



# CHEMICAL HYGIENE PROGRAM

## LABORATORY SAFETY MANUAL

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## **Preface**

Towson University is responsible for providing the safest possible working environment for all its employees. While it is impossible to remove all of the hazards that are present in research/teaching laboratories, the Chemical Hygiene Program (CHP) has been compiled in an effort to make the laboratory setting reasonably safe. The primary responsibility for laboratory safety lies with the occupants. The material contained in this program will provide important safety information for all employees working in laboratories on campus. The CHP does not stand-alone; other more specific programs such as fire safety and radiation safety support it, which are available at EHS's web site at [www.towson.edu/ehs/index.html](http://www.towson.edu/ehs/index.html). These programs and various specific training sessions will provide additional information concerning laboratory safety techniques.

The Occupation Health and Safety Administration (OSHA) have set forth regulations to be used for establishing the CHP. These are the foundation for Towson University's Chemical Hygiene Program. The Department of Environmental Health and Safety (EHS) has been delegated the authority for implementation of the CHP on campus. The complete written program is available to all campus employees at EHS's web site located at:

**[www.towson.edu/ehs/programs/chemical/index.html](http://www.towson.edu/ehs/programs/chemical/index.html)**

As with any safety program, changes to this program will be made from time to time. These changes will be due to changing regulations and implementing more effective ways to enhance the safety in laboratories.

(Note: This is an employee-oriented program. Whenever possible, the concepts, procedures, and practices contained or outlined herein are to be utilized when dealing with students in a setting where hazardous materials are utilized. Inquiries can be referred to EHS.)

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# Emergency Telephone Numbers

1. Baltimore County Fire Department (BCFD) .....911
2. Towson University Police Department (TUPD).....x4-4444
3. Medical Emergency (Ambulance) .....911
4. Department of Environmental Health & Safety.....x4-2949
5. Poison Control Center .....1-800-424-9300
6. Health Center .....x4-2466

## **I. Departmental Responsibilities**

### **A. The Department of Environmental Health & Safety (EHS)**

The function of this department is to reduce the possibility of accidents in research and teaching laboratories, which will, in turn, protect the campus population. The President through his Vice-President for Administration and Finance has delegated the authority to the Associate Vice-President for Facilities Management to achieve this goal. EHS, as a part of Facilities Management, will develop and implement campus safety standards that will provide a safe working environment. This will be accomplished through assistance from local, state, and federal agencies as well as the campus community. Contact EHS at x4-2949 or by e-mail at [safety@towson.edu](mailto:safety@towson.edu) .

### **B. Chemical Hygiene Officer (CHO)**

The CHO will be EHS's Program Coordinator. The function of the CHO will be to work with the administration and other employees to develop and implement appropriate chemical hygiene policies and practices. The CHO will conduct periodic safety audits of all campus laboratories. The CHO will also provide information and training to campus employees regarding safe laboratory practices.

### **C. The Academic Department Head**

The function of the department head is to select a representative to be the departmental contact with EHS's CHO. They will also be responsible for budgeting for safety needs appropriate for laboratories and ensuring that all departmental employees have been provided with the University website where they can access the University's Employee Safety Programs Handbook. (Additional acknowledgement forms can be obtained from EHS).

### **D. Academic Department Contact**

The function of the academic department contact will be to assist EHS with their expertise. This may include meetings, phone conversations or e-mails, to discuss the advancement in research, changes in experimental protocols, and appropriate departmental safety needs.

**E. The Principal Investigator (PI) or Laboratory Instructor (LI)**

The PI or LI (or the person in charge of the laboratory) will provide the needed information regarding the experiments being performed to EHS using the Assurance on Hazardous Procedure Form. (Student laboratory procedures will be excluded from this requirement). This information will be used to determine the safety precautions that will need to be established. The PI or LI will also be responsible for establishing recommended safe work practices, providing personal protective equipment when needed, ensuring that all personnel working in the laboratory are properly trained in safe laboratory practices and ensuring all applicable safety procedures are being complied with.

The PI or LI shall also be responsible for notifying EHS when a chemical is added or removed from their room(s). Include your name, the name of the chemical(s), quantity, manufacturer, building and room number where the chemical is being added/removed.

**F. Laboratory Workers**

Laboratory workers are responsible for adhering to the laboratory practices that have been established by the PI or LI, as well as outlined in the University's CHP.

## **II. Guidelines for General Laboratory Safety**

The basic purpose of a chemical hygiene program is to protect the campus population from potential hazards that may exist in laboratories. Use of common-sense safety rules can eliminate the majority of problems that may arise. Since all laboratory settings are different, the PI or LI is responsible for establishing and implementing rules specific to their research.

As procedures change, so must the precautions that are taken. Therefore, to have an effective safety program, additional rules must be implemented from time to time. By doing so, the possibility of an accident occurring is reduced. The following guidelines can be used for general laboratory safety to establish a basic set of rules:

### **A. General Laboratory Safety**

#### **1. Entrance into the laboratory**

The PI or LI shall:

- a. Determine the hazards that are present in the laboratory and post the entrance accordingly. (Both sides of the door should be posted to warn personnel entering the laboratory.) EHS is available to provide assistance for determining the postings.
- b. In addition to these hazard labels, the door shall be posted with the TUPD's emergency telephone number (x4-4444). The TUPD will maintain the phone numbers of the PI or LI responsible for the laboratory.

#### **2. Personnel entering laboratory**

The PI or LI shall:

- a. Restrict access to laboratories by unauthorized personnel.
- b. Before permitting entry into a laboratory, ensure that all hazards that are present have been identified and are posted on the door. Examples of the labels used on entrances or in areas of the laboratory can be found in Appendix A.
- c. Provide assistance to personnel entering a laboratory to ensure they are aware of all hazards present and understand what they are.

3. General Rules

The PI or LI shall:

- a. prohibit smoking, eating, drinking, chewing gum, the possession of food items or containers or utensils used for food, or application of cosmetics in the laboratory.
- b. prohibit horseplay, practical jokes, or similar acts of carelessness.
- c. ensure that safety equipment is present in their laboratory(ies) as required.
  1. This equipment should include:

Fire Extinguisher  
Smoke Detectors (if possible)  
Emergency Eyewash\*  
Emergency Shower\*  
Fume Hoods/Biological Safety Cabinets  
Telephone

NOTE: Per OSHA, emergency eyewash & showers are required to be readily accessible and within ten (10) seconds of any laboratory where chemicals are being used.

2. First-Aid kits will be provided and maintained by each department. A central location can be used for a fully stocked kit. This location should be prominently posted by the entrance in all laboratories. This will ensure that every accident, regardless of severity, is reported and the inventory in the kit controlled. The PI or LI will not be responsible for administering first-aid. In all “serious cases” requiring emergency treatment call for Emergency Response (from a safe location):

**FROM A CAMPUS PHONE: 911**  
**FROM AN EMERGENCY BLUE LIGHT/YELLOW PHONE: PRESS EMERGENCY BUTTON OR DIAL 911**  
**FROM A PAY PHONE: 911**

3. Ensure that all the equipment is free of obstruction.
  4. Ensure proper posting of the equipment to aid personnel in the event of an emergency.
  5. When working with potentially harmful chemicals, use a fume hood or glove box for additional protection.
  6. Be responsible for checking the operability of the safety equipment on a regular basis. If deficiencies are found, immediately contact Facilities Management to initiate repair of the equipment. EHS will conduct periodic inspections of emergency safety equipment and engineering controls with additional inspections when repair of equipment is completed.
- d. Require proper laboratory attire be worn. This includes:
1. Appropriate ANSI approved eyewear for the hazard.
  2. Closed-tip shoes (avoid wearing sneakers).
  3. Appropriate gloves.
  4. Flame-retardant lab coat.

A chart comparing the types of eye protection and current ANSI Z87.1 selection chart can be found in Appendix B. This can be used to determine the type of protection needed. It is recommended that tight-fitting, splash-proof, impact-resistant safety goggles be worn at all times. This will provide the maximum protection for most situations. For personnel who wear contact lenses, it should be noted that they do not provide physical or chemical protection. Except for individuals that are medically required to wear contact lenses, it is recommended that they should not be worn in the laboratory. Examples of appropriate materials used for gloves and aprons can be found in Appendix C. Confining loose clothing and long hair is also recommended.

- e. Practice good housekeeping. This includes:
1. Ensuring that the new, permanent containers are labeled with common/trade names, chemical name, manufacturer, and appropriate precautions. Do not use chemical structures or formulas as sole identification.

2. Promptly disposing of all old or expired chemicals in accordance with TU's Hazardous Waste Management Procedures:  
[www.towson.edu/ehs/programs/chemical/index.html](http://www.towson.edu/ehs/programs/chemical/index.html)
  3. Keeping aisles and exits clear at all times.
  4. Avoiding storage of chemicals and gas cylinders in hallways.
  5. Storing chemicals in closed containers.
  6. Utilizing proper procedures for spill clean up. (Emergency procedures, contained in this manual, will provide further information for handling spills.)
- f. If an accident occurs or a dangerous situation arises isolate the area and notify the personnel in charge of the laboratory immediately. Refer to TU's Emergency Response Guide for additional information:  
[www.towson.edu/ehs/programs/environmentalsafety.html](http://www.towson.edu/ehs/programs/environmentalsafety.html)
- g. When leaving the laboratory under normal circumstances,
1. Turn off all services not in use. This includes water, electric, gas, and vacuum services.
  2. Lower all fume hood sashes to lowest practical settings.
  3. Turn off all lights.
  4. Lock all entrances to the laboratory.

