

CHEMICAL HYGIENE PLAN TABLE OF CONTENTS

I. Introduction

A. Goals of the Chemical Hygiene Plan	3
B. Who is Covered by the Laboratory Standard	3
C. Who is NOT Covered by the Laboratory Standard	4
D. Summary of the Requirements	4

II. Responsible Chemical Hygiene Personnel

A. Goal	5
B. Key Personnel and Their Responsibilities.....	5

III. Standard Operating Procedures for Laboratories

A. Goal	6
B. General Statement	6
C. Standard Operating Procedures	6
D. Employee Exposure Determination and Monitoring	6
E. Medical Consultations & Medical Exams	7
F. Laboratory Facilities	8
G. Chemical Procurement	9
H. Hazard Identification.....	9
I. Material Handling	10
J. Lab Operations & Activities Requiring Approval	11
K. Emergency Prevention & Response.....	12
L. Waste Disposal	12
M. Information and Training	12
N. Inspections & Reviewing Chemical Hygiene Plan	13

IV. General Laboratory Safety Rules

A. Goal	14
B. Department-Specific General Rules.....	14
C. General Rules	14
D. Chemical Handling	15
E. Health & Hygiene	15
F. Food Handling	15
G. Housekeeping.....	16
H. Glassware	16
I. Flammability Hazards	16
J. Hazardous Waste Handling	16

V. Specific Exposure Control Measures

A. Goal	17
B. Criteria	17
C. Employee Exposure Control Measures... ..	19
D. Procedures For Handling Reproductive Toxins	20
E. Procedures For Handling Chemicals with High Acute Toxicity.....	20
F. Procedures for Handling Select Carcinogens... ..	21

VI. Inspection & Plan Review

A. Goal	22
B. Inspection Procedures	22
C. General Lab Ventilation	22
D. Laboratory Hoods	23
E. Review of the Chemical Hygiene Plan	24
F. Inspection and Plan Review Checklist.....	25

VII. Employee Information & Training

A. Goal	26
B. Information Requirements	26
C. Employee Training Requirements.....	26
D. Who Should be Trained	26
E. Recordkeeping	26
F. Information and Training Frequency	26
G. Employee Training Program	27

VIII. Exposure Monitoring & Medical Attention

A. Goal	27
B. Exposure Monitoring	27
C. Medical Attention	28
D. Medical Consultations & Exams	29

IX. References for Signs & Symptoms of Chemical Exposure

X. General Reference List

XI. Names & Synonyms of Carcinogens



CHEMICAL HYGIENE PLAN

I. INTRODUCTION

A. Goals of the Chemical Hygiene Plan

It is the policy of Seattle University to provide a place of employment free from recognized hazards likely to cause physical harm and that complies with all federal, state, and local laws and regulations affecting the safety and health of its employees. The Chemical Hygiene Plan addresses this goal for the laboratory workplace by including the requirements of the Washington Industrial Safety and Health Administration (WISHA) and the Occupational Safety and Health Administration (OSHA) Standard on Occupational Exposure of Hazardous Chemicals in Laboratories (WISHA's WAC 296-62-400 and OSHA's Laboratory Standard-29CFR1910.1450).

The WISHA Laboratory Standard requires that employers protect workers through the development and implementation of a Chemical Hygiene Plan containing work practices and control measures tailored to the individual laboratory workplace.

B. Who's Covered by the Laboratory Standard?

Rather than identify the specific types of laboratories that are or are not covered by the Laboratory Standard, WISHA developed applicability criteria based on the definitions of "laboratory use of hazardous chemicals" and "laboratory scale." Laboratories are defined as facilities where the "laboratory use of hazardous chemicals" occurs.

"Laboratory use of hazardous chemicals" refers to the 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.

"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. This definition excludes those workplaces whose function is to produce commercial quantities of materials.

Hazardous chemicals are those which pose a health hazard as defined in the Hazard Commu-

nication Standard (WAC 296-62-054). Health hazards include carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, and corrosives.

Employees who are to be addressed in the Chemical Hygiene Plan are individuals employed in the laboratory workplace who may be exposed to hazardous chemicals in his or her assignments. This includes employees who work in the laboratory or because of their work assignments, may be required to enter a laboratory where potential exposures may occur (e.g., maintenance or custodial personnel).

C. Who's NOT Covered by the Laboratory Standard?

The Laboratory Standard does not apply to:

- a. Uses of hazardous chemicals that do not meet the definition of "laboratory use" even if such use occurs in a laboratory; and
- b. Laboratory uses of hazardous chemicals which provide no potential for employee exposure such as 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;
- c. 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.
- d. The occasional visitor to the laboratory, such as a guest or sales person, is not included in the definition of employee and therefore does not need to be addressed in the Chemical Hygiene Plan.

D. Summary of the Requirements

The Laboratory Standard requires that covered laboratories prepare, implement, and make available to employees, a Chemical Hygiene Plan that can:

1. "Protect employees from health hazards associated with hazardous chemicals in the laboratory; and keeping laboratory employees exposures to WISHA regulated substances below the permissible exposure limits."
2. The Chemical Hygiene Plan should include:
 - a. Procedures for determining employee exposure that includes initial monitoring, periodic monitoring, and employee notification of the monitoring results;
 - b. Employee information and training to ensure that they are informed of the hazards of chemicals present in their work area(s);
 - c. Procedures for employees who work with hazardous chemicals to receive medical attention under specified circumstances;
 - d. A system for hazard identification of incoming containers of chemicals and for chemical substances developed in the lab;
 - e. Requirements for the use of proper respiratory equipment where necessary to maintain exposure below permissible exposure limits; and;
 - f. Record keeping procedures for employee exposure monitoring measurements and medical records,
3. The Chemical Hygiene Plan consists of the following sections:

- a. An Introduction that states the goals of the Chemical Hygiene Plan and
- b. Summarizes the topics covered;
- c. A listing of Chemical Hygiene Personnel responsible for varying aspects of the Plan's development and implementation;
- d. Seattle University Standard Operating Procedures for Laboratories that direct the department Environmental Health and Safety Coordinator and all laboratory employees in meeting the goals of the Chemical Hygiene Plan;
- e. General Laboratory Safety Rules that all laboratory employees should follow;
- f. A description of the situations where Specific Exposure Control Measures would need to be used by laboratory personnel;
- g. Procedures for Inspections and Reviewing the Chemical Hygiene Plan to ensure that equipment is functioning properly and that hygiene practices are followed and adequate;
- h. An Employee Information and Training Program to inform them of the hazards of, and protective measures for, chemicals used in their work areas and;
- i. A description of the situations that warrant employee Exposure Monitoring and;
- j. Medical Attention and the record keeping associated with these activities.

II. RESPONSIBLE CHEMICAL HYGIENE PERSONNEL

A. Goal

Successful development and implementation of a Chemical Hygiene Plan must be by the full commitment of the Senior Administrators, EH&S and Director of Public Safety. Implementation of this plan shall be by the Environmental Health & Safety Coordinator. The EH&S goal is to ensure that responsibility for chemical hygiene in the laboratories is shared by all academic departments with their faculty and staff who work in laboratories.

B. Key Personnel and Their Responsibilities

1. The Environmental Health and Safety Coordinator will work with each department to develop appropriate policies and practices for Seattle University.
 - a. Maintain adequate records detailing efforts and results of employee exposure monitoring (including associated accident reports, if applicable) and medical consultations and examinations;
 - b. Ensure that employees are provided with the required and appropriate training to carry out their responsibilities; and
 - c. Monitor the legal requirements concerning hazardous substances.
2. Each laboratory employee is responsible for planning and conducting each laboratory operation in accordance with the appropriate laboratory procedures and rules outlined in the Chemical Hygiene Plan. It is also an employee's responsibility to develop good personal chemical hygiene habits.

III. STANDARD OPERATING PROCEDURES FOR LABORATORIES

A. Goal

To protect employees working in laboratory's, the environment, or others who may be exposed from injury due to hazardous chemicals. Standard operating procedures that reflect a regulatory requirement contain the words "must" or "will". Good laboratory safety practices are also provided as standard operating procedures with the word "should".

B. General Statement

Seattle University Standard Operating Procedures (SOP's) for Laboratories are presented in this section. You may find it helpful to expand upon these standards or to add new standards that apply to your laboratory operations.

C. Employee Exposure Protection

Laboratory operations will be conducted in a manner that prevents employee exposure to WISHA regulated substances in excess of the permissible exposure limits (PEL's) specified in WAC 296-62-075.

1. Proper respiratory equipment will be provided to employees where the use of respirators is necessary to maintain exposure below permissible exposure limits. Respirators will be selected and used in accordance with Chapter 296-24-075 of the Washington Administrative Code.
2. Personal protective equipment and instructions on the proper use of this equipment will be provided to employees, as appropriate, to minimize exposure to hazardous chemicals.

D. Employee Exposure Determination and Monitoring

If there is reason to believe that exposure levels for a WISHA regulated substance routinely exceed the action level (or in the absence of an action level, the PEL). The Environmental Health and Safety Coordinator will ensure that employee exposure to that substance is measured.

1. Initial Exposure Determination - Factors which might raise the possibility of overexposure and therefore warrant an initial measurement of employee exposure include:
 - a. The manner in which the chemical procedures or operations involving the particular substance are conducted (e.g., use of an open vessel instead of a closed system);
 - b. The existence of historical monitoring data that shows elevated exposures to the particular substance for similar operations;
 - c. The use of a procedure that involves significant quantities or is performed over an extended period of time; or
 - d. Signs or symptoms of exposure (e.g., skin or eye irritation, shortness of breath, nausea, headache, etc.) which are experienced by the employee.
2. Exposure Monitoring - If the initial exposure determination described above discloses employee exposure over the action level for a particular substance (or in the absence of an action level, the PEL), Seattle University will immediately comply with the exposure monitoring requirements of the WISHA standard for that substance.

Monitoring airborne concentrations of individual hazardous chemicals should be conducted in the following circumstances:

- a. In testing or redesigning the hoods and other local ventilation devices in the laboratory;
 - b. When a specific substance that is highly toxic is regularly and continuously used; and
 - c. When requested by a laboratory employee because of a documented health concern or suspicion that a PEL may be exceeded.
3. Record keeping - Exposure testing procedures and results should be sent to the EH&S office who maintains these records. The employee will be notified of any monitoring results within 15 working days after receipt of the results either individually or by posting the results in an appropriate location that is accessible to employees.
- a. An accurate record of any measurements taken to monitor employee exposures must be kept, transferred, and made available for each employee in accordance with WISHA's Access to Employee Exposure and Medical Records requirements (WAC 296-62-052).

E. Medical Consultations and Medical Exams

Employees who work with hazardous chemicals will be provided with an opportunity to receive medical attention when overexposed to a hazardous chemical is suspected.

