess or waste. EHSO encourages the redistribution and exchange of surplus chemical products within the UH system as an alternative to disposal as waste. Information on the chemical exchange program and the UH electronic swap meet can be found online at www.hawaii.edu/ehso/hazmat and www.hawaii.edu/swapmeet. If no qualified user can be found then the material will be disposed of as hazardous waste. This program will reduce waste generation and save the University waste disposal costs.

C. Use of Less Hazardous or Non-hazardous Materials. The following provides some examples of the use of less hazardous or non-hazardous materials; everyone is encouraged to seek other alternatives to hazardous materials 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:

    a. 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 waste unless it can be reacted and neutralized.

b. 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.

c. Water Reactive Chemicals, (materials such as sodium metal, potassium metal, calcium metal, calcium carbide, calcium hydride, lithium hydride, lithium aluminum hydride, sodium hydride and potassium hydride) are not recommended for use as general purpose drying agents because they form flammable gases on contact with water and are both dangerous and expensive to dispose of. Small amounts of these materials can be safely disposed of by reacting them with water under controlled conditions by knowledgeable personnel to create non-hazardous or less hazardous materials. If a bottle of solvent contains a water reactive drying agent, this information must be clearly marked on the bottle. This is necessary for the safety of personnel handling the material during disposal.

3. Thermometers: Mercury thermometers should be replaced with non-mercury thermometers whenever possible. Broken mercury thermometers create spills that are a potential health hazard, time consuming to clean up, and are one of the most expensive hazardous wastes we handle. Non mercury thermometers with equivalent accuracy are available for temperature ranges of -20 to 250 degrees Centigrade. Contact EHSO 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.

D. Conversion to Non-hazardous Material. As part of instruction or research operations, hazardous materials can be converted into non-hazardous wastes The neutralization of acids or bases is an example of this. Experiments can be designed to convert residual or produced hazardous materials into non-hazardous wastes. In some cases this can have instructional value as well as reducing the amount of hazardous waste and its disposal cost.

UNIVERSITY OF HAWAII AT MANOA
PROCUREMENT AUTHORIZATION FOR HAZARDOUS MATERIALS

An approved (signed) copy of this form must accompany any purchase order or requisition for the procurement of the hazardous materials listed on page two of this form.
****

NAME: _____
(Principal Investigator)

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

LOCATION: _____
(Where chemical will be used)

Chemical Name	Solid/liquid/gas	Amount

Signature of Principal Investigator:_____ **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.
****

FOR EHSO USE ONLY

EHSO APPROVAL:_____ Date:_____
(Hazardous Materials Management Officer)

APPROVAL NO._____

9/19/02

LIST OF CHEMICALS REQUIRING ENVIRONMENTAL HEALTH & SAFETY OFFICE (EHSO) APPROVAL TO PURCHASE

Because the following chemicals are highly toxic, explosive , water reactive or for other reasons very difficult and expensive to dispose of (disposal costs can be more than $1000 per container) their use needs to be minimized and monitored. Contact Tim O'Callaghan, at EHSO (956-3198) for further information.

Arsine
Boron Trichloride
Boron Trifluoride
Bromine Chloride
Butyl Lithium
Carbon Monoxide
Carbonyl Sulfide
Cesium
Calcium Hydride
Chlorine
Chlorine Trifluoride
Chloropicrin
Cyanogen
Cyanogen Chloride
Diborane
3,5-Dinitrophenol
2,4-Dinitrophenylhydrazine
3,5-Dinitrosalicylic Acid
Ethylene Oxide
Fluorine
Hydrogen Bromide
Hydrogen Chloride
Hydrogen Cyanide
Hydrogen Fluoride
Hydrogen Sulfide
Lithium
Lithium Aluminum Hydride
Lithium Hydride
Methyl Amine
Methyl Bromide
Methyl Chloride
Methyl Lithium
Nitric Oxide
Nitrogen Dioxide
Nitrogen Trifluoride
Phosgene
Phosphine
Phosphorus
Picfume
Picric Acid
Picryl Sulfonic Acid
Picramide
Potassium
Rubidium
Silane
Silane Dichloride
Sodium
Sulfur Dioxide
Trinitroaniline
Trinitrobenzene
Trinitrocresol
Trinitronapthalene
Trinitrophenol
Trinitrotoluene
Urea Nitrate
Vinyl Chloride

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 50 mg/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.

---------- ----------
PRINCIPAL INVESTIGATOR **DATE**

---------- ----------
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.