## **B. Chemical Safety Guidelines**

The PI or LI shall:

1. **Experiments**
  - a. Only do experiments authorized by the Department.
  - b. Know the hazards associated with the experiment. Obtain the necessary information and training before performing the experiment.

- c. Conduct dry runs to familiarize yourself with new protocols.
- d. Not leave experiments unattended unless they are "failsafe". Safety precautions that must be taken include leaving the lights on, posting appropriate warning signs, and providing for proper containment of toxic substances in the event of an accident. It is best to assume that no experiment is "failsafe".
- e. Before performing an experiment, visually inspect the apparatus to be used. Check all tubing for deterioration. Avoid the use of broken or damaged glassware which may increase the possibility of an accident occurring. When using an evacuated glass apparatus, shield or wrap the container to contain chemicals and fragments in the event of an implosion.
- f. Use appropriate warning signs to notify personnel in the laboratory of possible hazards. Examples can be found in Appendix A.
- g. Do all experiments as far back on the bench or in the fume hood as possible. This will reduce the chances of accidental breakage.
- h. Use secondary containment devices (SCD's) to contain possible spills for all hazardous chemicals under the following circumstances:
  - 1. When transporting chemicals from one location to another in or outside of the laboratory.
  - 2. When transferring chemicals from one container to another (e.g., consolidating waste).
  - 3. When it is unsafe to transfer chemicals from a corroded container.
  - 4. When using large quantities (>5 ml) of mercury (e.g., manometers).
  - 5. For segregation of hazard classes when storing chemicals in the same area. (Common incompatibles can be found in Appendix G. For instance, storing strong acids with strong bases.)



6. For storage of hazardous wastes.
  - a. Leave plenty of time available to accomplish the experiment. Hurrying through a process may cause additional dangers to arise.
  - j. Only use equipment for its designed purpose.
  - k. Use appropriate fume hoods or other local ventilation devices for experiments that release toxic vapors or harmful agents. Make sure that the fume hood is properly functioning prior to use. As a rule of thumb, use a local ventilation device when working with volatile chemicals with a Permissible Exposure Limit (PEL) or a Threshold Limit Value (TLV) of less than 50 parts per million (ppm). A list of the current OSHA limits, with explanations, can be found in Appendix D.
  - l. Not overlook the possibility that scaling up a process will add new hazards.
  - m. Always use appropriate personnel protective equipment at all times when using hazardous chemicals in the laboratory.
  - n. Avoid working alone in the laboratory. If you must work after hours, make certain that there is someone present in the building that will check on you. When no one is present in the building, the TUPD can perform routine checks. The TUPD will need to be contacted to request periodic checks.
  - o. Be familiar with all established laboratory safety and emergency procedures.

## 2. **Chemical Use**

- a. Label all chemical containers with the date received and date opened. This will provide information regarding the stability of the chemical and can be used to determine if disposal is necessary. Also, ensure that the label has the proper IUPAC name, manufacturer and associated hazards for use of the chemical. Notify EHS when chemicals are added or removed from your room(s).
- b. Read the information on the chemical label prior to use and follow all of the precautions.

- c. Avoid direct contact with all chemicals. Always wash potentially exposed skin, especially hands, before leaving the laboratory.
- d. Not work with toxic chemicals in confined spaces which are inadequately ventilated.
- e. Avoid underestimating the risk. Always be prepared for unexpected violent reactions. For mixtures, assume that it is more toxic than its most toxic component, unless the Material Safety Data Sheet indicates otherwise.
- f. Strictly Prohibit mouth pipetting of all liquids.
- g. When transferring solvents from one container to another, ground all metal containers. A spark may cause a solvent fire. Ensure that the new, permanent containers are labeled with common/trade name, chemical name, manufacturer, and appropriate precautions. Do not use chemical structures as sole identification.
- h. Handle chemicals carefully at all times. Return chemicals to storage areas after use.
- i. Add all reagents slowly, keeping aware of any reactions that may take place. If a reaction does occur, stop the process immediately.
- j. Always add concentrated solutions, especially acids, to water or less concentrated solutions as slowly as possible. This will avoid violent reactions.
- k. Avoid tasting or smelling chemicals. Vent any apparatus which may discharge toxic chemicals into a local ventilation device, such as a fume hood. If you must smell a chemical, do not smell it directly. Wave the fumes past your nose.

**C. Safety Guidelines for Specific Materials or Devices**

The PI or LI shall:

**1. Peroxide-forming chemicals**

- a. Refer to TU's Hazardous Waste Management Procedures for a list of commonly used chemicals that form peroxides at:  
[www.towson.edu/ehs/programs/chemical/index.html](http://www.towson.edu/ehs/programs/chemical/index.html)

## 2. **Perchloric Acid**

- a. For concentrations of 85% or less:
  - 1. When heating a solution, a perchloric acid fume hood shall be used. These hoods are designed specifically for use with perchloric acid and are manufactured with a wash-down system and special lining material to avoid the buildup of perchlorates in the system. Contact EHS for additional information concerning these hoods.
  - 2. Avoid having the solution come in contact with strong dehydrating agents, oxidizable materials, or combustible materials.
  - 3. Minimize quantities present in the laboratory.
  - 4. Use appropriate safety equipment.
  - 5. In case of spill, dilute with water immediately. Follow emergency procedures contained in this manual.
- b. For concentrations greater than 85% (in addition to the requirements stated above):
  - 1. Only properly trained personnel should work with these concentrations.
  - 2. A second person must be present in the room when these experiments are being performed.
  - 3. Only fresh samples should be used and, if possible, only the amount needed should be made. Neutralize or dilute all unused acid at the end of each day.

## 3. **Mercury**

- a. Replace all mercury containing devices with environmentally safe, mercury free or digital devices.
- b. Use secondary basins to contain spills.
- c. Keep all containers closed when not in use.

- d. If a spill occurs, isolate the area and follow the procedures contained in TU's Mercury Spill Cleanup Procedures:

[www.towson.edu/ehs/programs/chemical/index.html](http://www.towson.edu/ehs/programs/chemical/index.html)

#### 4. **Radioactive Materials/Radiation-Producing Devices**

The PI or LI shall:

- a. Apply for authorization through EHS for the possession and use of radioactive materials or radiation-producing devices.
- b. Only use radioactive materials in areas that are authorized for use. Do not transport materials off campus without contacting EHS for approval.
- c. Before using radioactive material, obtain and wear proper dosimetry.
- d. When working with radioactive materials, follow the three basic principles of health physics:
  - 1. Limit the time in the presence of radiation.
  - 2. Work at the farthest possible distance from the radiation.
  - 3. Use appropriate shielding to reduce exposure to the radiation.
- e. Perform regular surveys in the laboratory that will ensure that an area is not contaminated and that personal exposures to radiation are kept as low as reasonably achievable.
- f. Do not leave laboratories containing radioactive materials unsecured.
- g. Label all storage areas to warn other personnel present in the laboratory. Examples of appropriate labels can be found in Appendix A.

- h. For additional information pertaining to the use of radioactive materials or radiation-producing devices can be found in the Radiation Protection Program:

[www.towson.edu/ehs/programs/biologicalsafety/index.html](http://www.towson.edu/ehs/programs/biologicalsafety/index.html)

## 5. **Lasers**

The PI or LI shall:

- a. Before use, the class of laser shall be determined. Most manufacturers will provide this information. If the class of the laser is not specified, contact EHS.
- b. Ensure that the entrance or the area in the laboratory and all lasers (except Class 1) are posted with appropriate warning signs. See Appendix A for examples of postings.
- c. Never look directly into the beam or pump source.
- d. Ensure the beam is discharged to a non-reflective, fire-resistant target. Do not aim the beam with your eye. Written procedures for aligning class 2, 3a, 3b, and 4 lasers shall be established. The path of the laser should be established above or below eye level.
- e. Ensure that all laser operators are properly trained or directly supervised at all times during use for all classes of lasers. (For class 3b and 4 lasers, only properly qualified and trained faculty, staff or graduate students may operate the device.)
- f. For class 3b and 4 lasers, establish written standard operating procedures. These written procedures shall be available to operators and maintenance personnel at all times. Provide a copy to EHS.
- g. Use safety devices (i.e. interlocks) at all times. Never bypass this device when using the laser.
- h. Control access to areas where class 3b or 4 lasers are used at all times. Keep spectators outside of these controlled areas at all times.

- i. Wear eye protection for class 3b and 4 lasers. Eye protection worn must be for the specific wavelength of the laser. Eye examinations shall be performed on an annual basis for personnel working with these classes of lasers. Contact EHS to arrange for this. Departments are responsible for all costs. EHS also recommends the use of eye protection for class 2 or 3a lasers.
- j. When repair work is required, only trained personnel may perform work for all classes of lasers. Special precautions should be established to prevent accidental exposure.