1. Medical attention will be provided to an employee under the following circumstances:
 - a. Whenever an employee develops signs or symptoms of exposure to a hazardous chemical to which they may have been exposed in the laboratory, the employee will be provided with the opportunity to receive an appropriate medical examination;
 - b. When exposure monitoring reveals an exposure level routinely above the action level (or PEL) for a WISHA regulated substance, medical surveillance will be conducted as required by the particular WISHA standard; and
 - c. Whenever an event takes place in the laboratory such as a spill, leak, or explosion that results in the likelihood of a hazardous exposure, the affected employee will be provided with the opportunity for medical consultation to determine the need for a medical exam.
2. All medical examinations and consultations will be performed under the direct supervision of a licensed physician and will be provided without cost to the employee, without loss of pay and at a reasonable time and place. All questions regarding medical consultations and examinations should be directed to the Seattle University Health Center.
3. The following information will be provided to a physician conducting medical consultations and exams:
 - a. The identity of hazardous chemicals to which the employee may have been

- exposed;
 - b. A description of the conditions under which the exposure occurred, including quantitative exposure data if available;
 - c. A description of the signs and symptoms of exposure that the employee is experiencing, if any.
4. Physician's Report - A written opinion from the examining physician for any consultations or exams performed under this Operating Procedure must include:
- a. Any recommendation for further medical follow-up;
 - b. The results of the medical examination and any associated tests;
 - c. Any medical condition revealed during the course of the exam which might compromise employee safety during, or as a result of, exposure to hazardous chemicals 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 exam and any medical condition that may require further examination or treatment.

The written opinion should not reveal specific diagnoses unrelated to occupational exposure, except as noted above.

5. Record keeping - An accurate record of any medical consultations or medical examinations must be kept by the Campus Safety Supervisor. Records for each employee must be transferred and made available as specified under WISHA's Access to Employee Exposure and Medical Records requirements (WAC 296-62-052).

F. Laboratory Facilities (Design Criteria)

The work conducted in a lab and its scale must be appropriate to the physical facilities available and to the quality of the ventilation system.

1. Laboratory Design

A laboratory facility should include, where appropriate:

- a. An adequate general ventilation system with air intakes and exhausts located to avoid intake of contaminated air;
- b. Well-ventilated stockrooms and storerooms;
- c. Proper chemical storage for specific hazardous materials (e.g., flammables, corrosives, poisons, etc.);
- d. Adequate laboratory hoods and sinks;
- e. Emergency equipment including fire extinguishers, spill kit;
- f. First aid equipment including first aid kits, eyewash fountains and drench showers;

2. Laboratory Ventilation

- a. The general laboratory ventilation system should: provide a source of air for breathing and for input to local ventilation devices, ensure that laboratory air is continually circulated and direct air flow into the laboratory from non-laboratory areas and out to the exterior of the building. General laboratory ventilation should not be relied on for protection from exposure to hazardous chemicals released

into the laboratory. A rate of 4-12 room air changes per hour is normally adequate general ventilation if local exhaust systems such as hoods are used as the primary method of control. General air flow should not be turbulent and should be relatively uniform throughout the laboratory.

- b. A laboratory hood with a minimum of 2.5 linear feet of hood space per person should be provided for every two workers if they spend most of their time working with chemicals. Airflow into and within the hood should not be excessively turbulent and hood face velocity should be adequate (typically 80-120 fpm).
- c. Hazardous chemicals stored in cabinets should be fitted with auxiliary ventilation systems. Stockrooms should be well ventilated.
- d. The quality and quantity of ventilation should be evaluated on installation, regularly monitored (at least every six months) and reevaluated whenever a change in ventilation devices is made.

G. Chemical Procurement

The activities and personnel involved in purchasing or otherwise acquiring chemicals for the laboratory will be addressed by the Chemical Hygiene Plan.

1. Purchase Approval

Seattle University at this time does not have a specific approval procedure for chemical purchases. However, it is Seattle University's policy that all chemical purchases be of minimum amount needed for the immediate needs and discourages stock piling of chemicals for the sake of better prices.

2. Receiving Shipments

Before a substance is received, information on proper handling, storage and disposal should be available and known to employees involved in shipping, receiving and distribution of laboratory chemicals.

H. Hazard Identification

Laboratory chemicals and facilities should be properly labeled to identify any hazards associated with them for employee information and protection.

1. Container Labels

Labels on incoming containers of hazardous chemicals must not be removed or defaced. Unlabeled bottles of chemicals should not be opened; such materials should be disposed of promptly as outlined in the Waste Disposal Procedures.

When dispensing chemicals from one container to another, make sure that the new container is properly labeled with the chemical name and hazards. All secondary containers should be labeled in this manner unless they are intended for the immediate use of the person who dispensed the chemicals.

2. Material Safety Data Sheets

Material Safety Data Sheets received with incoming shipments of hazardous chemicals must be maintained and made readily available to laboratory employees.

3. **Laboratory Signs**

Laboratory areas that have special or unusual hazards (e.g., radiation areas designated areas) should be posted with warning signs.

Signs should be posted to show the location of safety showers, eyewash stations, exits, first aid kits, fire extinguishers, etc. Extinguishers should be labeled to show the type of fire for which they are intended. Waste containers should be labeled to show the type of waste that can be safely deposited.

Consumption of food and beverages is not permitted in areas where laboratory operations are being carried out. Areas where food is permitted should be marked and a warning sign (e.g. EATING AREA -NO CHEMICALS) should be posted.

I. **Material Handling**

The storage, distribution, and methods of handling hazardous chemicals will be conducted in a way that minimizes the potential for accidents and employee exposure.

1. **Stockrooms / Storerooms**

Hazardous chemicals should be segregated in a well-identified area with local exhaust ventilation. Stockrooms/storerooms should be under the control of one person who is responsible for its safety and inventory control. Stored chemicals should be examined at least annually for replacement, deterioration, and container integrity.

2. **Distribution**

When chemicals are hand carried, they should be placed in an outside container or acid carrying bucket to protect against breakage and spillage. To avoid exposure to persons on passenger elevators, chemicals should be transported on freight-only elevators, if possible.

Compressed gas cylinders should never be rolled or dragged. Cylinders should be transported with a suitable hand cart and the cylinder strapped and chained in place.

3. **Laboratory Storage**

Quantities of chemicals stored in the laboratory should be kept to a minimum. Chemicals should be stored away from heat sources and direct sunlight. Periodic inventories will be conducted, at least every three months, with unnecessary items being returned to the storeroom/stockroom.

Incompatible materials should be segregated for storage.

4. **Use of a Hood**

A hood should be used for operations that might result in release of toxic chemical vapors or dust. In general, the hood should be used when working with any appreciably volatile substance with a Threshold Limit Value (TLV) of less than 50 ppm.

Storage of chemicals in the hood should not be allowed to block vents or air flow and should be kept to a minimum. The hood should be kept on if chemicals are stored there.

5. **Working Alone**

Experiments that are hazardous should not be conducted by a worker who is alone in a laboratory. Under normal working conditions, arrangements should be made between individuals working in separate laboratories or work areas to cross-check periodically.

Employees working alone after hours, weekends, or holidays should inform Campus Public Safety. The employee will call ext. 5990 at the beginning and end of the work period to inform CPS that they are working in the laboratory.

6. **Dispensing Chemicals**

When chemicals are being transferred from one container to another, employees should be sure that the new container is compatible with the chemical and is labeled with the identity of the chemical. Also, the use of safety labels, poison, corrosive, flammable, etc, and HMIS is strongly suggested.

J. Laboratory Operations/Activities Requiring Approval

Employees should be informed of those laboratory procedures and operations that require prior approval from the department Chair or laboratory supervisor to ensure that these activities are carefully monitored for adherence to the Chemical Hygiene Plan and regulatory requirements.

1. **Laboratory Operations Requiring Prior Approval**

- a. Non-routine procedures for which the employee has not been trained;
- b. Analytical work with an unknown substance;
- c. Disposal of chemical wastes;
- d. Operations or activities for which there are no written procedures; and
- e. Purchase of highly toxic and/or regulated chemicals.

2. **Department-Specific Prior Approval Activities**

The department Chair and/or the laboratory supervisor will determine if there are additional department-specific laboratory activities that require his or her approval. Employees should be informed of when they need prior approval before initiating an activity.

K. Emergency Prevention and Response

Laboratory employees should be familiar with S.U. emergency procedures to prevent and reduce the impact of laboratory accidents.

1. **Emergency Procedures**

The emergency procedures should address a failure in the ventilation systems and evacuation of the laboratory.

2. **First Aid**

The University must have personnel trained in first aid available during working hours to render assistance until medical help can be obtained.

3. **Emergency Equipment**

The Environmental Health and Safety Coordinator and/or Campus Public Safety will ensure that adequate emergency equipment is available in the laboratory and inspected periodically to ensure that it is functioning properly.

4. **Accident Reports**

All accidents and near accidents should be carefully investigated. The results of this investigation and recommendations for the prevention of similar occurrences should be compiled in a report and distributed to all who might benefit. Accident reports will be kept on file with the Environmental Health and Safety Coordinator and made available to employees upon request.

L. Waste Disposal

The Environmental Health and Safety Coordinator will ensure that laboratory chemicals are disposed of in compliance with appropriate regulations and in a way that minimizes damage to human health and the environment.

1. **Waste Handling**

Chemical wastes should be removed from the laboratory to a central waste storage area, by authorized personnel, at least once a month or upon request and from the central storage area at regular intervals. Unlabeled containers of chemicals and solutions should undergo prompt disposal.

2. **Waste Disposal/Recycling**

Laboratory wastes should be recycled whenever possible. Before disposing of any laboratory waste materials, consult the Environmental Health and Safety Coordinator for the proper disposal method or procedure. Hoods should not be used as a waste disposal method for volatile chemicals.

M. Information and Training

The Environmental Health and Safety Coordinator will provide laboratory and other appropriate employees (e.g., receiving and shipping personnel, custodial, maintenance, stockroom personnel, emergency teams) with information and training on the hazards of chemicals present in their work area and what to do if an accident occurs.

1. **Training Program**

Training will consist of at least the following subjects:

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

- 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 that Seattle University has implemented to protect employees from exposure to hazardous chemicals (e.g., General Laboratory Safety Rules, emergency procedures and protective equipment to be used).

2. Information for Employees

Employees will be provided the following information:

- a. The WISHA Standard for Occupational Exposure to Hazardous Chemicals in Laboratories (WAC 296-62-400);
- b. The location and availability of the Chemical Hygiene Plan (Lab Safety Comm.);
- c. The permissible exposure limits (PELs) for WISHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable standard;
- d. The signs and symptoms associated with exposure to hazardous chemicals used in the laboratory; and
- e. The location and availability of reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including Material Safety Data Sheets.

3. When to Provide Training and Information

Information and training will be provided at the time of the employee's initial assignment to the work area where hazardous chemicals are present and before assignments involving new exposure situations. Refresher information and training will be provided at least annually.

N. Inspections and Reviewing Chemical Hygiene Plan

General safety inspections of the laboratory and annual review of the Chemical Hygiene Plan will contribute to overall laboratory and employee safety. The Environmental Health and Safety Coordinator or his/her designee will ensure ~~that these procedures are followed in each department:~~

1. Inspecting Laboratory Safety Equipment

Laboratory safety equipment will be inspected at least semi-annually to ensure their fitness for use and modified if inadequate, including:

- a. Fume hoods and other protective equipment (environmental controls);
- b. Personal protective equipment (gloves, respirators);
- c. Emergency equipment (fire extinguishers, spill kit); and
- d. First aid equipment (showers, eyewash stations).