---------- ----------
HAZARDOUS MATERIALS MANAGEMENT OFFICER **DATE**

SPECIAL REQUIREMENTS:

ATTACHMENT 3

SAMPLE CHEMICAL INVENTORY FORMAT

Lab Room Number :_____

PI's Name :_____ **Date Completed:**_____

Chemical Name	CAS #	AMOUNT	HAZARD CLASS	Location

ATTACHMENT 4

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 Waste No.	Chemical Abstracts No.	Chemical Name
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
P007	2763-96-4	5-(Aminomethyl)-3-isoxazolol
P008	504-24-5	4-Aminopyridine
P009	131-74-8	Ammonium Picrate
P119	7803-55-6	Ammonium Vanadate

Hazardous Waste No.	Chemical Abstracts No.	Chemical Name
P099	506-61-6	Argintate (1-), bis(cyano-C-), potassium
P010	7778-39-4	Arsenic acid (H3AsO4)
P012	1327-53-3	Arsenic oxide (As2O3)
P011	1303-28-2	Arsenic oxide (As2O5)
P011	1303-28-2	Arsenic pentoxide
P012	1327-53-3	Arsenic trioxide
P038	692-42-2	Arsine, diethyl-
P036	696-28-8	Arsenous dichloride, phenyl-
P054	151-56-4	Aziridine
P067	75-55-8	Aziridine, 2-methyl-
P013	542-62-1	Barium cyanide
P024	106-47-8	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]-
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	7740-47-7	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
P189	55285-14-8	Carbamic acid, [(dibutylamino)-thio]methyl-,2,3-dihydro-2,2-dimethyl-7-benzofuranyl ester
P191	644-64-4	Carbamic acid, dimethyl-, 1-[(diemthylamino)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

Hazardous Waste No.	Chemical Abstracts No.	Chemical Name
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 (202CuCN)
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 (CNCl)
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)-
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)-
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,6aalpha, 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,6abeta,7 beta,7aalpha)-, & metabolites
P044	60-51-5	Dimethoate
P046	122-09-8	alpha,alpha-Dimethylphenethylamine
P191	644-64-4	Dimetilan

Hazardous Waste No.	Chemical Abstracts No.	Chemical Name
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	298-0404	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, & 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, mercuric salt
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')-

Hazardous Waste No.	Chemical Abstracts No.	Chemical Name
P196	15339-36-3	Manganese dimethyldithiocarbamate
P092	62-38-4	Mercury, (acetato-O)phenyl-
P065	628-86-4	Mercury fulminate
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-
P118	75-70-7	Methanethiol, trichloro-
P198	23422-53-9	Methanimidamide, N,N-diemthyl-N'-{3-[[(methylamino)-carbonyl]oxy]-phenyl}-, monohydrochloride
P197	17702-57-7	Methanimidamide, N,N-dimethyl-N'-{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-oxide
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	315-08-4	Mexacarbate
P072	86-88-4	alpha-Naphthylthiourea
P073	13463-39-3	Nickel carbonyl (NiCO)
P074	557-19-7	Nickel cyanide (NiCN)
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 (NO2)
P081	55-63-0	Nitroglycerine
P082	62-75-9	N-Nitrosodimethylamine
P084	4549-40-0	N-Nitrosomethylvinylamine
P085	152-16-9	Octamethylpyrophosphoramide
P087	20816-12-0	Osmium Tetroxide (OsO4)

Hazardous Waste No.	Chemical Abstracts No.	Chemical Name
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
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)-, methylcarbamate
P201	2631-37-0	Phenol, 3-methyl-5-(1-methylethyl)-, methylcarbamate
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
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 (KCN)

Hazardous Waste No.	Chemical Abstracts No.	Chemical Name
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
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 (thallous) salt
P103	630-10-4	Selenourea
P104	506-64-9	Silver cyanide (AgCN)
P105	26628-22-8	Sodium azide
P106	143-33-9	Sodium cyanide (NaCN)
P108	57-24-9	Strychnidin-10-one, & salts
P018	357-57-3	Strychnidin-10-one, 2,3-dimethoxy-
P108	57-24-5	Strychnine & salts
P115	7446-18-6	Sulfuric acid, dithallium (thallous) salt
P109	3689-24-5	Tetraethyldithiopyrophosphate
P110	78-00-2	Tetraethyl lead
P111	107-49-3	Tetraethyl pyrophosphate
P112	509-14-8	Tetranitromethane
P062	757-58-4	Tetraphosphoric acid, hexaethyl ester
P113	1314-32-5	Thallic oxide
P113	1314-32-5	Thallium oxide (Tl2O3)
P114	12039-52-0	Thallium (I) selenite (thallous selenite)
P115	7446-18-6	Thallium (I) sulfate (thallous sulfate)