6. **Biological hazards**

The PI or LI shall:

- a. Determine the Biosafety Level for the particular class of microorganism used and be aware of the potential hazards involved when working with the agent. Follow the CDC-NIH guidelines for use of the agent.
- b. Establish procedures to minimize splashing, spraying, or aerosolization. Assume that everything is infectious.
- c. When working with organisms that may become airborne, use approved engineering controls. Examples include biological safety cabinets and enclosed centrifuges. Ensure that proper maintenance procedures are established for this equipment. If engineering controls are impractical, use of personal protective equipment is required.
- d. Thoroughly clean exposed skin with soap and water immediately when contact with the organism has occurred and before leaving the laboratory. It is recommended to always wash hands after removing protective gloves. All work surfaces shall be decontaminated with an appropriate disinfectant specific for the agent used at the end of the day. A dilute bleach solution (1 part bleach to 9 parts water) or other approved disinfectants can be used.
- e. Disposal of all biohazards must be done in accordance with TU's Hazardous Waste Management Procedures:

[www.towson.edu/ehs/programs/chemical/index.html](http://www.towson.edu/ehs/programs/chemical/index.html)

7. **Select carcinogens, teratogens, mutagens, and other acutely hazardous chemicals for use in a designated area.**

The PI or LI shall:

- a. Refer to the list of "select" carcinogens, teratogens, mutagens, and other acutely hazardous chemicals in Appendix F. Information dealing with carcinogens is from the Occupational Safety and Health Administration (OSHA), the National Toxicology Program (NTP), and the International Agency for Research on Cancer (IARC). Use in a designated area is required. An additional list of other carcinogens is included. Designated use of these materials is not required, but is strongly recommended.
- b. Establish a designated area:
  1. Post the entrance to designated areas where carcinogens are used according to information for the specific chemical in 29 CFR 1910 subpart Z:

**Caution**  
**Cancer-Suspect Agent**  
**(Name of Agent)**  
**Authorized Personnel Only**

This posting will notify individuals, maintenance, emergency, and other laboratory personnel of the potential hazards present in the laboratory. Areas where these chemicals are stored should also be posted accordingly. Examples of these postings can be found in Appendix A.

2. Restrict access to the designated area to authorized personnel only. Personnel shall be trained in the safe use of the specific chemical.
3. Establish procedures for use. Attention must be given to:
  - a. Quantity of material used
  - b. Physical and chemical properties of the agent
  - c. Potency of the chemical
  - d. Type of experiments to be performed
  - e. Engineering controls that are available

f. Volatility of chemical

Most of this information is included in the Material Safety Data Sheets and other references available through EHS. A list of available references can be found in Appendix M.

NOTE: It is recommended that pregnant employees obtain medical advice prior to use.

c. Use of containment devices:

1. Incorporate the use of engineering controls into all experimental procedures for volatile chemicals and solids or liquids that may generate aerosols. This will keep a negative pressure in the area of use and provide additional protection. Engineering controls include fume hoods and biological safety cabinets.
2. When using vacuum lines, disposable filters or liquid traps must be incorporated into the system to prevent contamination of the equipment.
3. When performing an experiment requiring additional ventilation, keep the engineering control continuously running. Daily inspections should be performed to ensure that the control is properly functioning.
4. When engineering controls are not adequate protection, respiratory protection will be required.

d. Procedure for safe removal of waste:

1. Follow procedures outlined in TU's Hazardous Waste Management Procedures:  
[www.towson.edu/ehs/programs/chemical/index.html](http://www.towson.edu/ehs/programs/chemical/index.html)
2. Never dispose of these chemicals by way of the sanitary sewer, as domestic trash, or by evaporation.



- e. Decontamination procedures for personnel and equipment
  - 1. Ensure work surfaces are made of some type of impervious material. If not, use of plastic-lined absorbent paper will provide adequate containment and make decontamination easier.
  - 2. Decontaminate all work surfaces after each use.
  - 3. Ensure all designated areas are decontaminated before repair work or work with other chemicals can be performed.
  
- f. Additional Safe work practices
  - 1. Determine the primary routes of entry for each chemical to choose the appropriate protective equipment. Personal protective equipment can include a fully buttoned laboratory coat, double gloves, eye protection, and, when needed, a respirator. If possible to avoid decontamination, use disposable clothing and discard as a contaminated waste.
  - 2. Follow all of the precautions already outlined for use of hazardous chemicals.
  - 3. Before leaving the designated area, all personal protective equipment shall be removed and remain in the area. Personnel are required to wash hands and other potentially exposed skin.
  - 4. If you become contaminated, remove contaminated clothing immediately. When time permits, decontaminate or dispose as waste. Avoid wearing jewelry that cannot be easily decontaminated.
  - 5. When using these chemicals, keep an accurate inventory, including quantities and date of acquisition. Use the smallest possible amounts of the chemical.
  - 6. Use SCD(s) for laboratory transport of these chemicals.
  - 7. Regardless of size, contact EHS for all spills that occur when using these chemicals.

8. When using analytical instrumentation in procedures, place the sample in tightly stoppered tubes or vials to prevent contamination of equipment. If contamination occurs, the equipment must be decontaminated before reuse.

#### **D. Electrical Safety**

The PI or LI shall:

1. Only use three wire circuits that contain a ground.
2. Avoid the use of extension cords. If the need arises, ensure the following:
  - a. The cord is maintained in good condition.
  - b. Three wires of sufficient size are used to avoid overheating. (Use 14 gauge wire or greater).
  - c. The cord is not placed under stress and is protected against being pinched, cut, or walked upon.
3. Not use outlets in areas that are likely to become wet. If this is not possible, ground fault interrupter devices must be used on the circuit.
4. Not overload electrical outlets.
5. Use appropriate warning signs for electrical hazards.
6. When electrical equipment is being repaired, ensure that procedures have been implemented that will prevent electrical shock if the equipment is accidentally activated. Refer to TU's Lock Out/Tag Out Program:  
[www.towson.edu/ehs/programs/occupationsafety/index.html](http://www.towson.edu/ehs/programs/occupationsafety/index.html)
7. Disconnect all equipment from an electrical source when not in use.
8. Not use equipment that may have defects.
9. Know the location of the circuit breaker for the laboratory in case an emergency arises where the electricity must be cut off. Ensure that all circuit breakers are properly labeled. Facilities Management can be contacted for this information and when additional labeling is needed.

10. In order to avoid the production of static electricity, it is recommended that one or all of the following be used:
  - a. Humidifiers
  - b. Grounding straps
  - c. Conductive materials

**E. Compressed Gas Safety**

Refer to TU's Compressed Gas Cylinder Program:

[www.towson.edu/ehs/programs/occupationsafety/index.html](http://www.towson.edu/ehs/programs/occupationsafety/index.html)

**F. Use of Fume Hoods**

The PI or LI shall:

1. Ensure that the fume hood is properly functioning before use. Tissue paper can be used to determine direction and presence of airflow. If the hood is not working properly, contact the Facilities Management for repairs. Before repair work can begin, all chemicals must be removed from the hood. If radioactive materials, biohazards, select carcinogens, mutagens, or teratogens are used in the hood, appropriate decontamination must be performed prior to repairs. After repairs have been completed, EHS must be contacted to ensure that the fume hood is functioning properly prior to use.
2. If possible, avoid using the fume hood for storage. This will limit the space available for experiments.
3. Do work as deeply in hood as possible without obstructing air flow. A reduction in the hood's performance will occur if air baffles are blocked.
4. When performing an experiment, keep the sash closed as far as possible, without inhibiting mobility, to conduct the experiment. When working with toxic materials keep the sash at levels indicated by the fume hood inspection label to provide adequate ventilation. Examples of the inspection labels can be found in Appendix A. The hood should remain "on" at all times when chemicals are present, regardless of use or storage.
5. If possible, elevate large equipment approximately two inches to allow airflow under the equipment.

## **G. Other Prudent Practices**

The PI or LI shall:

1. Provide a chemical spill kit in each laboratory filled with essential equipment to be used for small spills. Contact EHS for information regarding the needed supplies.
2. Only have authorized personnel working in laboratories. Supervision of personnel who have not had proper training is required.
3. Handle dry ice with tongs or insulated gloves in a well-ventilated area. Frostbite may occur if the dry ice is handled with bare hands.
4. Not leave flames, open elements, or exposed heat sources unattended. This will eliminate the chance of accidental burning of other personnel in the laboratory and reduce the possibility of a fire.
5. Never work while under the influence of drugs or alcohol. This includes prescription or over-the-counter medication which carry warnings against operation of equipment.
6. Provide permission to individuals to remove chemicals or equipment from the laboratory.
7. Never look directly into an opened vessel or container.
8. Not use ignition sources in areas where flammable liquids are used or stored. For heating, steam plates can be used in place of Bunsen burners.
9. Avoid acceptance of an overabundance of "gifts", such as reagents or chemicals, from other facilities. When these chemicals are not used, the disposal of the additional material will increase costs that must be assumed by TU for disposal. If the department uses the chemical entirely, this will not be a problem. The following procedure shall be used for acceptance of gifts:
  - a. Obtain approved from the department chairperson.
  - b. If possible, the amount of material accepted should be limited to the amount needed or the amount that will be eventually used within a reasonable period of time. Avoid accepting a lot of additional useless chemicals with ones that are needed.

- c. Obtain a Material Safety Data Sheet (MSDS) for all chemicals on campus. A copy shall be provided to EHS.
- d. EHS under the requirements of the CHP, may be required to review the use of certain chemicals and assist with establishing safe working practices.

### **III. Guidelines for Chemical Storage**

Refer to TU's Chemical Storage Guidelines and Compressed Gas Cylinder Program:

[www.towson.edu/ehs/programs/chemical/index.html](http://www.towson.edu/ehs/programs/chemical/index.html)

[www.towson.edu/ehs/programs/occupationsafety/index.html](http://www.towson.edu/ehs/programs/occupationsafety/index.html)

### **IV. Chemical Waste Disposal Procedures**

Refer to TU's Hazardous Waste Management Procedures:

[www.towson.edu/ehs/programs/chemical/index.html](http://www.towson.edu/ehs/programs/chemical/index.html)

### **V. Emergency Procedures**

Refer to TU's Emergency Response Guide:

[www.towson.edu/ehs/programs/environmentalsafety.html](http://www.towson.edu/ehs/programs/environmentalsafety.html)

### **VI. Other Safety Programs**

EHS offers other safety programs that can be used in conjunction with the CHP. An overview of these programs can be found in the TU's **Employee Safety Programs**.