2. Review of the Chemical Hygiene Plan

The Chemical Hygiene Plan for the laboratory will be reviewed by the Environmental Health and Safety Coordinator,
Environmental Health and Safety Coordinator and others designated by the Environmental Health and Safety Coordinator, at least annually
for:

- a. Compliance with appropriate regulations and for adequacy in protecting employees from the health and physical hazards associated with chemicals in use in the laboratory. The results of this review should be recorded, including notes on needed changes, when those changes were made, etc.
- b. The Plan will be updated as necessary (e.g., when there are changes in laboratory operations, laboratory personnel, etc.) and in a timely manner.

IV. GENERAL LABORATORY SAFETY RULES

A. Goal

To protect the health and safety of laboratory employees who work with hazardous chemicals through training and careful attention to safe operating practices.

B. Department-Specific General Rules

The following section contains the General Laboratory Safety Rules for all Seattle University laboratories. You can include any department-specific laboratory safety rules that you have developed as well.

C. General Rules

1. Know the safety rules and procedures that apply to your work. Before you begin any new operation, determine the potential hazards and appropriate safety precautions to take.
2. Know the location of and how to use emergency equipment in your area, and how to obtain additional help in an emergency. Be familiar with emergency procedures.
3. Know the types of protective equipment that are available and use the proper equipment for each job.
4. Watch out for unsafe conditions and call attention to them so that corrections can be made as soon as possible. Someone else's accident can be a danger to you as well.
5. Consuming food or beverages or smoking in laboratories or areas where chemicals are being used or stored will not be permitted.
6. Practical jokes or other behavior which might distract, startle, or confuse another worker can be dangerous and must be avoided.
7. Make sure that you use equipment for its designed purpose only.
8. If you leave an operation unattended for any period, leave the laboratory lights on, post a sign, and take the necessary precautions for the event of a failure of a utility service (such as cooling water).
9. Notify the Laboratory Supervisor immediately if you have been exposed to a hazardous chemical.

D. Chemical Handling

1. Do not smell or taste chemicals.
2. Always add acid to water. Never add water to acid.
3. Know the hazards posed by the different classes of chemicals including: oxidizers, flammables, corrosives, and compressed gasses, acutely hazardous and chronically hazardous chemicals.
4. Consult your lab supervisor as to the safe handling of any new chemical you are unfamiliar with. It is recommended that the Material Safety Data Sheet (MSDS) be

read and understood before using any new chemical.

5. Be aware of the proper waste disposal methods for the chemicals you are handling. Improper disposal may lead to injury to human health, the environment and/or facility equipment.
6. Be sure that equipment is carefully secured before its use. Combine reagents in the proper order, and avoid adding solids to hot liquids.
7. Do not work alone in the laboratory without notifying the Laboratory Supervisor and making arrangements to have someone check in on you periodically.
8. When transporting, storing, using, or disposing of any substance, be sure that the substance cannot accidentally come into contact with an incompatible substance. This contact could result in explosions or the production of highly toxic or flammable substances.
9. When chemicals are being transferred from one container to another, be sure that the new container is compatible with the chemical and is labeled with the identity of the chemical. Labels will be dated and have the name of the employee making the transfer.

E. Health and Hygiene

1. Wear appropriate eye protection at all times in areas where chemicals are used or stored. Do not use contact lenses in the laboratory.
2. Use protective apparel, including face shields, gloves, and other special clothing, as needed. Inspect gloves before each use, wash them before removal, and replace them periodically. Avoid contact between gloves exposed skin, clothing, and your eyes or mucous membranes during use.
3. Long hair and loose clothing should be confined to avoid accidents, lab smocks are highly recommended. No shorts or short skirts should be worn in the labs or storage areas. Sandals, cloth sneakers, opened toes, and perforated shoes will not be worn.
4. Mouth suction to pipette chemicals or to start a siphon, **WILL NOT** be permitted for any laboratory procedure; a pipette, pipit bulb, or aspirator will be used to provide a vacuum.
5. Avoid exposure to gases, vapors, and aerosols. Use appropriate safety equipment when this type of exposure is likely.
6. Wash well before leaving the laboratory.

F. Food Handling

1. No food or beverages will be stored, handled, or consumed in the laboratory or other areas where chemicals are used or stored.
2. Do not bring chemicals or chemical equipment into areas designated for food consumption or smoking.
3. Glassware or utensils used for laboratory operations will never be used to prepare or consume food. Laboratory refrigerators, ice chests, microwave ovens, cold rooms, etc. must not be used for food storage.

G. Housekeeping

1. Work areas will be kept clean and free from obstructions. Cleanup should follow the completion of each operation or at the end of each day.
2. Wastes will be deposited in the appropriate receptacles. Equipment and chemicals should be stored properly and clutter should be minimized.

3. Laboratory accidents and spills will be attended to immediately. Follow the appropriate emergency procedures.
4. Chemical and waste containers will be kept labeled at all times. The laboratory supervisor should be informed immediately of the presence of any unlabeled containers. Do not open unlabeled containers.
5. Access to exits, emergency equipment, controls, etc. will not be blocked.
6. Notify the Laboratory Supervisor immediately if equipment is malfunctioning. Discontinue use of the equipment if a safety hazard exists.
7. Chemical storage under the hoods should be kept to a minimum. Leave the hood on when it is not in use if chemicals are stored there.

H. Glassware

1. Accidents involving glassware are the leading cause of laboratory injuries. Careful storage and handling procedures should be used to avoid glassware breakage.
2. Adequate hand protection should be used when inserting glass tubing into rubber stoppers or corks or when placing rubber tubing on glass hose connections. Tubing should be fire polished or rounded and lubricated, and hands should be held close together to limit movement of glass should a fracture occur.
3. Vacuum-jacketed glass apparatus should be handled with extreme care to prevent implosions. Only glassware designed for vacuum work should be used for that purpose.
4. Hand protection should be worn when picking up broken glass. Small pieces should be swept up with a brush and dust pan.

I. Flammability Hazards

1. Do not use an open flame to heat a flammable liquid or to carry out a distillation under pressure. Use an open flame only when it is necessary and extinguish it as soon as it is no longer needed.
2. Before lighting a flame, remove all flammable substances from the immediate area and notify others in the area. Check all containers of flammable substances in the area to ensure that they are tightly closed.
3. Store flammable materials in a flammable cabinet or other appropriate location.
4. Make sure that all flammable cabinets and containers are properly grounded to prevent accidental ignition of flammable vapors and liquids.

J. Hazardous Waste Handling

1. Hazardous wastes should be properly labeled and stored in a separate hazardous waste area.
2. See your Laboratory Supervisor for the proper hazardous waste disposal procedures.

ANY QUESTIONS OR CONCERNS ABOUT LABORATORY SAFETY SHOULD BE ADDRESSED WITH YOUR LABORATORY SUPERVISOR.

V. SPECIFIC EXPOSURE CONTROL MEASURES

A. Goal

To address the criteria that would invoke the use of specific exposure control measures, above and beyond the Standard Operating Procedures and General Laboratory Safety Rules, which will reduce employee exposure to hazardous chemicals.

B. Criteria

Criteria for determining when and what types of specific exposure control measures should be implemented may be based on (1) the degree of toxicity of a substance to be used, (2) the exposure potential of the procedures to be performed, or (3) the capacity of the engineering controls, administrative practices or personal protective equipment to control employee exposures effectively.

1. Degree of Toxicity of Substances

Additional laboratory procedures must be developed by each department and included in the Plan where appropriate to protect employees who are working with particularly hazardous chemicals including select carcinogens, reproductive toxins and substances with a high degree of acute toxicity.

Select Carcinogens are substances meeting one of the following criteria:

- a. Regulated by WISHA or OSHA as a carcinogen; or
- b. Under the category "known to be carcinogens" in the Annual Report on Carcinogens published by the National Toxicology Program (NTP - latest edition); or
- c. Listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC - latest edition); or
- d. 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:
 - 1) after inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m³;
 - 2) after repeated skin application of less than 300 (mg/kg of body weight) per week; or
 - 3) after oral dosages of less than 50 mg/kg of body weight per day.
- e. Reproductive Toxins are chemicals affecting the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis). In addition, certain reproductive toxins may cause infertility in females or males.
- f. High Acute Toxicity Substances may be fatal or cause damage to target organs resulting from a single exposure. Examples include hydrogen cyanide, hydrogen sulfide, and nitrogen dioxide.

General procedures for handling these types of chemicals are included in this guidance. Each Laboratory Supervisor should review these general procedures and adapt them as appropriate to their specific laboratory chemicals and operations.

2. Exposure Potential

The routes of exposure to chemicals may occur by inhalation, ingestion, contact with skin or eyes, or injection.

- a. Inhalation of chemical vapors, mists, gases or dusts can produce poisoning through the mucous membrane of the nose, mouth, throat, and lungs and can seriously damage these tissues. The degree of injury resulting from exposure to toxic vapors, mists, gases or dusts depends on the toxicity of the material and its solubility in tissue fluids, its concentration and the duration of exposure.
- b. Ingestion of many chemicals can be extremely dangerous. The relative acute toxicity of a chemical can be evaluated by determining its LD50, defined as the quantity of chemical that will cause the death of 50% of the test animals when ingested in a single dose. In addition, many chemicals will directly damage the tissue of the mouth, throat, nose, lungs, and gastrointestinal tract.
- c. Contact with skin and eyes can lead to significant chemical injury. A common result of skin contact is local irritation, but many chemicals can be absorbed through the skin and cause systemic poisoning. Most chemicals are damaging to the eyes that are very sensitive organs. Alkaline materials, phenols, and strong acids can cause permanent loss of vision.
- d. Injection of chemicals is not a very common route of exposure, but may occur through mechanical injection from glass, or other materials contaminated with chemicals, or when chemicals are handled in syringes.

Other factors to consider in evaluating the degree of exposure potential from the use of a particular chemical or activity involving the chemical include the following:

- Chemical's volatility, flammability, and reactivity;
- Potential for unplanned chemical reactions; •
High heat of reaction;
- Amount of time that a worker will be exposed;
- Sensitivity of the laboratory worker (e.g., asthma, allergies, pregnancy); •
Potential for generating aerosols; and
- Potential for an uncontrollable release.

3. Capacity of Engineering Controls, Administrative Practices, and PPE

Evaluating the need for specific exposure control measures when an employee is handling certain chemicals or using certain procedures should include a review of existing engineering controls, administrative practices and personal protective equipment (PPE).

The capacity of general ventilation and local exhaust systems should be evaluated against the required level of employee exposure protection. For example, work with a highly acute toxin such as hydrogen cyanide should be conducted under a hood with a face velocity of at least 60 fpm (or other containment device) if the procedure could result in the generation of aerosols or vapors.

Administrative practices, such as record keeping, training and medical surveillance, may need to be revised for particular laboratory activities to ensure employees are adequately protected from overexposure to hazardous chemicals. It may be appropriate to maintain inventory and usage records for select carcinogens and provide routine medical surveillance for individuals who will be handling these substances in toxicologically significant quantities.

The compatibility of available PPE and substances and/or procedures to be used are another area to consider in deciding whether to implement certain exposure control measures. Laboratory employees should be trained on the proper use and type of PPE to use and should seek guidance from their Laboratory Supervisor if they are uncertain about its adequacy for a specific operation.