Hazardous Waste No.	Chemical Abstracts No.	Chemical Name
P109	3689-24-5	Thiodiphosphoric acid, tetraethyl ester
P045	39196-18-4	Thiofanox
P049	541-53-7	Thioimidodicarbonic diamide (H2NCS)2NH
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 (V2O5) 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')-,
P121	557-21-1	Zinc cyanide [Zn (CN)2]
P122	1314-84-7	Zinc phosphide (Zn3P2) when in concentrations greater than 10%
P205	137-30-4	Ziram

Excess Hazardous Materials and Hazardous Waste Turn in Form

This form is to be used for the turn in of excess hazardous materials or hazardous waste to the Environmental Health and Safety Office (EHSO) for reuse or disposal. Please refer to the Hazardous Materials Management Program requirements for information on the types of materials accepted and the proper disposition of other materials. This form can be duplicated as necessary. See the attached sheet for information on completing the form. The completed form can be submitted by fax to EHSO at 956-3205.

Dept/Org:_____ Date:_____

Name:_____ Phone:_____

Location:_____ Page:___of___

List of Materials:

* Item No#	Chemical Name	Quantity	** Physical State	For EHSO Use

*Item No# = List the Item Number and mark the individual containers with the same Item Number.
**Physical state = S (Solid), L (Liquid), G (Gas/Aerosol)

* Item No#	Chemical Name	Quantity	** Physical State	For EHSO Use

Generator Certification: I Certify that the information provided is complete and accurately describes, to the best of my knowledge, the material to be turned in;

_____ _____

Signature Date

EHSO Approval:_____ _____

Hazardous Materials Management Officer Date

Material Acceptance: The material submitted for turn in has been inspected and determined to match the list above and is labeled and packed in accordance with University Hazardous Materials Control and Hazardous Waste Disposal requirements.

_____

EHSO Representative Date

9/20/2002

EXCESS HAZARDOUS MATERIAL AND HAZARDOUS WASTE TURN IN FORM

Name:_____ **Page:**_____ **of**_____

* Item No#	CHEMICAL NAME	Quantity	** Physical State	For EHSO Use

*Item No# = List the Item Number and mark the individual containers with the same Item Number.
**Physical State = S (Solid), L (Liquid), G (Gas/Aerosol)

9/20/2002

LINE BY LINE INSTRUCTIONS FOR FILLING OUT THE EHSO EXCESS HAZARDOUS MATERIAL AND HAZARDOUS WASTE TURN IN FORM

Department/Organization: The source of the material (e.g. Chemistry, Engineering, Botany, and Cancer Center of Hawaii, Hawaii Institute of Marine Biology)

Date: Today's date.

Name: Name of the generator who signs the form must appear here. Additional names can be listed as necessary. For example, John Smith, contact Harry Brown for Pick-up.

Phone No: Telephone number of contact person.

Location: Location where material can be picked up (e.g. Bilger 214 or Look Laboratory)

List of Materials: Each material is to be listed on a separate line. This information is critical for us to properly handle and dispose of the material. Unknowns are extremely difficult and expensive to dispose of. Try to identify the material in a broad category such as "unknown acid" or "unknown flammable solvent". If the material is truly unknown write "unknown" in the Chemical Name space on the form. Note; your department will be charged $70 for each container of unknown material.

Chemical Name: This is the name on the container label. Do not use chemical formulas or abbreviations. If the material is not pure then the concentration should be given (e.g. 10% hydrogen peroxide solution, Acid waste: 2 Molar hydrochloric acid, waste solvent: 60% isopropyl alcohol, 40% acetone.) The more information that you can supply, the easier and less expensive it will be for us to handle the material. Also, when you list ten (10) or more items list each item with a number and also mark the corresponding number on the container. This will assist EHSO in matching the items to the list when we pickup the items and pack for disposal.

Quantity: Indicate the approximate amount in pounds for solids and gallons for liquids. For items less than 0.01 pound (4.5 grams) report 0.01 pounds. For items less than 0.01 gallons (40 ml or 1.3 ounces) report 0.01 gallons.

Physical State: This identifies the type of material (solid, liquid, gas/aerosol) and is important as the hazard class or EPA waste code may depend on the physical state of the material. Use "S" for solids, "L" for liquids and "G" for gases or aerosols.