#### **A. Hazard Communication Program**

[www.towson.edu/ehs/programs/environmentalsafety.html](http://www.towson.edu/ehs/programs/environmentalsafety.html)

The Hazard Communication Program, also referred to as the Right-to-Know (RTK) Program, provides necessary information concerning the chemical hazards present in work areas of campus employees who do not work with chemicals on a laboratory scale.

The information required by this standard will be used in conjunction with the Laboratory Standard. The basis for the Hazard Communication Program is a written document that describes the program and is available to all campus employees for their information. The program provides information concerning the labeling requirements for chemicals, use of Material Safety Data Sheets (MSDS) to identify hazards, and training and orientation programs. A Chemical Information List (CIL) is also available. This is a list of all the chemicals present in a building or laboratory.

If you have questions about the chemicals present in your area or of the available training, contact EHS at x4-2949 or e-mail [safety@towson.edu](mailto:safety@towson.edu).

## **B. Fire and Life Safety Program**

[www.towson.edu/ehs/programs/environmentalsafety.html](http://www.towson.edu/ehs/programs/environmentalsafety.html)

The Fire and Life Safety Program identifies possible fire and life safety hazards on campus and offers solutions to remedy the problem. This is accomplished through building safety inspections and fire drills. For more information about fire safety on campus contact EHS.

## **C. Radiation Protection Program**

[www.towson.edu/ehs/programs/biologicalsafety/index.html](http://www.towson.edu/ehs/programs/biologicalsafety/index.html)

The Radiation Protection Program will be responsible for the safe use of radioactive materials and radiation-producing devices on campus. The Radiation Safety Officer will establish procedures and policies for safe use. Laboratories using these materials or devices will generally be posted with some type of radiation sign. Examples and explanations of labels can be found in Appendix A. These laboratories are for authorized personnel only.

Personnel who work or wish to work with radioactive material (especially unsealed sources) or radiation-producing devices shall follow all of the laboratory safety guidelines outlined in this manual. In addition, the PI must obtain an authorization for use of the material or device. The authorization that is obtained will limit the use of a particular device or isotope and activity. Information concerning the use of radioactive material or radiation-producing devices can be found in the Radiation Protection Program located at the above referenced web site. Radiation Safety will also be concerned with the safe use of other types of radiation. This would include microwave ovens, lasers, ultraviolet light, and video display terminals. EHS will provide information and/or surveys for this on request.

## D. Hearing Conservation Program

[www.towson.edu/ehs/programs/occupationalafety/index.html](http://www.towson.edu/ehs/programs/occupationalafety/index.html)

The Hearing Conservation Program is designed to protect and monitor specific campus personnel's exposure to noise. The Department of Communications Sciences and Disorders and EHS has established a program to instruct campus personnel on the basics of hearing protection. In addition, high-risk noise areas on campus will be identified. Hearing protection equipment will be assigned to personnel in these areas.

If you feel that you work in a high noise area, contact EHS. The work area will be screened with sound level meters to determine the source of the noise and the sound levels to which you are being exposed. If necessary, additional detailed monitoring will be done to determine your time-weighted average noise exposure over an eight (8) hour workday.

If you are being exposed to noise in excess of the Threshold Limit Values (TLV's), you will be enrolled in the program. An initial hearing test will be performed with annual tests thereafter. Suitable hearing protection devices will be provided with training for their use.

## E. Medical and Post-Exposure Monitoring Program

[www.towson.edu/ehs/index.html](http://www.towson.edu/ehs/index.html)

The Medical Monitoring Program has been designed to follow the medical status of those individuals who work with asbestos, bloodborne pathogens, pesticides, and hazardous chemicals; who wear a respirator; and who are exposed to noise levels in excess of Threshold Limit Values (TLVs). The necessity for medical monitoring and the tests that are performed will be based on the type of work an individual performs and their exposure to certain environmental hazards. The exams will be performed on an annual basis unless otherwise required by OSHA or the attending physician. The program will consist of different types of exams such as a chest x-ray, a pulmonary function test, and a general physical.

When working with hazardous chemicals, an exposure that requires medical attention may occur. The type of monitoring will depend on the specific substance. The need for post-exposure monitoring may be determined by:

1. **Showing signs and symptoms of exposure.** Before working with hazardous chemicals this information should be reviewed. The routes of entry for a chemical exposure are inhalation, ingestion, injection, and absorption (mainly through the eyes or skin). A Material Safety Data Sheet (MSDS) will provide adequate information concerning chemical exposure.

However, other resources can be used to obtain additional information. Information available through EHS can be found in Appendix M.

2. **Exceeding the Permissible Exposure Limits (PEL).** The limits that OSHA has adopted for exposure to certain chemicals are located in Appendix D. When working with chemicals that do not have a PEL, other values will be used as required. For a low PEL, use of a fume hood or respiratory protection device will be required. EHS will evaluate areas where exposure to chemicals in excess of a PEL may occur and offer recommendations for use.
3. **Spills, leaks, or explosions.** When a spill, leak, or explosion occurs, the situation and individual involved will be evaluated to determine the need for medical treatment. The determination will be based on the presence of signs and symptoms of exposure and if a PEL has been exceeded.

#### **F. Respiratory Protection Program**

[www.towson.edu/ehs/programs/occupationsafety/index.html](http://www.towson.edu/ehs/programs/occupationsafety/index.html)

The Respiratory Protection Program will provide campus employees with a safe, respirable atmosphere. This will be accomplished by the use of acceptable engineering controls. Examples include enclosing or confining the hazardous process or operation, general or local ventilation, limiting time of exposure, and substitution of less toxic materials. When these measures cannot be accomplished; appropriate respiratory protective devices will be utilized. Training in the use of respirators will be provided to all employees involved in the program.

#### **G. Laboratory Safety Inspections**

In an attempt to establish a safe working environment in campus laboratories, periodic laboratory safety inspections will be performed by EHS in cooperation with each department. Examples of the forms used in these inspections can be found in Appendix K. The following are the inspections that will be done at regular intervals:

##### **A. General Laboratory Inspection**

This inspection checks the general safety in the laboratory. It ensures that the appropriate safety equipment is present and operational and that safe laboratory practices are being utilized.



## B. NFPA 704M Inspections

The National Fire Protection Association 704M System is used to identify the hazards present in the laboratory. This inspection classifies the chemicals in the laboratory according to their health, flammability, and reactivity hazards. In addition to this, a water reactive hazard, if present, is determined. The four-color diamond placed on the entrance to the room represents this information. The diamond is divided into the four hazard classes. The representation of the colors found on the diamond is as follows:

1. **Blue: Health Hazard**
2. **Red: Flammability Hazard**
3. **Yellow: Reactivity Hazard**
4. **White: Special Hazard** (Generally water reactivity)

The system uses numbering from zero to four, with four being the most hazardous situation and zero being the least. When water reactive chemicals are present, a **W** is placed in the white section. Personnel entering the laboratory to warn them of the hazards that are present can use this information.

## C. Flammable and Combustible Liquid Inventory

This inspection determines the amount of flammable and combustible liquids present in each laboratory. The National Fire Protection Association has set limits for the amount of liquids stored in or outside of a flammable safety cabinet. Each liquid is placed into a class according to the flash point and the boiling point. Information concerning the flash or boiling point of a liquid can be found in the Material Safety Data Sheets for the chemical and specific examples can be found in Appendix L. The following are definitions of class types:

<u>Class</u>	<u>Specification</u>
IA	Flash Point < 73°F (22.8°C) Boiling Point < 100°F (37.8°C)
IB	Flash Point < 73°F (22.8°C) Boiling Point <= 100°F (37.8°C)
IC	Flash Point > 73°F (22.8°C) And < 100°F (37.8°C)
II	Flash Point >= 100°F (37.8°C) And < 140°F (60°C)
IIIA	Flash Point >= 140°F (60°C) And < 200°F (93.4°C)

**D. Radiation Safety Inspections**

This inspection will be used for laboratories utilizing unsealed radioactive materials and/or radiation-producing devices. The basis for these surveys will deal with the compliance with regulations set forth by the Maryland Department of the Environment, other agencies, and the principal investigator's authorization. A point system will be used as an indication of compliance.

**E. Chemical Inventory Lists - Right to Know**

In accordance with OSHA's Hazard Communication Standard, a list of all chemicals used in laboratories on campus must be compiled. The inspection will inventory all of the chemicals present in the laboratory. This information will be used to ensure the presence of a Material Safety Data Sheet on campus. The list will be made available to all campus employees and regulatory agencies.

**F. Fire and Life Safety Inspection**

All areas on campus will be inspected to ensure compliance with applicable fire and life safety codes. Dormitories, dining halls, and academic, administrative, and service buildings will be inspected. Additional inspections will be performed at the request of campus personnel or when an incident occurs.