C. Employee Exposure Control Measures

The WISHA Laboratory Standard requires that each laboratory evaluate the need for specific exposure control measures when employees are working with select carcinogens, reproductive toxins, or substances with a high degree of acute toxicity. These measures include the establishment of designated areas, use of containment devices, decontamination procedures and safe removal of contaminated waste.

1. Designated Areas

WISHA recommends that the use of select carcinogens, reproductive toxins, or substances of high acute toxicity be restricted to "designated areas", especially when other less toxic chemicals are being used in the same area. A designated area may be an entire laboratory, an area within a lab, or a device such as a lab hood. The goal is to limit exposures and alert all employees in the vicinity to the potential hazard.

2. Containment Devices

Circumstances involving select carcinogens, reproductive toxins, or substances of high acute toxicity that may warrant the use of containment devices (such as a fume hood) include:

- The use of volatile substances;
- Manipulations that may generate an aerosol; and
- Any handling or reaction that may result in an uncontrollable release.
- Critical hoods should have a monitoring device to allow convenient confirmation of adequate hood performance before use. If this is not possible, work with substances of high or unknown toxicity should be avoided unless other types of ventilation devices are provided.

3. Decontamination Procedures

It may be appropriate to establish decontamination procedures to adequately address the decontamination required for certain designated areas in the laboratory. Vacuum pumps and other contaminated equipment including glassware should be decontaminated in the hood before removing them from the designated area. The controlled area should be decontaminated periodically and always before normal work is resumed there.

4. Safe Removal of Contaminated Waste

Safe disposal of contaminated wastes should be part of the planning process for any laboratory experiment or procedure. If practical, very hazardous substances should be converted to less hazardous substances in the laboratory rather than being directly placed in containers for disposal. The people picking up contaminated waste should be aware of the hazards and should know what to do in the event of a spill during

transport. To ensure the safe removal of wastes from the laboratory, the Environmental Health and Safety Coordinator should be contacted for the proper disposal methods.

Solid chemical wastes should be placed in suitable containers. It is important to ensure that all waste containers are properly labeled to identify the associated contents and hazards. Laboratory employees involved in disposing of the wastes should be aware of the hazards of the wastes, the importance of segregating incompatible materials and the applicable regulatory requirements.

D. Procedures for Handling Reproductive Toxins

Examples: Lead Compounds, Organomercurials, Formamide Ethidium Bromide

1. Women of child bearing age should only handle these substances in a hood whose satisfactory performance has been confirmed.
2. Avoid skin contact by using gloves and wearing long sleeves and other protective apparel as appropriate.
3. Always wash hands and arms immediately after working with these materials.
4. Keep records of the amounts of these materials on hand, amounts used, and the names of the workers involved.
5. Employees should be familiar with the emergency procedures for accidents or spills involving these substances.
6. Unbreakable containers of these substances should be stored in a well ventilated area and should be labeled properly.

E. Procedures for Handling Chemicals with High Acute Toxicity

Examples: Hydrofluoric Acid, Cyanides, Regulated Chemicals

1. Use and store these substances in areas of restricted access with special warning signs.
2. Always use a hood or other containment device for procedures that may result in the generation of aerosols or vapors containing the substance. The released vapors should be trapped to prevent their discharge with the hood exhaust.
3. Avoid skin contact by using gloves and wearing long sleeves and other protective apparel as appropriate.
4. Always wash hands and arms immediately after working with these materials.
5. Keep records of the amounts of these materials on hand, amounts used, and the names of the workers involved.
6. Employees should be familiar with the emergency procedures for accidents or spills involving these substances. If a major spill occurs outside the hood, emergency responders should wear appropriate personal protective equipment and all other workers should evacuate the area.
7. Be sure that at least two people are present at all times when a highly toxic compound, or compound of unknown toxicity, is being used.
8. Breakable containers of these substances should be stored in resistant trays and work and storage surfaces should be covered with removable, absorbent plastic-backed paper.
9. Contaminated clothing should be chemically decontaminated, if possible, or destroyed. Contaminated waste should be stored in suitably labeled impervious containers. Liquids can be stored in glass or plastic bottles containing vermiculite.

F. Procedures for Handling Select Carcinogens

Examples: Benzene, Nickel, Vinyl Chloride

1. All work with these substances should be conducted in a _designated area_ such as a restricted access hood, glove box, or portion of a lab designated for use of chronically toxic substances. People with access to this area should be aware of the substances used and the necessary precautions to take. The designated area should be clearly marked with warning and restricted access signs.
2. The use and disposal of these substances should be approved by the Lab Tactician before this activity.
3. Always use a hood or other containment device for procedures that may result in the generation of aerosols or vapors containing the substance. The released vapors should be trapped to prevent their discharge with the hood exhaust.
4. Vacuum pumps should be protected against contamination by scrubbers or other devices and vented into the hood. Vacuum pumps and other contaminated equipment should be decontaminated in the hood before removing them from the designated area. The designated area should also be decontaminated before resuming work there.
5. Avoid skin contact by using gloves and wearing long sleeves and other protective apparel as appropriate.
6. Remove any protective clothing before leaving a designated area and place it in an appropriate, labeled container.
7. Always wash hands, arms, face and neck immediately after working with these materials.
8. Keep records of the amounts of these materials on hand, amounts and dates used, and the names of the employees involved.
9. Employees should be familiar with the emergency procedures for accidents or spills involving these substances. If a major spill occurs outside the hood, emergency responders should wear appropriate personal protective equipment and all other workers should evacuate the area.
10. Be sure that at least two people are present at all times when a highly toxic compound, or compound of unknown toxicity, is being used.
11. These substances should be stored in unbreakable containers in a ventilated area with limited access. Work and storage surfaces should be covered with removable, absorbent plastic-backed paper. All containers should be labeled with the identity and hazards of the substance.
12. Contaminated clothing should be chemically decontaminated, if possible, or destroyed. Contaminated waste should be stored in suitably labeled impervious containers. Liquids can be stored in glass or plastic bottles containing vermiculite. Containers of contaminated wastes should be transferred from the designated area in a secondary container.
13. Determine the appropriateness of medical surveillance for employees if they are working with toxicologically significant quantities of these substances on a regular basis.
14. Positive pressure glove boxes should be checked for leaks before each use. Negative pressure glove boxes should have a ventilation rate of at least 2 volumes per hour and a pressure of at least 0.5 inches of water. Exit gases should be trapped or filtered and then released through the hood

VI. INSPECTION & PLAN REVIEW

A. Goal

To develop a well organized laboratory inspection program that allows you to identify and correct the cause of chemical exposures before they occur and:

- Generate and help maintain a high level of prevention consciousness;
- Assist in the education of employees and supervisors in the merits and methods of detecting and eliminating accident causes;
- Demonstrate management's sincere interest in its employee's health, safety, and welfare;
- Foster a better understanding of the responsibilities that each must assume in the prevention of accidents; and
- Help determine where additional training or instruction may be required.
- To develop a Chemical Hygiene Plan review process that evaluates the effectiveness of the overall Plan and identifies the need for updates to ensure that employees are adequately protected against harmful exposure to hazardous chemicals.

B. Inspection Procedures

General laboratory inspection procedures address the following items:

- General ventilation systems, local ventilation equipment (such as fume hoods) and other protective equipment;
- Personnel protective equipment including gloves, face guards and respirators;
- Emergency equipment such as spill kits, eyewash stations, and fire extinguishers;
- First aid equipment including chemical and fire blankets, and first aid kits.
- Informal inspections of housekeeping and personal chemical hygiene should be conducted periodically.

C. General Laboratory Ventilation

Each laboratory should be evaluated for the quality and quantity of general ventilation present. This evaluation should be repeated periodically and any time a change is made in the general ventilation system or in the local ventilation systems within the laboratory. Air flow patterns can be observed using commercially available smoke sources. If the general ventilation is satisfactory, the movement of air from the doorways (and other input ports) through the laboratory to the hoods (or other exhaust ports) should be relatively uniform. There should be no areas where the air remains static or where airflow velocities are high. Whenever serious ventilation problems are suspected, air flow rates can be measured using special instruments as a way of identifying differences between input and exhaust air.

Laboratory work involving use of hazardous chemicals should be conducted in a manner that prevents contact with the skin and unsafe employee exposure through vapors or dust that enter the general laboratory environment. These activities are normally conducted in a hood. Laboratory workers should regard the general laboratory atmosphere as a source of air to breathe and as a source of input air for the local ventilation systems (e.g., hoods).

D. Laboratory Hoods

WISHA requires that fume hoods and other protective equipment must be functioning properly to ensure employee protection from chemical exposure. A comprehensive inspection of this equipment should be conducted at least every six months and should consider the following:

- Hoods should not be regarded as a means of disposing chemicals, but rather as a backup safety device in case dusts or vapors escape from the apparatus being used;
- Hoods should be tested before use to ensure adequate face velocities (typically 80 to 120 fpm) and the absence of turbulent flow, perhaps with the use of a continuous monitoring device;
- The hood should be kept closed except during manipulations of apparatus in the hoods;
- The placement of equipment and other items in the hood, an open window in the lab, or a person walking by the hood can all affect a hood's performance; and
- Chemicals stored in hoods should be kept to a minimum and they should not block air vents or disrupt air flow. If hazardous chemicals must be stored in a hood temporarily, the hood should be kept on.

Hood performance should be tested against the design specifications for uniform air flow across the hood face and for total exhaust air volume. The uniformity of airflow to the hood can be determined by taking a series of air velocity measurements at the face of the hood (face velocities) in a grid pattern. If the values for specific points across the hood face vary by more than 20 fpm, from the average value, corrections should be made to achieve uniform airflow. This may involve adjusting interior hood baffles or altering the path of input air flowing into the room.

The total volume of air being exhausted is the product of the average face velocity and the area of the hood opening. In general, face velocities between 80 to 120 fpm will provide laminar flow of air over the floor and sides of the hood. Higher face velocities (over 125 fpm) result in air turbulence at the hood face and within the hood. This could lead to vapors spilling out into the general laboratory atmosphere.

The optimum face velocity of a hood, known as the capture velocity, will vary depending upon its configuration. Capture velocity increases when the hood sash is lowered, thus reducing the hood face area. The capture velocity when the hood is in use should be greater than the currents of air at the hood face.

The presence of air turbulence at the face of the hood and within the hood should also be determined by observing smoke pattern. If there is excessive turbulence or if the hood fails to capture smoke, changes may be required in the face velocity, location of air input ports, location of the hood, or the volume of input air.

Another method of evaluating hood performance is to monitor worker exposure while the hood is being used for its intended purpose. The criterion for this type of evaluation would be the desired performance of the hood (i.e., does it contain vapors and gases at an acceptable worker exposure level?).

A hood test should be conducted any time there is a change in any aspect of the lab's ventilation system (i.e., change in total volume of input air, addition of other hoods, etc.).

Other local ventilation systems, including canopy hoods and snorkels located over various instruments, should also be inspected at least every six months to ensure that they are functioning properly. Ideally, all ventilation systems should have a monitoring device that

allows the user to easily determine whether the total system and its necessary components are functioning to provide a safe work place.