For EHSO Use: EHSO uses this space to record the DOT hazard class and the EPA waste code for the material.

Generator Certification: A person currently trained as a hazardous waste generator must sign the form. This signature acknowledges your responsibility for the material.

EHSO Approval: The Hazardous Materials Management Officer (HMMO) will review the form for completeness and conformance with the regulations. If there are any problems or questions, the HMMO will contact the generator. Upon approval of the form by the HMMO the generator will be contacted and a mutually convenient time for pickup of the material will be arranged by EHSO.

Material Acceptance: EHSO personnel will inspect the material, prior to accepting it. Any material that does not match the material on the approved form or that does not conform to the requirements for labeling, packaging and container condition will not be accepted. The EHSO Representative signature verifies that the generator has complied with the applicable requirements.

If you have any questions on the proper disposal of materials or on the form, please contact EHSO (63202 or 63198).

9/11/2002

Weight and Volume Conversion Table

The following tables are provided for convenience to those using the waste turn in form. Numbers are approximations and have been rounded off.

1. Weights: grams to pounds 1 gram = 0.0022 pounds

<5 grams.....0.01 pounds (per instructions all weights less than 5 grams or 0.01 pounds are to be reported as 0.01 pounds)

5	grams.....0.01 lbs.	10	grams..... 0.02 lbs.
20	grams..... 0.04 lbs.	30	grams..... 0.07 lbs.
40	grams..... 0.09 lbs.	50	grams..... 0.11 lbs.
100	grams..... 0.22 lbs.	500	grams..... 1.10 lbs.

2. Volumes: liters to gallons 1 liter = 0.2642 gallons

≤ 40 ml.....… 0.01 (per instructions volumes ≤ 40 ml are reported as 0.01 gal.)

50	ml..... 0.01 gal	60	ml.....….... 0.02 gal
100	ml..... 0.03 gal	150	ml.…..... 0.04 gal
200	ml..... 0.05 gal	300	ml.....… 0.08 gal
400	ml ..... 0.11 gal	500	ml.....…. 0.13 gal
600	ml..... 0.16 gal	700	ml.....….. 0.18 gal
800	ml.…..… 0.21 gal	900	ml.…..... 0.24 gal
1.0	liter.....……0.26 gal	1.5	liters.……0.40 gal
2.0	liters..……0.53 gal	2.5	liters.……0.66 gal
3.0	liters.……..0.79 gal	4.0	liters.....….1.06 gal

0.5 pints (8 oz)…..0.06 gallons

1.0 pint (16 oz)… 0.13 gallons

1.0 quart (32 oz)... 0.25 gallons

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

UNIVERSITY OF HAWAII AT MANOA

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.

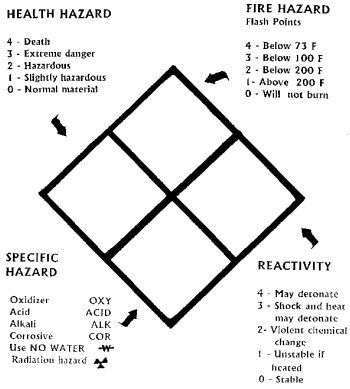
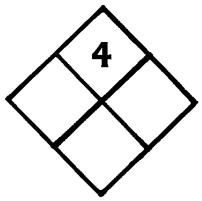
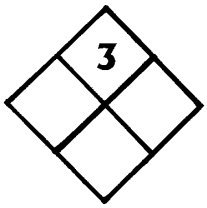
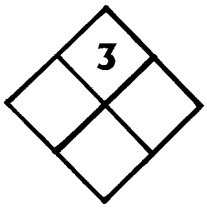
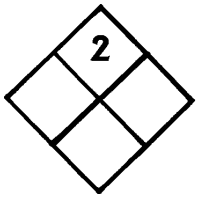
2 Transfer of flammable liquids from 5 gallon containers (or less) to smaller containers shall be done in a laboratory fume hood or in an approved flammable liquid storage room.