# **Tables**

Table 1. Maximum Container Sizes for flammables and combustibles

CONTAINER TYPE:	FLAMMABLE LIQUID			COMBUSTIBLE LIQUID	
	CLASS:			CLASS:	
	IA	IB	IC	II	IIIA
GLASS	1 pt	1 qt	1 gal	1 gal	5 gal
METAL	1 gal	5 gal	5 gal	5 gal	5 gal
SAFETY CANS	2 gal	5 gal	5 gal	5 gal	5 gal
METAL DRUM (DOT)	60 gal	60 gal	60 gal	60 gal	60 gal

# **Appendix A**

## **Laboratory and Area Postings**

## Sign Explanations

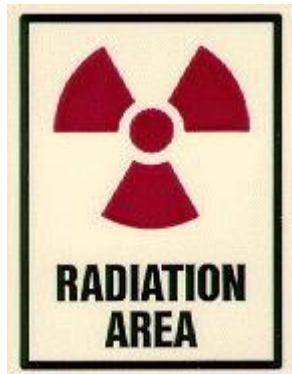
### 1. Caution Radioactive Material

Indicates a room or area that uses or stores radioactive material in an amount exceeding ten (10) times the quantity specified in Section D of COMAR 10.14.02.01 Appendix B.



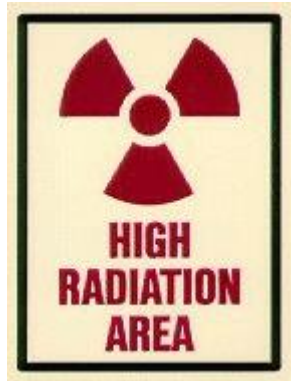
### 2. Caution Radiation Area

Indicates a room or area where personnel can receive a dose equivalent in excess of 5 mRem in any one hour or 100 mRem in any five (5) consecutive days.



**3. Caution High Radiation Area**

Indicates a room or area where personnel can receive a dose equivalent in excess of 100 mRem in any one hour.



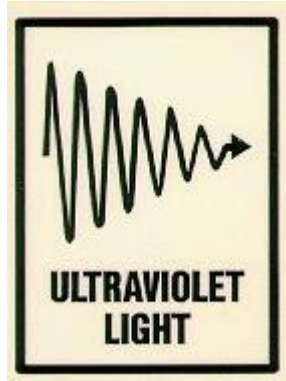
**4. Caution X-ray**

Indicates a room or area where x-rays are produced.



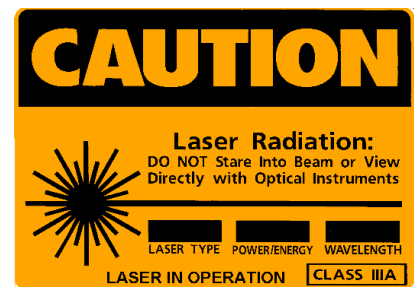
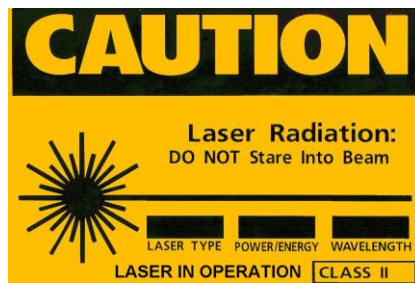
5. **Caution Ultraviolet Light**

Indicates a room or area where personnel have the possibility of being exposed to ultraviolet light.



6. **Caution: Laser Light**

Indicates the presence or use of a Class 2 or certain 3a lasers in the laboratory. The information contained in positions 1, 2, and 3 are dependent of the class of laser.





**7. Danger: Laser Light**

Indicates the presence or use of Class 3b, 4, and certain 3a lasers in the laboratory. The information contained in positions 1, 2, and 3 are dependent of the class of laser.



**8. Biological Hazard**

Indicates the use or presence of an agent that may prove infectious to human beings. This may also be accompanied by other indications present, such as infected animals.



**9. Carcinogenic Agent**

Indicates an area where known cancer agents or suspected chemical carcinogens are used or stored. Additional requirements, such as protective gear, may also be indicated.



**10. Eye Protection Required**



Indicates an area where eye protection is required. The majority of laboratories on campus require the use of eye protection.

**11. Emergency Information Signs**

EXAMPLES INCLUDE:  
**EMERGENCY SHOWER**  
**EMERGENCY EYEWASH**  
**EXIT**  
**FIRE EXTINGUISHER**  
**FIRST AID KIT**

Indicates areas or devices where emergency equipment is located. This will aid personnel in case of emergency.

**12. Flammable Liquids**



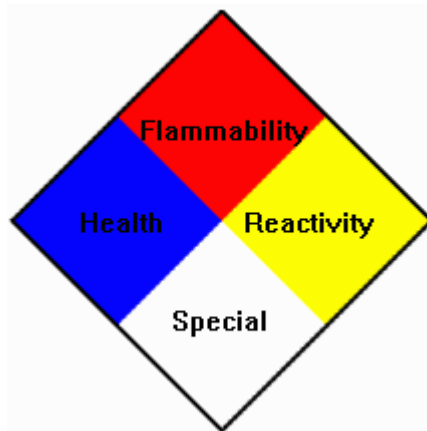
Indicates a room or area where flammable liquids are used or stored. Smoking is prohibited in these areas.

**13. No eating, drinking, or smoking in the area**



Indicates a room or area where there exists a possibility of internal contamination from toxic materials. This label should be posted in all chemical laboratories.

**14. NFPA Hazard diamond**

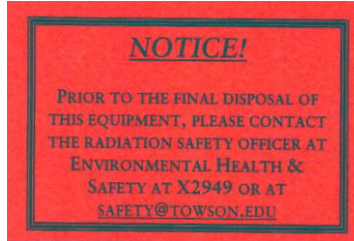


Indicates the relative dangers that may exist in a laboratory according to health, flammability, and reactivity hazards.



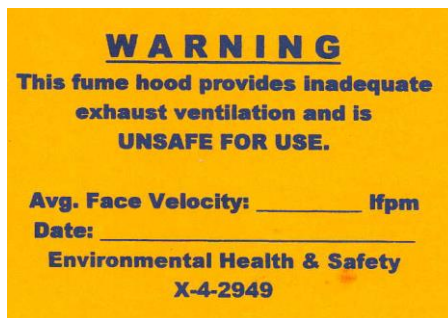
**17. Equipment repair/disposal label**

Indicates equipment that must have the approval of EHS before repair or disposal can take place.



**18. Inadequate Fume Hood**

Indicates that the fume hood has inadequate airflow for use with toxic chemicals.



**19. Adequate fume hood**

Indicates the condition of the sash for use with toxic chemicals. For hoods with vertical sashes.



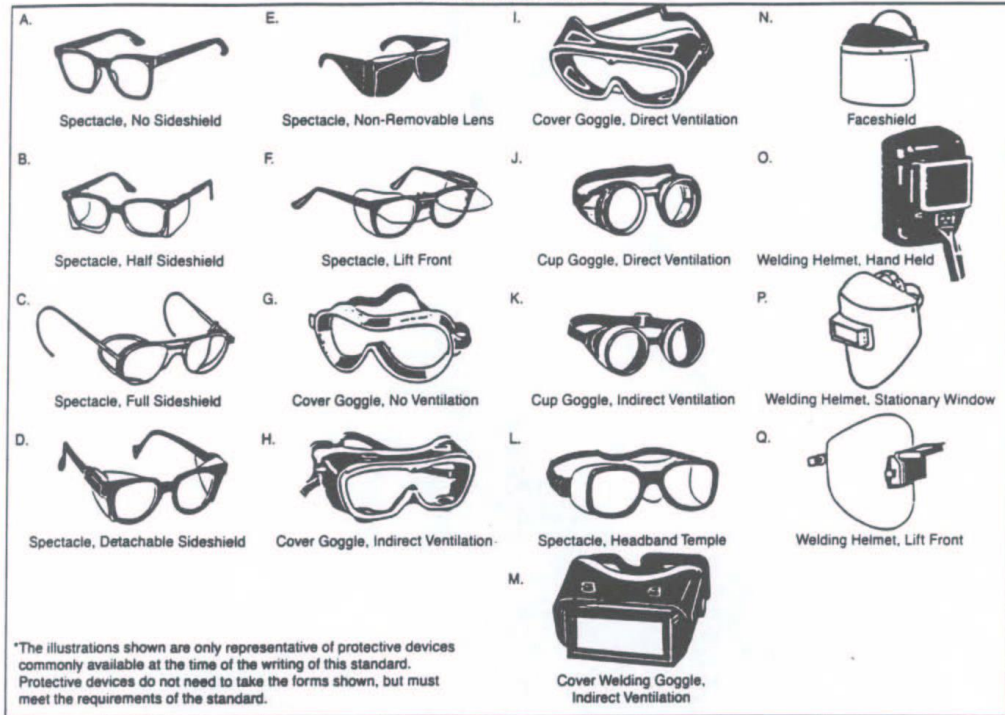
# **Appendix B**

## **Types of Recommended ANSI Approved Eye Protection**

(Note: This section will be updated as the ANSI Standard is modified)

Reprinted from American National Standards Practice for Occupational and Educational Eye and Face Protection, ANSI Z87.1-1989, approved by the American National Standards Institute on February 2, 1989 and published by the American Society of Safety Engineers as the Secretariat of the standards project.

PROTECTIVE DEVICES



NOTES:

(1) Care shall be taken to recognize the possibility of multiple and simultaneous exposure to a variety of hazards. Adequate protection against the highest level of each of the hazards must be provided.

(2) Operations involving heat may also involve optical radiation. Protection from both hazards shall be provided.

(3) Faceshields shall only be worn over primary eye protection.