E. Review of the Chemical Hygiene Plan

The effectiveness of the Chemical Hygiene Plan must be reviewed and evaluated at least annually and updated if necessary. Factors to consider in the review include:

- Changes in laboratory procedures, operations or equipment that may affect the potential for employee exposure to hazardous chemicals;
- The addition or deletion of the use of specific hazardous chemicals that warrant a review of laboratory safety procedures;
- Changes in laboratory personnel and/or their responsibilities; and
- The review and evaluation of inspection records, accident investigations, professional research on chemical hygiene techniques, etc.

INSPECTION & PLAN REVIEW CHECKLIST

YES NO

— —

The Chemical Hygiene Plan adequately protects employees from health hazards associated with hazardous chemicals in the laboratory, and keeps employee exposures below the permissible exposure limits for WISHA regulated substances established in WAC 296-62-075.

The Chemical Hygiene Plan consists of:

YES NO

— —

Standard Operating Procedures regarding health and safety considerations for the use of hazardous chemicals in laboratories;

— —

Criteria used to determine and implement control measures to reduce employee exposure to hazardous chemicals including engineering controls, personal protective equipment and hygiene practices;

- | | | |
|---|---|---|
| — | — | Inspection procedures to ensure that fume hoods and other protective equipment is functioning properly and adequately; |
| — | — | Employee information and training programs; |
| — | — | The identification of circumstances under which a particular lab operation, procedure or activity will require approval from the Environmental Health and Safety Coordinator; |
| — | — | Provisions for medical consultation and medical examinations under specified circumstances; |
| — | — | The designation of Chemical hygiene Personnel responsible for the implementation of the Plan; |
| — | — | Provisions for additional employee protection for work with particularly hazardous substances such as select carcinogens, reproductive toxins, and substances that have a high degree of acute toxicity; |
| — | — | Provisions for employee exposure monitoring if there is reason to believe that exposure levels for a regulated substance routinely exceed the action level (or PEL in the absence of an action level); |
| — | — | Procedures to ensure that labels on incoming containers are not removed or defaced and that Material Safety Data Sheets with incoming shipments of hazardous chemicals are maintained and available to employees; |
| — | — | A procedure for respirator use where appropriate; and |
| — | — | Record keeping procedures for each employee regarding monitoring data and medical examination results. |

A check in any of the boxes in the NO column indicates a need to revise the Chemical Hygiene Plan to address that deficiency. The revision date should be noted next to the individual item(s) once the Plan has been amended.

VII. EMPLOYEE INFORMATION & TRAINING

A. Goal

To provide information and training about the hazards of chemicals present in the laboratory work area in a manner and at a frequency that will educate employees on how to protect themselves and others from potential harm in the laboratory.

B. Information Requirements

Laboratory employees must be provided with specific information on the chemicals used in their work areas. WISHA's information requirements are summarized in this section under the heading "Information Program". Section 9 of this program contains a listing of general references which employees may want to review.

C. Employee Training Requirements

Employees must be trained on the potential chemical hazards in their work areas and on appropriate sections of the Chemical Hygiene Plan.

D. Who Should Be Trained?

This training should be provided to all employees who actually work in the laboratory and to other employees whose assignments may require that they enter a laboratory where exposures might occur, such as maintenance and custodial personnel. Employees who are responsible for receiving and handling shipments of new chemicals or chemical wastes should also be informed of the potential hazards and appropriate protective measures for chemicals they may receive.

E. Record keeping

Training of laboratory personnel should be documented and kept in the employees file. An Example Laboratory Employee and Environmental Health and Safety Coordinator Records are provided in this section for this purpose.

F. Information & Training Frequency

The WISHA Laboratory Standard requires that employees receive information and training at the time of their initial assignment to a work area where hazardous chemicals are present and before assignments involving new exposure situations. Refresher training and information must be provided at least annually.

Laboratory employees will be informed of at least the following information:

- contents of the OSHA Standard and its Appendices; •
- location and availability of the Chemical Hygiene Plan;
- permissible exposure limits (PEL's) for OSHA regulated substances or recommended exposure limits for other hazardous chemicals;
- signs and symptoms of exposure to hazardous chemicals used in the laboratory; and
- location and availability of known reference materials on the hazards, safe handling,

storage and disposal of hazardous chemicals found in the lab including but not limited to Material Safety Data Sheets received from the chemical supplier.

H. Employee Training Program

Laboratory employees will be trained on the applicable details of the Chemical Hygiene Plan (CHP) including a review of the following:

- General Rules for Laboratory Safety;
- Appropriate sections of the Standard Operating Procedures such as:
 - a) Laboratory Operations / Activities Requiring Approval; Material Handling (including dispensing and labeling of chemicals); Waste Disposal Methods;
 - b) Chemical Hygiene Personnel;
 - Emergency procedures as outlined in the University's Emergency Response Plan, including spills, fires, explosions, evacuation, and decontamination; and
 - Specific exposure control measures to be used in handling particularly hazardous chemicals.

WISHA requires that the training also address:

- Methods and observations that can be used to detect the presence or release of a hazardous chemical (including any monitoring being conducted and the visual appearance or odor of a chemical when released);
- The physical and health hazards of chemicals in the work area; and
- Measures employees can take to protect themselves from these hazards, including the location and proper use of protective apparel and equipment and the location of emergency equipment and exits.

VIII. EXPOSURE MONITORING & MEDICAL ATTENTION

A. Goal

To provide laboratory workers with an appropriate level of exposure monitoring and medical attention to protect them from adverse health effects resulting from potential exposure to hazardous chemicals.

B. Exposure Monitoring

The Laboratory Standards for exposure monitoring are summarized on the following pages. The Environmental Health & Safety Department will maintain any records of exposure monitoring, including the test method and results. Employee exposure monitoring records should be kept in the employees file.

If there is reason to believe that exposure levels for a WISHA regulated substance routinely exceed the action level (or in the absence of an action level, the PEL), employee exposure to that substance will be measured.

1. Initial Exposure Determination

Factors that might raise the possibility of overexposure and therefore warrant an initial measurement of employee exposure include;

- The manner in which the chemical procedures or operations involving the particular substance are conducted (e.g., use of an open vessel instead of a closed system);
- The existence of historical monitoring data that shows elevated exposures to the particular substance for similar operations;
- The use of a procedure that involves significant quantities or is performed over an extended period; or
- Signs or symptoms of exposure (e.g., skin or eye irritation, shortness of breath, nausea, headache, etc.) which are experienced by the employee.

2. Exposure Monitoring

If the initial exposure determination described above discloses employee exposure over the action level for a particular substance (or in the absence of an action level, the PEL), Seattle University will immediately comply with the exposure monitoring requirements of the WISHA standard for that substance.

Monitoring airborne concentrations of individual hazardous chemicals should be conducted in the following circumstances:

- a. in testing or redesigning the hoods and other local ventilation devices in the laboratory, and
- b. when a specific substance that is highly toxic is regularly and continuously used (e.g. three times a week).

3. Record keeping

Exposure testing procedures and results should be sent the Environmental Health & Safety Department who coordinates and maintains these records.

The employee will be notified of any monitoring results within 15 working days after receipt of the results either individually or by posting the results in an appropriate location that is accessible to employees.

C. Medical Attention

The Environmental Health & Safety Department will maintain an accurate record for each laboratory employee undergoing medical consultations or medical examinations as required by the WISHA Laboratory Standard. (Medical examinations are to be provided at no cost to the employee.) Information that should be kept in an employee's file includes, where appropriate, the following information:

- Exposure monitoring test methods and results;
- Material Safety Data Sheet of the hazardous chemical(s) involved;
- Accident Report; and
- Information submitted to, and received from, the physician.

Checklists are provided which summarize the information that Seattle University must provide to a physician and the information that a physician must provide to Seattle University regarding the employee and their actual or potential exposure to a hazardous chemical in the laboratory.

D. Medical Consultations and Medical Exams

Employees who work with hazardous chemicals will be provided with an opportunity to receive medical attention when overexposure to a hazardous chemical is suspected.

1. Medical attention will be provided to an employee under the following circumstances:

- Whenever an employee develops signs or symptoms of exposure to a hazardous chemical to which they may have been exposed in the laboratory, the employee will be provided with the opportunity to receive an appropriate medical examination;
- When exposure monitoring reveals an exposure level routinely above the action level (or PEL) for a WISHA regulated substance, medical surveillance will be conducted as required by the particular WISHA standard; and
- Whenever an event takes place in the laboratory such as a spill, leak, or explosion that results in the likelihood of a hazardous exposure, the affected employee will be provided with the opportunity for medical consultation to determine the need for a medical exam.

2. Type of Medical Attention

All medical examinations and consultations will be performed under the direct supervision of a licensed physician and will be provided without cost to the employee, without loss of pay and at a reasonable time and place. All questions regarding medical consultations and examinations should be directed to Human Resources.

3. Information for the Physician

The following information will be provided to a physician conducting medical consultations and exams:

- The identity of hazardous chemicals to which the employee may have been exposed;
- A description of the conditions under which the exposure occurred, including quantitative exposure data if available;
- A description of the signs and symptoms of exposure that the employee is experiencing, if any.

4. Physician's Report

A written opinion from the examining physician for any consultations or exams performed under this Operating Procedure must include:

- Any recommendation for further medical follow-up;

- the results of the medical examination and any associated tests;
- Any medical condition revealed during the exam that might compromise employee safety during, or resulting from, exposure to hazardous chemicals found in the workplace; and
- A statement that the employee has been informed by the physician of the results of the consultation or medical exam, and any medical condition that may require further examination or treatment.

The written opinion should not reveal specific diagnoses unrelated to occupational exposure, except as noted above.

5. **Record keeping**

An accurate record of any medical consultations or medical examinations must be kept by the Environmental Health & Safety Department. Records for each employee must be transferred and made available as specified under WISHA's Access to Employee Exposure and Medical Records requirements (WAC 296-62-052).