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
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
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
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
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
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

UNIVERSITY OF HAWAII AT MANOA

REPRODUCTIVE TOXICANTS
CHEMICAL NAME and CAS NUMBER

Acetohydroxamic acid.....546883

Actinomycin D.....50760

All-trans retinoic acid.....302794

Alprazolamm.....8981977

Amikacin sulfate.....3983555

Aminoglutethimide.....125848

Aminoglyosides.....-----

Aminopterin.....54626

Angiotensin converting enzyme (ACE inhibitors).....-----

Anisindione.....117373

Aspirin.....50782

Barbiturates.....-----

Benomyl.....17804352

Benzphetamine hydorchloride.....5411223

Benzodiazepines.....-----

Bischloroethyl nitrosurea (BCNU) (carmustine).....154938

Bromoxynil.....1689845

Butabarbital sodium.....143817

1,4-Butanediol dimethylsulfonate (busulfan).....55981

Carbon disulfide.....75150

Carbon monoxide.....630080

Carboplatin.....41575944

Chenodiol.....474259

Chlorcyclizine hydrochloride.....1620219

Clorambucil.....305033

Chlordecone (kepone).....143500

Chlordiazepoxide.....58253

Chlordiazepoxide hydorchloride.....438415

1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea (CCNU).....13010474

Clomiphene citrate.....50419

Chlorazepate dipotassium.....57109907

Cocaine.....50362

Colchicine.....64868

Conjugated estrogens.....-----

Cyanazine.....21715462

Cycloheximide.....66819

Cyclophosphamide (anhydrous).....50180

Cyclophosphamide (hydrated).....6055192

Cyhexatin.....13121705

Cytarabine.....147944

Danazol.....17230885

Daunorubicin hydrochloride.....23541506

Demeclocycline hydrochloride (internal use).....64733

Diazepam.....439145

Fluorouracil.....51218

Fluoxymesterone.....76437

Flurazepam hydorchloride.....1172185

Flutamide.....13311847

Halazepam.....23093173

Hexachlorobenzene.....118741

Ifosfamide.....3778732

Iodine-131.....24267569

Isotretinoin.....4759482

Lead.....-----

Lithium carbonate.....554132

Lithium citrate.....919164

Lorazapam.....846491

Lovastatin.....75330755

Medroxyprogesterone acetate.....71589

Megestrol acetate.....595335

Melphalan.....148823

Menotropins.....9002680

Meprobamate.....57534

Mercaptopurine.....6112761

Methacycline hydorchloride.....3963959

Methimazole.....60560

Methotrexate.....59052

Tethotrexate sodium.....15475566

Methyl bromide.....74839

Methyl mercury.....-----

Methyltestosterone.....58184

Midazolam hydrochlorid.....59467968

Minocycline hydrochloride (internal use).....13614987

Misoprostol.....62015398

Mitoxantrone hydrochloride.....70476823

Nafgarelin acetate.....86220420

Pipobroman.....54911

Plicamycin.....18378897

Polychlorinated biphenyls.....-----

Procarbazine hydrochloride.....366701

Propylthiouracil.....51525

Ribarvirin.....36791045

Secobarbital sodium.....309433

Streptomycin sulfate.....3810740

Tamoxifen citrate.....54965241

Temazepam.....846504

Testosterone cyoionate.....846504

Testosterone enanthate.....315377

2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD).....1746016

Tetracycline (internal use).....-----

Thalidomide.....50351

Thioguanine.....154427

Tobacco smoke (primary).....-----

Tobramycin sulfate.....49842071

Toluene.....108883

Triazolam.....28911015

Trilostane.....13647353

Uracil mustard.....66751

Urofollitropin.....26995915

Valproate (valproic acid).....99661

FEMALE REPRODUCTIVE TOXICITY

Anabolic steroids.....-----

Carbon disulfide.....75150

Cocaine.....50362

Cyclophosphamide (anhydrous).....50180

Cyclophosphamide (hydrated).....6055192

Ethylene oxide.....75218

Lead.....-----

Tobacco smoke (primary).....-----

Uracil mustard.....66751

MALE REPRODUCTIVE TOXICITY

Benomyl.....17804352

Cardon disulfide.....75150

Colchicine.....64868

Cyclophosphamide (anyhdrous).....50180

Cyclophosphamide (hydrated).....6055192

1,2-Dibromo-3-chloropropane (DBCP).....96128

m-Dintrobenzene.....99650

o-Dintrobenzene.....528290

p-Dintrobenzene.....100254

Dinoseb.....88857

Ethylene glycol monoethyl ether.....110805

Ethylene glycol monomethyl ether.....109864

Lead.....-----

Nitrofurantoin.....67209

Tobacco smoke (primary).....-----

Uracil mustard.....66751

*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
Chlorocetone	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
Fluorine	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
Peracetic Acid
Perhaloate
Perborates
Percarbonates
Perchlorates
Perchloric Acid
Permanganates
Peroxides
Persulfate
Sodium Borate Perhydrate
Sulfuric Acid

APPENDIX XII

CLOSEOUT PROCEDURES AND CHECKLIST

CLOSE-OUT 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 close-out 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.