(4) Filter lenses shall meet the requirements for shade designations in Table 1.

(5) Persons whose vision requires the use of prescription (Rx) lenses shall wear either protective devices fitted with prescription (Rx) lenses or protective devices designed to be worn over regular prescription (Rx) eyewear.

(6) Wearers of contact lenses shall also be required to wear appropriate covering eye and face protection devices in a hazardous environment. It should be recognized that dusty and/or chemical environments may represent an additional hazard to contact lens wearers.

(7) Caution should be exercised in the use of metal frame protective devices in electrical hazard areas.

(8) Refer to Section 6.5, Special Purpose Lenses.

(9) Welding helmets or handshields shall be used only over primary eye protection.

(10) Non-sideshield spectacles are available for frontal protection only.



AMERICAN NATIONAL STANDARD Z87.1-1989

SELECTION CHART

PROTECTORS

		ASSESSMENT SEE NOTE (1)	PROTECTOR TYPE	PROTECTORS	LIMITATIONS	NOT RECOMMENDED
I M P A C T	Chipping, grinding, machining, masonry work, riveting, and sanding.	Flying fragments, objects, large chips, particles, sand, dirt, etc.	B,C,D, E,F,G, H,I,J, K,L,N	Spectacles, goggles faceshields  SEE NOTES (1) (3) (5) (6) (10) For severe exposure add N	Protective devices do not provide unlimited protection.  SEE NOTE (7)	Protectors that do not provide protection from side exposure. SEE NOTE (10)  Filter or tinted lenses that restrict light transmittance, unless it is determined that a glare hazard exists. Refer to OPTICAL RADIATION.
	H E A T	Furnace operations, pouring, casting, hot dipping, gas cutting, and welding.	Hot sparks	B,C,D, E,F,G, H,I,J, K,L,*N	Faceshields, goggles, spectacles *For severe exposure add N  SEE NOTE (2) (3)	Spectacles, cup and cover type goggles do not provide unlimited facial protection.  SEE NOTE (2)
Splash from molten metals			*N	*Faceshields worn over goggles H,K  SEE NOTE (2) (3)	SEE NOTE (3)	
High temperature exposure			N	Screen faceshields, Reflective faceshields.  SEE NOTE (2) (3)		
C H E M I C A L	Acid and chemicals handling, degreasing, plating	Splash	G,H,K  *N	Goggles, eyecup and cover types.  *For severe exposure, add N	Ventilation should be adequate but well protected from splash entry	Spectacles, welding helmets, handshields
		Irritating mists	G	Special purpose goggles	SEE NOTE (3)	
D U S T	Woodworking, buffing, general dusty conditions.	Nuisance dust	G,H,K	Goggles, eyecup and cover types	Atmospheric conditions and the restricted ven- tilation of the protector can cause lenses to fog. Frequent cleaning may be required.	
O P T I C A L  R A D I A T I O N	WELDING:  Electric Arc		O,P,Q	TYPICAL FILTER LENS SHADE PRO- TECTORS SEE NOTE (9)  10-14 Welding Helmets or Welding Shields	Protection from optical radiation is directly related to filter lens density. SEE NOTE (4). Select the darkest shade that allows adequate task performance.	Protectors that do not provide protection from optical radiation.  SEE NOTE (4)
	WELDING:  Gas		J,K,L, M,N,O, P,Q	SEE NOTE (9)  4-8 Welding Goggles or Welding Faceshield	SEE NOTE (3)	
	CUTTING			3-6		
	TORCH BRAZING			3-4		
	TORCH SOLDERING		B,C,D, E,F,N	1.5-3 Spectacles or Welding Faceshield		
	GLARE		A,B	Spectacle  SEE NOTE (9) (10)	Shaded or Special Purpose lenses, as suitable.  SEE NOTE (8)	

EYE PROTECTION DEVICES

Type	Front Splash Protection	Side Splash Protection	Front Flying Object Impact Protection	Side Impact Protection	Neck, Face Protection	Comfort to Wearer	Estimated Acceptability to Student	Use Lifetime	Cost
Goggles	Excellent	Excellent	Excellent	Excellent	Poor	Fair	Poor	Fair	Moderate to in-expensive
Glasses (no shields)	Good	Poor	Excellent	Poor	Poor	Good to very Good	Very Good	Very Good	Moderate
Glasses (shields)	Good	Good	Good	Fair	Poor	Good	Good	Very Good	Moderate
Face Shields	Excellent	Good to Excellent	Excellent (If adequate thickness)	Good to Excellent	Depends on type and length	Fair	Good for short periods	Fair	Moderate

# **Appendix C**

## **Polymeric Materials Used For Gloves, Aprons, and Other Protective Devices**

	Butyl Rubber	CPE	NBR	Neoprene	Nitrile	Nitrile and PVC	PVA	PVC	Natural Rubber	Vitron
<b>CHEMICAL RESISTANCE</b>										
Corrosives										
Liquid Acid										
Organic	G	*	G	*	G	G	*	*	G	P
Inorganic	*	G	G	G	G	G	-	G	*	G
Solid Acid	G	G	-	G	G	G	P	G	-	G
Liquid Base	G	G	G	G	G	G	P	G	G	*
Solid Base	G	G	G	G	G	G	P	G	G	*
Poisons	G	G	-	G	*	*	G	*	G	-
Oxidizers	G	G	-	G	G	G	P	G	G	G
Solvents: #										
Ethanol	G	-	G	G	G	G	P	P	P	G
Methanol	G	G	G	P	P	G	P	P	P	G
Acetone	G	G	P	P	P	P	P	P	P	P
Acetonitrile	G	-	-	G	P	-	G	P	P	P
Toluene	P	P	G	P	P	P	P	P	P	G
Chloroform	P	P	G	P	P	P	G	P	P	G
Carbon Tetrachloride	P	P	G	P	G	G	G	P	P	G
Dichloromethane	P	P	-	P	P	P	P	P	P	G
Benzene	P	P	G	P	P	G	P	P	P	G
Hexane	P	G	G	P	G	G	G	P	P	G
Xylene	P	P	G	P	P	P	G	P	P	G
Ether	P	G	G	P	P	P	G	P	P	P
Petroleum Ether	P	G	-	P	-	-	-	-	P	-
<b>PHYSICAL RESISTANCE</b>										
Abrasion Resistance	F	E	E	E	E	G	F	G	E	G
Cut Resistance	G	G	E	E	E	G	F	P	E	G
Flexibility	G	G	E	G	E	G	P	F	E	G
Heat Resistance	E	G	G	G	G	F	G	P	F	G
Ozone Resistance	E	E	F	E	F	E	E	E	P	E
Puncture Resistance	G	G	E	G	E	G	F	G	E	G
Tear Resistance	G	G	G	G	G	G	G	G	E	G
RELATIVE COST	HIGH	LOW	MED	MED	MED	MED	MED	LOW	MED	HIGH

### **Column Headings:**

Butyl Rubber: Butyl Rubber  
CPE: Chlorinated Polyethylene  
NBR: Nitrile-butadiene Rubber  
Neoprene: Neoprene  
Nitrile and PVC: Nitrile Rubber and Polyvinyl Chloride  
PVA: Polyvinyl Alcohol  
PVC: Polyvinyl Chloride  
Natural Rubber: Natural Rubber  
Viton: Viton

### **Notes:**

E = Excellent  
G = Good  
F = Fair  
P = Poor

- : No information provided

\* : Information varies for each chemical. Must do on a case-by-case basis.

# : Because the chemical resistance varies with each solvent, commonly used solvents will be handled on an individual basis.

### **Chemicals Used for Evaluation:**

Liquid Acid (Inorganic): Hydrochloric Acid, Chromic Acid Solution, Phosphoric Acid, Sulfuric Acid

Liquid Acid (Organic): Acetic Acid, Formic Acid, Butyric Acid

Solid Acid: Ammonium Hydrogen Fluoride (solid), Trichloroacetic Acid

Liquid Base: Ammonium Hydroxide, Sodium Hydroxide, Potassium Hydroxide

Solid Base: Sodium Hydroxide pellets

Poisons: Ammonium Arsenate, Arsenic Pentoxide, Arsenic, Phenol, Cyanide Compounds

Oxidizers: Barium Nitrate, Potassium Permanganate, Silver Nitrate, Nitric Acid ( $\geq 40\%$ ), Calcium Nitrate, Potassium Perchlorate, Hydrogen Peroxide, Perchloric Acid, Potassium Chromate

# **Appendix D**

## **Permissible Exposure Limits (PEL)**

Reprinted from Title 29 Code of Federal Regulations part 1910.1000-Air Contaminants-Permissible Exposure Limits available through the U.S. Department of Labor Occupational Safety and Health Administration (1989).



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## SUBPART Z—TOXIC AND HAZARDOUS SUBSTANCES

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### 1910.1000—AIR CONTAMINANTS

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An employee's exposure to any substance listed in Tables Z-1-A, Z-2 or Z-3 of this section shall be limited in accordance with the requirements of the following paragraphs of this section.

**(a) Table Z-1-A.**

**(1) Substances in Transitional Limits Columns with limits preceded by "C"—Ceiling Values.** An employee's exposure to any substance in Table Z-1-A under the Transitional Limits columns, the exposure limit of which is preceded by a "C", shall at no time exceed the exposure limit given for that substance in Table Z-1-A under the Transitional Limits columns.