IX. **REFERENCES FOR SIGNS & SYMPTOMS OF HAZARDOUS CHEMICAL EXPOSURE**

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. Dept. of Health and Human Services, Public Health Service, U.S. Government Printing Office, Washington D.C., (latest edition).
3. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. World Health Organization Publications Center 49 Sheridan Avenue, Albany, N.Y. 12210 (latest edition).
4. NIOSH/OSHA Pocket Guide to Chemical Hazards NIOSH Pub. No. 85-114, U.S. Government Printing Office, Washington D.C., 1985 (or latest edition).
5. Occupational Health Guidelines, NIOSH/OSHA NIOSH Pub. No. 81-123. U.S. Government Printing Office, Washington D.C., 1981. 6. Patty, F.A., Industrial Hygiene and Toxicology, John Wiley & Sons, Inc., New York, N.Y. (five volumes).
7. 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. Government Printing Office, Washington D.C., 20402.
8. The Merck Index: An Encyclopedia of Chemicals and Drugs. Merck and Company, Inc., Rahway, N.J., 1976 (or latest edition).
9. Sax, N.I. Dangerous Properties of Industrial Materials, 5th. edition, Van Nostrand Reinhold, N.Y., 1979.
10. Sittig, Marshall, Handbook of Toxic and Hazardous Chemicals, Noyes Publications, Park Ridge, N.J., 1981.
11. Bretherick, L., Hazards in the Chemical Laboratory, 3rd. edition, Royal Society of Chemistry, London, 1988.
12. Best Company, Best Safety Directory, Vols. I and II., Oldwick, N.J., 1981
13. Bretherick, L., Handbook of Reactive Chemical Hazards, 2nd. edition, Butterworths, London, 1979.
14. Code of Federal Regulations, 29 CFR part 1910 subpart Z. U.S. Government Printing Office, Washington D.C. 20402 (latest edition).
15. Material Safety Data Sheets

X. GENERAL REFERENCE LIST

1. Furr, A. Keith, Ph.D. 1990. Handbook of Laboratory Safety. CRC Press. 3rd Edition.

2. National Research Council, 1981. Prudent Practices for Handling hazardous Chemicals in Laboratories. National Academy Press.
3. American Conference of Governmental Industrial Hygienists (ACGIH), (latest edition). Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes. P.O. Box 1937
4. National toxicology Program, (latest edition). Annual Report on Carcinogens. U.S. Dept. of Public Health and Human Services, Public Health Service, Washington, D.C.
5. International Agency for Cancer research (IARC), (latest edition). IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. World Health Organization Publications, Albany, NY.
6. National Institute of Occupational Safety and Health, 1985. NIOSH/OSHA Pocket Guide to Chemical Hazards. NIOSH Publication No. 81-123. U.S. Government Printing Office, Washington, D.C.
7. Patt, F.A. Industrial Hygiene and Toxicology (Five Volumes). John Wiley & Sons, Inc., New York, NY.
8. Merck and Company, 1976. The Merck Index: An Encyclopedia of Chemicals and Drugs.
9. Sax, N.I. 1979 Dangerous Properties of Industrial Materials, 5th Edition. Van Nostrand Reinhold, NY.
10. National Institute of Occupational Safety and Health, (latest annual edition). Registry of Toxic Effects. U.S. Department of Health and Human Services, Centers for Disease Control.

NAMES AND SYNONYMS OF CARCINOGENS LISTED IN THE 9TH REPORT ON CARCINOGENS

KNOWN TO BE HUMAN CARCINOGENS: This list included agents, substances, mixtures, and exposure circumstances that are known to be carcinogenic in humans.			
CASRN	NAME OR SYNONYM	LISTING IN THE 9 TH RoC	FIRST LISTED
1402-68-2	Aflatoxins	K	1
	Alcoholic Beverage Consumption	K	9
92-67-1	4-Aminobiphenyl (4-Aminodiphenyl)	K	1

91-59-8	2-Aminoaphthalene (2-Naphthylamine)	K	1
	Analgesic Mixtures Containing Phenacetin	K	4
	Arsenic Compounds, Inorganic	K	1
1332-21-4	Asbestos	K	1
113-86-6	Azathioprine	K	4
71-43-2	Benzene	K	1
92-87-5	Benzidine	K	1
542-88-1	bis(Chloromethyl) Ether	K	1
55-98-1	Busulfan (see 1,4-Butanediol Dimehtylsulfonate)	K	4
106-99-0	1,3 Butadiene	K	5
55-98-1	1,4 Butanediol Dimethylsufonate (Myleran; Busulfan)	K	4
7440-43-9	Cadmium (under Cadmium and Cadmium Compound)	K	1
10108-64-2	Cadmium Chloride (under Cadmiumand Cadmium Compound)	K	1
1306-19-0	Cadmium Oxide	K	1
10124-36-4	Cadmium Sulfate	K	1
1306-23-6	Cadmium Sulfide	K	1
305-03-3	Chlorambucil	K	2
13909-09-6	1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosoarea (meCCNU) K	K	6
107-30-2	Chloromethyl Methyl Ether	K	1
	Chromium Hexavalent Compounds	K	1
8007-45-2	Coal Tar (under Tars and Mineral Oils)	K	1
	Coke Oven Emissions	K	1
8001-58-9	Creosote (Coal) (under Tars and Mineral Oils)	K	4
8021-39-4	Creosote (Wood) (under Tars and Mineral Oils)	K	4
14464-46-1	Cristobalite [under Silica, Crystalline (Respirable Size)]	K	6
50-18-0	Cyclophosphamide	K	1
59865-13-3	Cyclosporin A (Cylcosporine A; Ciclosporin)	K	1
56-53-1	Diethylstilbestrol	K	8
1937-37-7	Direct Black 38	K	3
2602-46-2	Direct Blue 6	K	3
	Dyes that Metabolize to Benzidine	K	9
	Enviornmental Tobacco Smoke	K	9

NAMES AND SYNONYMS OF CARCINOGENS LISTED IN THE 9TH REPORT ON CARCINOGENS cont..

CASRN	NAME OR SYNONYM	LISTING IN THE 9 TH RoC	FIRST LISTED
66733-21-9	Erionite	K	1
75-21-8	Ethylene Oxide	K	2
7758-97-3	Lead Chromate (under Chromium Hexavalent Compounds)K	K	1
13909-09-6	MeCCNU[see 1-(2-Chloroethyl)-3-(4-Methylhexyl)-1nitrosoarea] K	K	6
148-82-3	Melphalan	K	1

298-81-7	Methoxsalen (under Methoxsalen with Ultraviolet A Therapy (PUVA) (<i>Methaoxsalen not carcinogenic alone</i>)	K	4
	Mineral Oils	K	1
505-60-2	Mustard Gas	K	1
55-98-1	Myleran (see 1,4-Butadienol Dimethylsulfonate)	K	4
91-59-8	2-Naphthylamine (2-Naphthylamine; 2-Aminonaphthalene)	K	1
7280-37-7	Piperazine Estrone Sulfate (under Conjugated Estrogens)	K	4
14808-60-7	Quartz [under Silica, Crystalline (Respirable Size)]	K	6
10043-92-2	Radon	K	7
	Silica, Crystalline (Respirable Size)	K	6
	Smokeless Tobacco	K	9
16680-47-0	Sodium Equilin Sulfate (under Conjugated Estrogens)	K	4
438-67-5	Sodium Estrone Sulfate (under Conjugated Estrogens)	K	5
	Solar Radiation and Exposure to Sunlamps and Sunbeds	K	9
	Soots	K	1
	Strong Inorganic Acid Mists Containing Sulfuric Acid	K	9
7789-06-2	Strontium Chromate (under Chromium Hexavalent Compounds)	K	1
10540-29-1	Tamoxifen	K	9
	Tars	K	1
52-24-4	Thiotepa [in 7 th ARC as tris(1-Aziridiny)phosphine Sulfide)]	K	2
1314-20-1	Thorium Dioxide	K	2
	Tobacco Smoking	K	9
15468-32-3	Tridymite [under Silica, Crystalline (Respirable Size)]	K	6
52-24-4	Tris(1-aziridiny)phosphine Sulfide (Thiotepa)	K	2
75-01-4	Vinyl Chloride	K	1
13530-65-9	Zinc Chromate (under Chromium Hexavalent Compounds)	K	1

Known (K)= Known to be a Human Carcinogen & Numbers designate the number of the Report on Carcinogens when first listed:

1. First Annual Report on Carcinogens, 1980
2. Second Annual Report on Carcinogens, 1981
3. Third Annual Report on Carcinogens, 1983
4. Fourth Annual Report on Carcinogens, 1985
5. Fifth Annual Report on Carcinogens, 1989
6. Sixth Annual Report on Carcinogens, 1991
7. Seventh Annual Report on Carcinogens, 1994
8. Eighth Annual Report on Carcinogens, 1998
9. Ninth Annual Report on Carcinogens, 2000

2A. Known To Be Human Carcinogens

CASRN	Name or Synonym	Known/RAHC	First Listed	Page No.
1402-68-2	Aflatoxins	K	1	15
92-67-1	4-Aminobiphenyl (4-Aminodiphenyl)	K	1	15
91-59-8	2-Aminonaphthalene (2-Naphthylamine)	K	1	39
	Analgesic Mixtures Containing Phenacetin	K	4	16
7440-38-2	Arsenic (and Certain Arsenic Compounds)	K	1	17
1303-28-2	Arsenic Pentoxide	K	1	17
1327-53-3	Arsenic Trioxide	K	1	17
1332-21-4	Asbestos	K	1	19
446-86-6	Azathioprine	K	4	22

10294-40-3	Barium Chromate (Chromium Compounds)	K	1	29
71-43-2	Benzene	K	1	23
92-87-5	Benzidine	K	1	24
542-88-1	Bis(chloromethyl) Ether	K	1	25
55-98-1	Busulfan (1.4 Butanediol Dimethylsulfonate)	K	4	27
55-98-1	1.4-Butanediol Dimethylsulfonate	K	4	27
10103-62-5	Calcium Arsenate (Arsenic Compounds)	K	1	17
52740-16-6	Calcium Arsenite (1:1) (Arsenic Compounds)	K	1	17
15194-98-6	Calcium Arsenite (2:1) (Arsenic Compounds)	K	1	17
27152-57-4	Calcium Arsenite (2:3) (Arsenic Compounds)	K	1	17
13765-19-0	Calcium Chromate (Chromium Compounds)	K	1	29
305-03-3	Chlorambucil	K	2	27
13909-09-6	1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-Nitrosourea (MeCCNU)	K	6	28
107-30-2	Chloromethyl Methyl Ether	K	1	25
1066-30-4	Chromic Acetate (Chromium Compounds)	K	1	29
1308-38-9	Chromic Oxide (Chromium Compounds)	K	1	29
	Chromite Ore (Chromium Compounds)	K	1	29
7440-47-3	Chromium (Chromium Compounds)	K	1	29
29689-14-3	Chromium Carbonate (Chromium Compounds)	K	1	29
7789-04-0	Chromium Phosphate (Chromium Compounds)	K	1	29
1333-82-0	Chromium Trioxide (Chromium Compounds)	K	1	29
8007-45-2	Coal Tar (Soots, Tars, and Mineral Oils)	K	1	42
111114-92-4	Cobalt Chromium Alloy (Chromium Compounds)	K	3	29
	Coke Oven Emissions	K	1	31
8001-58-9	Creosote (Coal)(Soots, Tars, and Mineral Oils)	K	4	42
8021-39-4	Creosote (Wood)(Soots, Tars, and Mineral Oils)	K	4	42
50-18-0	Cyclophosphamide	K	1	33
59865-13-3	Cyclosporin A (Cyclosporine A: Ciclosporin)	K	8	34
56-53-1	Diethylstilbestrol	K	1	35
10048-95-0	Sodium Hydrogen Arsenate (Arsenic Compounds)	K	1	17
66733-21-9	Erionite	K	1	17
7784-40-9	Lead Arsenate (Arsenic Compounds)	K	1	36
7758-97-6	Lead Chromate Oxide (Chromium Compounds)	K	1	29
18454-21-1	Lead Chromate Oxide (Chromium Compounds)	K	1	29
13909-09-6	MeCCNU (1-(2-Chloroethyl)-3-(4-methylhexyl)-1-Nitrosourea)	K	6	28
148-82-3	Melphanlan	K	1	37
298-81-7	Methoxsalen (Methoxsalen with Ultraviolet A Therapy (PUVA))[methoxsalen not carcinogenic alone]	K	4	38
	Mineral Oils	K	1	42
505-60-2	Mustard Gas	K	1	39
55-98-1	Myleran (1.4 Butanediol Dimethylsulfonate)	K	4	27
91-59-8	2-Naphthylamine	K	1	39
7280-37-7	piperazine Estrone Sulfate (Conjugated Estrogens)	K	4	32
7784-41-0	Potassium Arsenate (Arsenic Compounds)	K	1	17
13464-35-2	Potassium Arsenite (Arsenic Compounds)	K	1	17
7789-00-6	Potassium Chromate (Chromium Compounds)	K	1	29
7778-50-9	Potassium Dichromate (Chromium Compounds)	K	1	29
10043-92-2	Radon	K	7	40
CASRN	Name or Synonym	Known/RAHC	First Listed	Page No
7631-89-2	Sodium Arsenate (Arsenic Compounds)	K	1	17
7784-46-5	Sodium Arsenite (Arsenic Compounds)	K	1	17
7775-11-3	Sodium Chromate (Chromium Compounds)	K	1	29
10588-01-9	Sodium Dichromate (Chromium Compounds)		K	1
29				
16680-47-0	Sodium Equilin Sulfate (Conjugated Estrogens)	K	4	32
438-67-5	Sodium Estrone Sulfate (Conjugated Estrogens)	K	5	32
	Soots	K	1	42
7789-06-2	Strontium Chromate (Chromium Compounds)	K	1	29
	Tars	K	1	42
52-24-4	Tris (1-aziridinyl)phosphine Sulfide (Thiotepa)	K	2c, 8^d	46