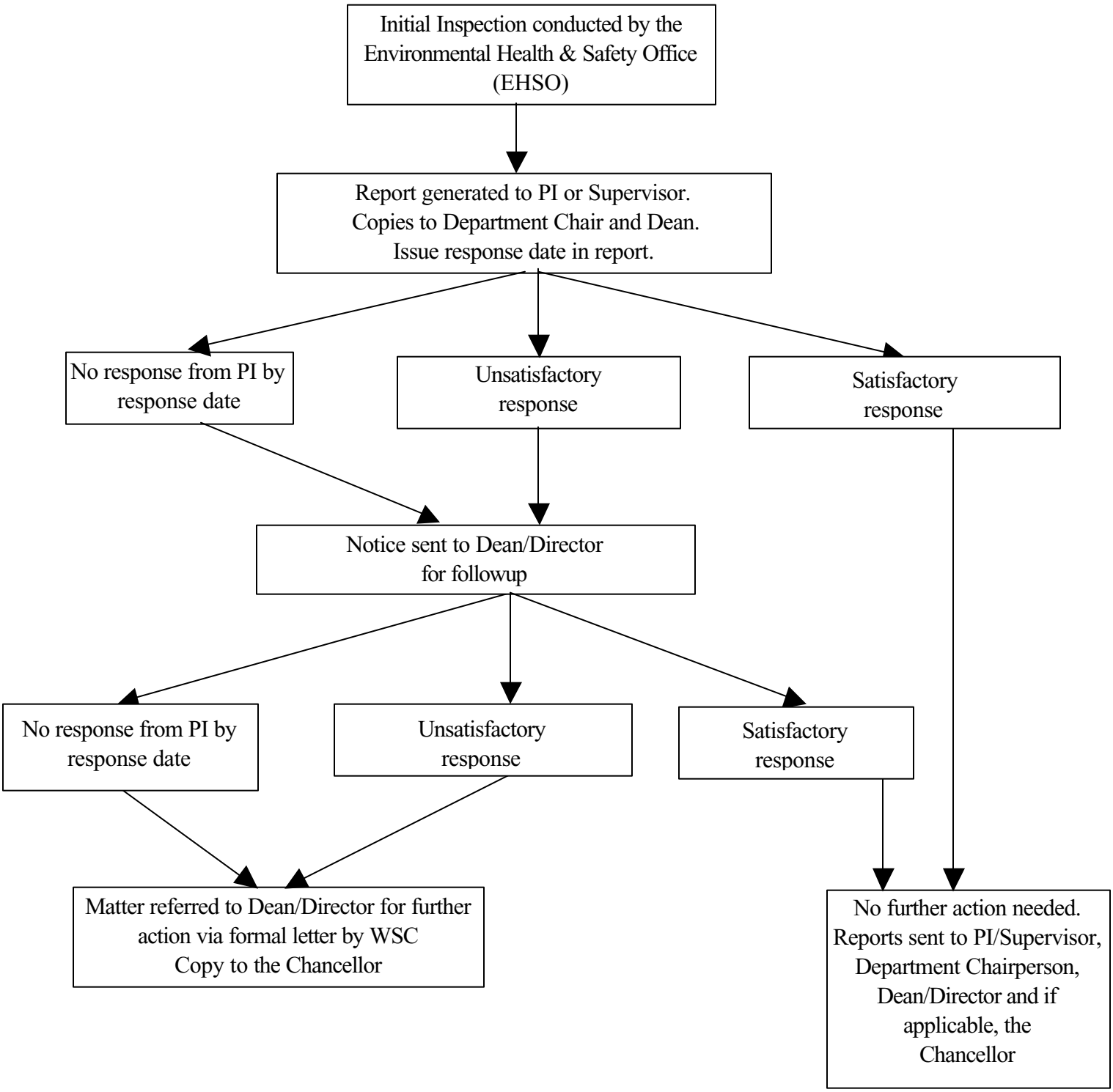
Once the response from the supervisor has been received and reviewed by the EHSO, a compliance date will be established. If the supervisor does not respond to the report, the EHSO will establish the compliance date. In either case, the supervisor will be informed about the compliance date. Once the compliance 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 <u>minor</u> 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 <u>major</u> 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 (x6-6911)

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;

UH EH&S Office	X68660
Campus Security	X66911

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.