**(2) Other Substances in Transitional Limits Columns—8-hour Time Weighted Average.** An employee's exposure to any substance in Table Z-1-A under the Transitional Limits columns, the exposure limit of which is not preceded by a "C", shall not exceed the 8-hour Time Weighted Average given for that substance in Table Z-1-A under the Transitional Limits columns in any 8-hour work shift of a 40-hour work week.

**(3) Final Rule Limits Columns.** An employee's exposure to any substance listed in Table Z-1-A shall not exceed the Time Weighted Average (TWA), Short Term Exposure Limit (STEL) and Ceiling Limit specified for that substance in Table Z-1-A under the Revised Limits columns.

**(4) Skin Designation.** To prevent or reduce skin absorption, an employee's skin exposure to substances listed in Table Z-1-A with an "X" in one or both of the Skin Designation columns following the substance name shall be prevented or reduced to the extent necessary in the circumstances through the use of gloves, coveralls, goggles, or other appropriate personal protective equipment, engineering controls or work practices.

**(5) Definitions.** The following definitions are applicable to the Final Rule Limits columns of Table Z-1-A:

(i) Time weighted average (TWA) is the employee's average airborne exposure in any 8-hour work shift of a 40-hour work week which shall not be exceeded.

(ii) Short term exposure limit (STEL) is the employee's 15-minute time weighted average exposure which shall not be exceeded at any time during a work day unless another time limit is specified in a parenthetical notation below the limit. If another time period is specified, the time weighted average exposure over that time period shall not be exceeded at any time during the working day.

(iii) Ceiling is the employee's exposure which shall not be exceeded during any part of the work day. If instantaneous monitoring is not feasible, then the ceiling shall be assessed as a 15-minute time weighted average exposure which shall not be exceeded at any time over a working day.

**(6) Additional Definition.** The terms "substance", "air contaminant," and "material" are equivalent in meaning for 29 CFR 1910.1000.

**(b) Table Z-2.** Table Z-2 is applicable for the transitional period and to the extent set forth in paragraph (f) of this section.

**(1) 8-hour time weighted averages.** An employee's exposure to any material listed in table Z-2, in any 8-hour work shift of a 40-hour work week, shall not exceed the 8-hour time weighted average limit given for that material in Table Z-2.

**(2) Acceptable ceiling concentrations.** An employee's exposure to a material listed in table Z-2 shall not exceed at any time during an 8-hour shift the acceptable ceiling concentration limit given for the material in the table, except for a time period, and up to a concentration not exceeding the maximum duration and concentration allowed in the column under, "acceptable maximum peak above the ceiling concentration for an 8-hour shift."

implemented whenever feasible. When such controls are not feasible to achieve full compliance, protective equipment or any other protective measures shall be used to keep the exposure of employees to air contaminants within the limits prescribed in this section. Any equipment and/or technical measures used for this purpose must be approved for each particular use by a competent industrial hygienist or other technically qualified person. Whenever respirators are used, their use shall comply with §1910.134.

**(f) Effective dates, start-up dates and transitional provisions.**

(1) **Effective date.** The effective date for the permissible exposure limits specified in the Final Rule Limits columns of Table Z-1-A is March 1, 1989.

**(2) Start-up dates.**

(i) The permissible exposure limits specified in the Final Rule Limits columns of Table Z-1-A shall be achieved by any reasonable combination of engineering controls, work practices and personal protective equipment effective September 1, 1989, through December 30, 1992.

**(ii)**

(a) The permissible exposure limits specified in the Final Rule Limits columns of Table Z-1-A shall be achieved by the method of compliance specified in paragraph (e) of this section effective December 31, 1992, if by December 31, 1991 a final rule has been published in the Federal Register amending or determining not to amend paragraph (e) of this section.

(b) If no final rule has been published in the Federal Register by December 31, 1991, amending or determining not to amend paragraph (e) of this section, then the permissible limits specified in the Final Rule Limits columns of Table Z-1-A shall be achieved by the methods of compliance specified by paragraph (e) of this section effective December 31, 1993, and paragraph

(f)(2)(i) of this section shall remain in effect through December 30, 1993.

(iii) The skin designations in the Final Rule Limits columns become effective September 1, 1989. The skin designations in the Transitional Limits columns are in effect from March 1, 1989, through August 31, 1989.

**(3) Transitional provisions.**

(i) The permissible exposure limits specified in the Transitional Limits columns of Table Z-1-A, Table Z-2 and Table Z-3 shall continue to be achieved by the methods of compliance specified in paragraph (e) of this section through December 30, 1992. If paragraph (f)(2)(ii)(b) of this section takes effect, this provision is extended through December 30, 1993. The permissible exposure limits specified in Tables Z-2 and Z-3 for substances mentioned in the Final Rule Limits column of Table Z-1-A only by cross reference to Table Z-2 or Z-3 shall remain in effect indefinitely and continue to be achieved by the methods of compliance specified in paragraph (e) of this section.

[54 F.R. 28059, July 5, 1989]

(ii) The permissible exposure limits specified in the Transitional Limits columns of Table Z-1-A, Z-2 and Z-3 shall be applicable to the extent cross referenced in 29 CFR Parts 1915, 1917 and 1918.

(iii) If any new or amended provisions or new or revised limits for any substance or substances are either administratively stayed or judicially stayed or vacated, then the existing provisions or limits for those substances specified in the Transitional Limits columns of Table Z-1-A, Table Z-2 or Table Z-3 shall remain in effect until such stay is lifted, or indefinitely, if the limit is vacated.

(4) Enforcement of the limits are indefinitely stayed for: aluminum alkyls; ethylidene norbornene; hexafluoracetone; mercury (alkyl compounds); oxygen difluoride; phenylphosphine; and sulfur pentafluoride; until OSHA publishes in the Federal Register a notice that a sampling and analytical technique is available.



TABLE Z-1-A. Limits For Air Contaminants

Substance	CAS No. <sup>1</sup>	Transitional Limits PEL <sup>a</sup>		Skin Designation	Final Rule Limits <sup>2,3</sup>						
		ppm <sup>a</sup>	b mg/m <sup>3</sup>		TWA		STEL <sup>c</sup>		CEILING		Skin Designation
					ppm <sup>a</sup>	b mg/m <sup>3</sup>	ppm <sup>a</sup>	b mg/m <sup>3</sup>	ppm <sup>a</sup>	b mg/m <sup>3</sup>	
Acetaldehyde	75-07-0	200	360	—	100	180	150	270	—	—	—
Acetic acid	64-19-7	10	25	—	10	25	—	—	—	—	—
Acetic anhydride	108-24-7	5	20	—	—	—	—	—	5	20	—
Acetone	67-64-1	1000	2400	—	750	1800	1000	2400	—	—	—
Acetonitrile	75-05-8	40	70	—	40	70	60	105	—	—	—
2-Acetylaminofluorine; see 1910.1014	53-96-3	—	—	—	—	—	—	—	—	—	—
Acetylene dichloride; see 1,2-Dichloroethylene	—	—	—	—	—	—	—	—	—	—	—
Acetylene tetrabromide	79-27-6	1	14	—	1	14	—	—	—	—	—
Acetylsalicylic acid (Aspirin)	50-78-2	—	—	—	—	5	—	—	—	—	—
Acrolein	107-02-8	0.1	0.25	—	0.1	0.25	0.3	0.8	—	—	—
Acrylamide	79-06-1	—	0.3	X	—	0.03	—	—	—	—	X
Acrylic acid	79-10-7	—	—	—	10	30	—	—	—	—	X
Acrylonitrile; see 1910.1045	107-13-1	—	—	—	—	—	—	—	—	—	—
Aldrin	309-00-2	—	0.25	X	—	0.25	—	—	—	—	X
Allyl alcohol	107-18-6	2	5	X	2	5	4	10	—	—	X
Allyl chloride	107-05-1	1	3	—	1	3	2	6	—	—	—
Allyl glycidyl ether (AGE)	106-92-3	(c)10	(C)45	—	5	22	10	44	—	—	—
Allyl propyl disulfide	2179-59-1	2	12	—	2	12	3	18	—	—	—
alpha-Alumina	1344-28-1	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	—	10	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—
Aluminum (as Al) Metal	7429-90-5	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	—	15	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—
Pyro powders	—	—	—	—	—	5	—	—	—	—	—
Welding fumes***	—	—	—	—	—	5	—	—	—	—	—
Soluble salts	—	—	—	—	—	2	—	—	—	—	—
Alkyls	—	—	—	—	—	2	—	—	—	—	—
4-Aminodiphenyl; see 1910.1011	92-67-1	—	—	—	—	—	—	—	—	—	—
2-Aminoethanol; see Ethanolamine	—	—	—	—	—	—	—	—	—	—	—
2-Aminopyridine	504-29-0	0.5	2	—	0.5	2	—	—	—	—	—
Amitrole	61-82-5	—	—	—	—	0.2	—	—	—	—	—
Ammonia	7664-41-7	50	35	—	—	—	35	27	—	—	—
Ammonium chloride fume	12125-02-9	—	—	—	—	10	—	20	—	—	—
Ammonium sulfamate	7773-06-0	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	—	10	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—
n-Amyl acetate	628-63-7	100	525	—	100	525	—	—	—	—	—
sec-Amyl acetate	626-38-0	125	650	—	125	650	—	—	—	—	—
Aniline and homologs	62-53-3	5	19	X	2	8	—	—	—	—	X
Anisidine (o-,p-isomers)	29191-52-4	—	0.5	X	—	0.5	—	—	—	—	X
Antimony and compounds (as Sb)	7440-36-0	—	0.5	—	—	0.5	—	—	—	—	—
ANTU (alpha Naphthylthiourea)	86-88-4	—	0.3	—	—	0.3	—	—	—	—	—
Arsenic, organic compounds (as As)	7440-32-2	—	0.5	—	—	0.5	—	—	—	—	—
Arsenic, inorganic compounds (as As); see 1910.1018	7440-38-2	—	—	—	—	—	—	—	—	—	—