1314-20-1	Thorium Dioxide	K	2	48
52-24-4	Thiotepa [in 7th ARC as Tris (1-aziridinyl)phosphine Sulfide]	K	2^c, 8^d	46
75-01-4	Vinyl Chloride	K	1	48
13530-65-9	Zinc Chromate (Chromium Compounds)	K	1	29

^a Known (K) = *Known to be a Human Carcinogen*

RAHC (R) = *Reasonably Anticipated to be a Human Carcinogen*

^b Numbers designated the number of the Report on Carcinogens when first listed.

1 = First Annual Report on Carcinogens, 1980

2 = Second Annual Report on Carcinogens, 1981 3 =

Third Annual Report on Carcinogens, 1983 4 =

Fourth Annual Report on Carcinogens, 1985 5 = Fifth

Annual Report on Carcinogens, 1989 6 = Sixth

Annual Report on Carcinogens, 1991 7 = Seventh

Annual Report on Carcinogens, 1994 8 = Eighth

Report on Carcinogens, 1997

^c First time listed as *Reasonable Anticipated to be a Human Carcinogen*

Bold entries indicate new listing in The Report on Carcinogens, Eighth Edition

2B. Reasonably anticipated to be Human Carcinogens

CASRN	Name or Synonym	Known/RAHC	First Listed	Page No.
75-07-0	Acetaldehyde	R	6	51
53-96-3	2-Acetylaminofluorene	R	2	52
79-06-1	Acrylamide	R	6	53
107-13-1	Acrylonitrile	R	2	
55				
23214-92-8	Adriamycin® (Doxorubicin hydrochloride)	R	4	56
117-79-3	2-Aminoanthraquinone	R	3	
57				
97-56-3	o-Aminoazotoluene	R	5	58
82-28-0	1-Amino-2-methylantraquinone	R	2	59
61-82-5	Amitrole	R	3	60
134-29-2	o-Anisidine Hydrochloride	R	2	
176				
	Aroclor (Polychlorinated Biphenyls)	R	2	176
11097-69-1	Aroclor® 1254 (Polychlorinated Biphenyls)	R	2	176
11096-82-5	Aroclor® 1260 (Polychlorinated Biphenyls)	R	2	176
320-67-2	Azacitidine (5-Azacytidine)	R	8	61
154-93-8	BCNU [Bis(chloroethyl) Nitrosourea]		R	465
56-55-3	Benz[a]anthracene (Polycyclic Aromatic Hydrocarbons)	R	2	178
205-99-2	Benzol[b]fluoranthene (Polycyclic Aromatic Hydrocarbons)	R	2	
178				
205-82-3	Benzol[f]fluoranthene (Polycyclic Aromatic Hydrocarbons)	R	2	
178				
207-08-9	Benzol[k]fluoranthene (Polycyclic Aromatic Hydrocarbons)	R	2	
178				
50-32-8	Benzol[a]pyrene (Polycyclic Aromatic Hydrocarbons)	R	2	178
98-07-7	Benzotrichloride	R	4	62
7440-41-7	Beryllium (Beryllium Compounds)	R	2	62
12770-50-2	Beryllium Aluminum Alloy (Beryllium Compounds)	R	2	62
66104-24-3	Beryllium Aluminum Alloy (Beryllium Compounds)	R	2	62
7787-47-5	Beryllium Chloride (Beryllium Compounds)	R	2	62
	Beryllium Copper (Beryllium Compounds)	R	2	62
7787-49-7	Beryllium Fluoride (Beryllium Compounds)	R	2	62
13327-32-7	Beryllium Hydroxide (Beryllium Compounds)	R	2	62
1304-56-9	Beryllium Oxide (beryllium Compounds)	R	2	62
13598-15-7	Beryllium Phosphate (Beryllium Compounds)	R	2	
62				
13510-49-1	Beryllium Sulfate (Beryllium Compounds)	R	2	62
7787-56-6	Beryllium Sulfate Tetrahydrate (Beryllium Compounds)	R	2	62

39413-47-3	Beryllium Zinc Silicate (Beryllium Compounds)	R		2		62
1302-52-9	Beryl Ore (Beryllium Compounds)	R		2		62
154-93-8	Bis(chlorethyl) Nitrosourea (BCNU)		R		4	
65						
90-94-8	Bis(dimethylamino)benzophenone (Michler's Ketone)	R		3		144
117-81-7	Bis(2-ethylhexyl) Phthalate [Di(2-ethylhexyl)phthalate]		R		3	
100						
75-27-4	Bromodichloromethane	R		6		66
106-99-0	1,3-Butadiene		R		5	
67						
25013-16-5	Butylated Hydroxyanisole (BHA)	R		6		68
7440-43-9	Cadmium (Cadmium Compounds)	R		1		69
513-78-0	Cadmium Carbonate (Cadmium Compounds)		R		1	
69						
10108-64-2	Cadmium Chloride (Cadmium Compounds)	R		1		69
14486-19-2	Cadmium Fluoborate (Cadmium Compounds)	R		1		69
10325-94-7	Cadmium Nitrate (Cadmium Compounds)	R		1		69
1306-19-0	Cadmium Oxide (Cadmium Compounds)	R		1		69
10124-36-4	Cadmium Sulfate (Cadmium Compounds)	R		1		69
1306-23-6	Cadmium Sulfide (Cadmium Compounds)	R		1		69
56-23-5	Carbon Tetrachloride	R		2		70
13010-47-4	CCNU [1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea	R		4		76
	Ceramic Fibers	R		7		74
143-50-0	Chlordecone (see Kepone®)		R		2	
135						
115-28-6	Chlorendic Acid		R		5	
74						
63449-39-8	Chlorinated Paraffins	R		5		75
Z108171-26-2	Chlorinated Paraffins (C ₁₂ , 60% Chlorine)	R		5		75
13010-47-4	1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea (CCNU)	R		4		76
67-66-3	Chloroform	R		2		77
563-47-3	3-Chloro-2-methylpropene		R		5	
78						
95-83-0	4-Chloro-o-phenylenediamine	R		4		79
95-69-2	p-Chloro -o-toluidine	R		8		80
3165-93-3	p-Chloro -o-Toluidine Hydrochloride	R		8		80
54749-90-5	Chlorozotocin	R		8		81
569-61-9	C.I. Basic Red 9 Monohydrochloride			R		582
15663-27-1	Cisplatin	R		6		83
120-71-8	p-Cresidine		R		2	
83						
14464-46-1	Cristobalite (Silica, Crystalline)	R		6		190
135-20-6	Cupferron		R		3	
84						
4342-03-4	Dacarbazine	R		4		85
117-10-2	Danthron (1,8-Dihydroxyanthraquinone)	R		8		85
50-29-3	DDT (Dichlorodiphenyltrichloroethane)	R		4		86
13654-09-6	Decabromobiphenyl (Polybrominated Biphenyls)	R		3		175
117-81-7	DEHP [Di(2-ethylhexyl) Phthalate]		R		3	
100						
55-18-5	DEN (N-Nitrosodiethylamine)	R		2		159
39156-41-7	2,4-Diaminoanisole Sulfate		R		2	
88						
101-80-4	Diaminodiphenyl Ether		R		5	
171						
95-80-7	2,4-Diaminotoluene	R		2		88
226-36-8	Dibenz[a,h]acridine (Polycyclic Aromatic Hydrocarbons)		R		2	
178						
224-42-0	Dibenz[a,j]acridine (Polycyclic Aromatic Hydrocarbons)		R		2	
178						
53-70-3	Dibenz[a,h]anthracene (Polycyclic Aromatic Hydrocarbons)	R		2		178
194-59-2	7H-Dibenzol[c,g]carbazole (Polycyclic Aromatic Hydrocarbons)		R		2	

178					
192-65-4	Dibenzol[a,e]pyrene (Polycyclic Aromatic Hydrocarbons)	R		2	
178					
189-64-0	Dibenzol[a,h]pyrene (Polycyclic Aromatic Hydrocarbons)	R		2	
178					
189-55-9	Dibenzol[a,r]pyrene (Polycyclic Aromatic Hydrocarbons)	R		2	
178					
191-30-0	Dibenzol[a,l]pyrene (Polycyclic Aromatic Hydrocarbons)	R		2	
178					
96-12-8	1,2-Dibromo-3-chloropropane	R		2	90
106-93-4	1,2-Dibromoethane (Ethylene dibromide:EDB)		R		2
91					
106-46-7	1,4-Dichlorobenzene		R		5
93					
91-94-1	3,3'-Dichlorobenzidine	R		2	94
612-83-9	3,3'-Dichlorobenzidine Dihydrochloride		R		6
94					
50-29-3	Dichlorodiphenyltrichloroethane (DDT)	R		4	86
107-06-2	1,2-Dichloroethane (Ethylene Dichloride)		R		2
95					
75-09-2	Dichloromethane (Menthylene Chloride)	R		5	97
542-75-6	1,3-Dichloropropene (Technical Grade)		R		5
98					
1464-53-5	Diepoxybutane	R		3	99
95-06-7	N,N-Diethyldithiocarbamic acid 2-chloroallyl ester (Sulfallate)	R		3	194
117-81-7	Di(2-ethylhexyl)Phthalate		R		3
100					
55-18-5	Diethylnitrosamine (N-Nitrosodiethylamine)	R		2	159
64-67-5	Diethyl Sulfate	R		4	102
101-90-6	Diglycidyl Resorcinol Ether		R		5
103					
117-10-2	1,8-Dihydroxyanthraquinone (Danthron)	R		8	85
119-90-4	3,3'-Dimethoxybenzidine		R		3
104					
60-11-7	4-Dimethylaminoazobenzene	R		2	105
119-93-7	3,3'-Dimethylbenzidine		R		3
105					
79-44-7	Dimethylcarbamoyl Chloride		R		2
106					
57-14-7	1,1-Dimethylhydrazine (UDMH)	R		4	107
62-75-9	Dimethylnitrosamine (N-Nitrosodimethylamine)	R		2	160
77-78-1	Dimethyl Sulfate	R		2	108
513-37-1	Dimethylvinyl Chloride		R		6
109					
42397-64-8	1,6-Dinitropyrene	R		8	151
42397-65-9	1,8-Dinitropyrene	R		8	152
123-91-1	1,4-Dioxane		R		2
109					
1937-37-7	Direct Black 38	R		3	111
2602-46-2	Direct Blue 6	R		3	112
2475-45-8	Disperse Blue 1	R		8	113
62-75-9	DMN (N-Nitrosodimethylamine)	R		2	160
23214-92-8	Doxorubicin hydrochloride (Adriamycin®)	R		4	56
759-73-9	ENU		R		2
163					
106-89-8	Epichlorohydrin		R		4
114					
50-28-2	Estradiol-17 (Estrogens-Not Conjugated)	R		4	115
53-16-7	Estrone (Estrogens-Not Conjugated)	R		4	116
57-63-6	Ethinylestradiol (Estrogens-Not Conjugated)	R		4	117
140-88-5	Ethyl Acrylate		R		5
119					

51-79-6	Ethyl Carbamate (Urethane)	R		3		208
106-93-4	Ethylene Dibromide		R		2	
91						
107-06-2	Ethylene Dichloride		R		2	
95						
75-21-8	Ethylene Oxide	R		2		119
96-45-7	Ethylene Thiourea	R		3		122
62-50-0	Ethyl Methanesulfonate	R		6		123
759-73-9	N-Ethyl-N-Nitrosourea		R		2	
163						
	FireMaster BP-6 (Polybrominated Biperyls)	R		3		175
67774-32-7	Firemaster FF-1 (Polybrominated Biperyls)	R		3		175
500-00-0	Formaldehyde (gas)		R		2	
124						
110-00-9	Furan	R		8		126
	Glasswool	R		7		127
556-52-5	Glycidol	R		7		129
67774-32-7	Hexabromobiphenyl	R		3		175
118-74-1	HexaChlorobenzene		R		3	
130						
319-84-6	a-Hexachlorocyclohexane		R		2	
137						
319-85-7	b-Hexachlorocyclohexane		R		2	
137						
58-89-8	y-Hexachlorocyclohexane	R		2		137
608-73-1	Hexachlorocyclohexane		R		2	
137						
67-72-1	Hexachloroethane	R		7		131
608-31-9	Hexamethylphosphoramide		R		4	
132						
302-01-2	Hydrazine		R		3	
133						
10034-93-2	Hydrazine Sulfate	R		3		133
122-66-7	Hydrazobenzene		R		2	
134						
193-39-5	Idenol		R		2	
178						
9004-66-4	Iron Dextran Complex	R		2		135
25429-29-2	Kanechlor®500 (Polychlorinated Biphenyls)	R		3		176
143-50-0	Kepone ® (Chlordecone)		R		2	
135						
301-04-2	Lead Acetate		R		2	
136						
7446-27-7	Lead Phosphate	R		2		136
58-89-9	Lindane	R		2		137
101-14-4	MBOCA		R		3	
139						
72-33-3	Mestranol (Estrogens-Not Conjugated)	R		4		118
75-55-8	2-Methylaziridine (Propylenimine)	R		4		138
3697-24-3	5-Methylchrysene	R		2		178
101-14-4	4,4'-Methylenebis		R		3	
139						
101-61-1	4,4'-Methylenebis		R		3	
140						
75-09-2	Methylene Chloride	R		5		97
101-77-9	4,4'-Methylenedianiline		R		4	
141						
13552-44-8	4,4'-Methylenedianiline Dihydrochloride	R		4		141
66-27-3	Methyl Menthanesulfonate	R		6		142
70-25-7	N-Methyl-N'-nitro-N-nitrosoguanidine	R		6		143
684-93-5	N-Methyl-N-Nitrosoguanidine		R		2	
164						

443-48-1	Metronidazole	R		4	
144					
90-94-8	Michler's Ketone	R		3	144
2385-85-5	Mirex	R		2	145
7440-02-0	Nickel (Nickel Compounds)	R		1	146
373-02-4	Nickel Acetate (Nickel Compounds)		R		1
146					
3333-67-3	Nickel Carbonate (Nickel Compounds)	R		1	146
13463-39-3	Nickel Carbonyl (Nickel Compounds)	R		1	146
12054-48-7	Nickel Hydroxide (Nickel Compounds)	R		1	146
121125-56-3	Nickel Hydroxide (Nickel Compounds)	R		1	146
1271-28-9	Nickelocene (Nickel Compounds)	R		1	146
1313-99-1	Nickel oxide (Nickel Compounds)	R		1	146
12035-72-0	Nickel Subsulfide (Nickel Compounds)	R		1	146
123-13-9	Nitilotriacetic Acid		R		3
149					
91-23-6	o-Nitroanisole	R		8	150
7496-02-8	6-Nitrochrysene	R		8	152
1836-75-5	Nitrofen	R		3	155
55-86-7	Nitrogen Mustard Hydrochloride	R		4	155
49-46-9	2-Nitropropane	R		4	156
5522-43-0	1-Nitropyrene	R		8	153
57835-92-4	4-Nitropyrene	R		8	154
38252-74-3	N-Nitroso-n-butyl-N-(3-carbopropyl)amine	R		2	157
3817-11-6	N-Nitroso-n-butyl-N-(4-hydroxybutyl)amine	R		2	157
924-16-3	N-Nitrosodi-n-butylamine		R		2
157					
1116-54-7	N-Nitrosodiethanolamine	R		2	158
55-18-5	N-Nitrosodiethylamine	R		2	159
62-75-9	N-Nitrosodimethylamine	R		2	160
621-64-7	N-Nitrosodi-n-propylamine		R		2
162					
759-73-9	N-Nitroso-N-ethylurea		R		2
163					
64091-91-4	4-(N-Nitrosomethylamino)-1-(3-pyridyl)-1-butanone (NNK)	R		6	164
684-93-5	N-Nitroso-N-methylurea		R		2
164					
4549-40-0	N-Nitrosomethylvinylamine	R		2	165
59-89-2	N-Nitrosomorpholine	R		2	166
16543-55-8	N-Nitrosornicotine	R		2	167
100-75-4	N-Nitrosopiperidine		R		2
167					
930-55-2	N-Nitrosopyrrolidine		R		2
168					
13256-22-9	N-Nitrososarcosine	R		2	169
64091-91-4	NNK	R		6	164
68-22-4	Norethisterone	R		4	170
303-47-9	Ochratoxin A		R		6
170					
61288-13-9	Octabromobiphenyl	R		3	175
101-80-4	4,4'-Oxydianiline		R		5
171					
434-07-1	Oxymetholone		R		1
172					
	PAHs	R		5	178
	PBBs	R		3	175
1336-36-3	PCBs	R		2	176
127-18-4	Perchloroethylene		R		5
196					
62-44-2	Phenacetin	R		1	173
136-40-3	Phenazopyridine Hydrochloride		R		2
173					

63-92-3	Phenoxybenzamine Hydrochloride	R	5	174
57-41-0	Phenytoin	R	1	174
	Polybrominated Biphenyls	R	3	175
1336-36-3	Polychlorinated Biphenyls	R	2	176
	Polycyclic Aromatic Hydrocarbons	R	5	178
366-70-1	Procarbazine Hydrochloride		R	2
181				
57-83-0	Progesterone	R	4	182
1120-71-4	1,3-Propane Sultone	R	4	183
57-57-8	b-Propiolactone	R	2	184
75-56-9	Propylene Oxide	R	6	184
75-55-8	Propylenimine	R	4	138
51-52-5	Propylthiouracil	R	4	186
14808-60-7	Quartz	R	6	190
50-55-5	Reserpine	R	2	187
81-07-2	Saccharin	R	2	188
94-59-7	Safrole	R	2	189
7446-34-6	Selenium Sulfate	R	3	190
	Silica, Crystalline	R	6	190
18883-66-4	Streptozotocin	R	2	193
95-06-7	Sulfallate	R	3	194
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	R	2	195
127-18-4	Tetrachloroethylene		R	5
196				
509-14-8	tetranitromethane		R	7
197				
62-55-5	Thioacetamide	R	3	198
62-56-5	Thiourea	R	3	199
26471-62-5	Toluene Diisocyanate	R	4	200
95-53-4	o-Toluidine	R	3	202
636-21-5	o-Toluidine Hydrochloride		R	2
202				
8001-35-2	Toxaphene	R	2	203
50-29-3	1,1,1-Trichloro-2,2-bis	R	4	86
88-06-2	2,4,6-Trichlorophenol	R	3	204
96-18-4	1,2,3,-Trichloropropane	R	8	205
15468-32-3	Tridymite	R	6	190
126-72-7	Tris Phosphate		R	2
207				
57-14-7	UDMH	R	4	107
51-79-6	Urethane	R	3	208
106-87-6	4-Vinyl-1-cyclohexene Diepoxide		R	7
209				

^a Known (K) = Known to be a Human Carcinogen

RAHC (R) = Reasonably Anticipated to be a Human Carcinogen

^b Numbers designate the number of the Report on Carcinogens when first listed.

1 = First Annual Report on Carcinogens (1980)

2 = Second Annual Report on Carcinogens, 1981 3 =

Third Annual Report on Carcinogens, 1983 4 =

Fourth Annual Report on Carcinogens, 1985 5 = Fifth

Annual Report on Carcinogens, 1989 6 = Sixth

Annual Report on Carcinogens, 1991 7 = Seventh

Annual Report on Carcinogens, 1994 8 = Eighth

Report on Carcinogens, 1997

^c First time listed as *Reasonable Anticipated to be a Human Carcinogen*

Bold entries indicate new listing in The Report on Carcinogens, Eighth Edition

3. Delisted Substances

In this Table are several substances formerly listed in the NTP Report on Carcinogens. These chemicals are not present in the *Eighth Report on Carcinogens* because either no documented continuing exposure of residents of the United States to these chemicals/substances exists (since they are produced or used), or because there has been a revision in the rulings/findings as to the carcinogenic potential of these entries (due to new tests, etc.). The last report on Carcinogens in which these substances appeared and to which therefore reference can be made for all information available, is also given in this Table.

3. Delisted Substances

Substance Name	CASRN	Last Listing	Reason for delisting
Aramite®	140-57-8	4 th ARC (1985)	No U.S. residents exposed
N,N-Bis(2-chloroethyl)-2-naphthylamine (Chlomaphazine)	494-03-1	4 th ARC (1985)	No U.S. residents exposed
Chloramphenicol	56-75-7	1 st ARC (1980)	Human data considered inadequate
Cycasin	14901-08-07	4 th ARC (1985)	No U.S. residents exposed
Methyl Iodide	78-88-4	4 th ARC (1985)	Re-evaluated by IARC: now considered "equivocal"
5-Nitro-o-anisidine	99-59-2	5 th ARC (1989)	Insufficient evidence of carcinogenicity
p-Nitrosodiphenylamine	156-10-5	5 th ARC (1989)	Insufficient evidence of carcinogenicity
ARC=Annual Report of Carcinogens			