TABLE Z-1-A. Limits For Air Contaminants

Substance	CAS No. <sup>f</sup>	Transitional Limits PEL <sup>a</sup>		Skin Designation	TWA		Final Rule Limits <sup>**</sup> STEL <sup>c</sup>		CEILING		Skin Designation
		ppm <sup>a</sup>	mg/m <sup>3</sup> b.		ppm <sup>a</sup>	mg/m <sup>3</sup> b	ppm <sup>a</sup>	mg/m <sup>3</sup> b	ppm <sup>a</sup>	mg/m <sup>3</sup> b	
Arsine	7784-42-1	0.05	0.2	—	0.05	0.2	—	—	—	—	—
Asbestos; see 1910.1001 and 1910.1101	Varies	—	—	—	—	—	—	—	—	—	—
Atrazine	1912-24-9	—	—	—	—	5	—	—	—	—	—
Azinphos-methyl	86-50-0	—	0.2	X	—	0.2	—	—	—	—	X
Barium, soluble compounds (as Ba)	7440-39-3	—	0.5	—	—	0.5	—	—	—	—	—
Barium sulfate	7727-43-7	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	—	10	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—
Benomyl	17804-35-2	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	—	10	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—
See Table Z-2 for the limits applicable in the operations or sectors excluded in 1910.1028 <sup>d</sup>											
Benzene; see 1910.1028	71-43-2	—	—	—	—	—	—	—	—	—	—
Benzidine; see 1910.1010	92-87-5	—	—	—	—	—	—	—	—	—	—
p-Benzoquinone; see Quinone	—	—	—	—	—	—	—	—	—	—	—
Benzo(a)pyrene; see Coal tar pitch volatiles	—	—	—	—	—	—	—	—	—	—	—
Benzoyl peroxide	94-36-0	—	5	—	—	5	—	—	—	—	—
Benzyl chloride	100-44-7	1	5	—	1	5	—	—	—	—	—
Beryllium and beryllium compounds (as Be)	7440-41-7	See Table 2-2		Note: See Table Z-2.							
Biphenyl; see Diphenyl	—	—	—	—	—	—	—	—	—	—	—
Bismuth telluride, Undoped	1304-82-1	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	—	15	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—
Bismuth telluride, Se-doped	—	—	—	—	—	5	—	—	—	—	—
Borates, tetra, sodium salts	—	—	—	—	—	—	—	—	—	—	—
Anhydrous	1330-43-4	—	—	—	—	10	—	—	—	—	—
Decahydrate	1303-96-4	—	—	—	—	10	—	—	—	—	—
Pentahydrate	12179-04-3	—	—	—	—	10	—	—	—	—	—
Boron oxide	1303-86-2	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	—	10	—	—	—	—	—
Boron tribromide	10294-33-4	—	—	—	—	—	—	—	1	10	—
Boron trifluoride	7637-07-2	(C)1	(C)3	—	—	—	—	—	1	3	—
Bromacil	314-40-9	—	—	—	1	10	—	—	—	—	—
Bromine	7726-95-6	0.1	0.7	—	0.1	0.7	0.3	2	—	—	—
Bromine pentafluoride	7789-30-2	—	—	—	0.1	0.7	—	—	—	—	—
Bromoform	75-25-2	0.5	5	X	0.5	5	—	—	—	—	X
Butadiene (1,3-Butadiene)	106-99-0	1000	2200	—	1000	2200	—	—	—	—	—
Butane	106-97-8	—	—	—	800	1900	—	—	—	—	—
Butanethiol; see Butyl mercaptan	—	—	—	—	—	—	—	—	—	—	—
2-Butanone (Methyl ethyl ketone)	79-93-3	200	590	—	200	590	300	885	—	—	—
2-Butoxyethanol	111-76-2	50	240	X	25	120	—	—	—	—	X
n-Butyl acetate	123-86-4	150	710	—	150	710	200	950	—	—	—
sec-Butyl acetate	105-46-4	200	950	—	200	950	—	—	—	—	—
tert-Butyl acetate	540-88-5	200	950	—	200	950	—	—	—	—	—
Butyl acrylate	141-32-2	—	—	—	10	55	—	—	—	—	—
n-Butyl alcohol	71-36-3	100	300	—	—	—	—	—	50	150	X
sec-Butyl alcohol	78-92-2	150	450	—	100	305	—	—	—	—	—
tert-Butyl alcohol	75-65-0	100	300	—	100	300	150	450	—	—	—

TABLE Z-1-A. Limits For Air Contaminants

Substance	CAS No. <sup>f</sup>	Transitional Limits PEL <sup>a</sup>		Skin Designation	TWA		Final Rule Limits** STEL <sup>c</sup>		CEILING		Skin Designation
		ppm <sup>a</sup>	b mg/m <sup>3</sup>		ppm <sup>a</sup>	b mg/m <sup>3</sup>	ppm <sup>a</sup>	b mg/m <sup>3</sup>	ppm <sup>a</sup>	b mg/m <sup>3</sup>	
Butylamine	109-73-9	(C)5	(C)15	X	—	—	—	—	5	15	X
tert-Butyl chromate (as CrO <sub>3</sub> )	1189-85-1	—	(C)0.1	X	—	—	—	—	—	0.1	X
n-Butyl glycidyl ether (BGE)	2426-08-6	50	270	—	25	135	—	—	—	—	—
n-Butyl lactate	138-22-7	—	—	—	5	25	—	—	—	—	—
Butyl mercaptan	109-79-5	10	35	—	0.5	1.5	—	—	—	—	—
o-sec-Butylphenol	89-72-5	—	—	—	5	30	—	—	—	—	X
p-tert-Butyltoluene	98-51-1	10	60	—	10	60	20	120	—	—	—
Cadmium fume (as Cd)	7440-43-9	See Table Z-2		—	—	—	—	—	—	—	—
Cadmium dust (as Cd)	7440-43-9	See Table Z-2		—	—	—	—	—	—	0.3	—
Calcium carbonate	1317-65-3	—	—	—	—	—	—	—	—	0.6	—
Total dust	—	—	15	—	—	15	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—
Calcium cyanamide	156-62-7	—	—	—	—	0.5	—	—	—	—	—
Calcium hydroxide	1305-62-0	—	—	—	—	5	—	—	—	—	—
Calcium oxide	1305-78-8	—	5	—	—	5	—	—	—	—	—
Calcium silicate	1344-95-2	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	—	15	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—
Calcium sulfate	7778-18-9	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	—	15	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—
Camphor, synthetic	76-22-2	—	2	—	—	2	—	—	—	—	—
Caprolactam	105-60-2	—	—	—	—	—	—	—	—	—	—
Dust	—	—	—	—	—	1	—	3	—	—	—
Vapor	—	—	—	—	5	20	10	40	—	—	—
Captafol (Difolatan <sup>®</sup> )	2425-06-1	—	—	—	—	0.1	—	—	—	—	—
Captan	133-06-2	—	—	—	—	5	—	—	—	—	—
Carbaryl (Sevin <sup>®</sup> )	63-25-2	—	5	—	—	5	—	—	—	—	—
Carbofuran (Furadan <sup>®</sup> )	1563-66-2	—	—	—	—	0.1	—	—	—	—	—
Carbon black	1333-86-4	—	3.5	—	—	3.5	—	—	—	—	—
Carbon dioxide	124-38-9	5000 <sup>a</sup>	9000	—	10,000	18,000	30,000	54,000	—	—	—
Carbon disulfide	75-15-0	See Table Z-2		—	4	12	12	36	—	—	X
Carbon monoxide	630-08-0	50	55	—	35	40	—	—	200	229	—
Carbon tetrabromide	558-13-4	—	—	—	0.1	1.4	0.3	4	—	—	—
Carbon tetrachloride	56-23-5	See Table Z-2		—	2	12.6	—	—	—	—	—
Carbonyl fluoride	353-50-4	—	—	—	2	5	5	15	—	—	—
Catechol (Pyrocatechol)	120-80-9	—	—	—	5	20	—	—	—	—	X
Cellulose	9004-34-6	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	—	15	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—
Cesium hydroxide	21351-79-1	—	—	—	—	2	—	—	—	—	—
Chlordane	57-74-9	—	0.5	X	—	0.5	—	—	—	—	X
Chlorinated camphene	8001-35-2	—	0.5	X	—	0.5	—	1	—	—	X
Chlorinated diphenyl oxide	55720-99-5	—	0.5	—	—	0.5	—	—	—	—	—
Chlorine	7782-50-5	(C)1	(C)3	—	0.5	1.5	1	3	—	—	—
Chlorine dioxide	10049-04-4	0.1	0.3	—	0.1	0.3	0.3	0.9	—	—	—
Chlorine trifluoride	7790-91-2	(C)0.1	(C)0.4	—	—	—	—	—	0.1	0.4	—
Chloroacetaldehyde	107-20-0	(C)1	(C)3	—	—	—	—	—	1	3	—
a-Chloroacetophenone (Phenacyl chloride)	532-27-4	0.05	0.3	—	0.05	0.3	—	—	—	—	—
Chloroacetyl chloride	79-04-9	—	—	—	0.05	0.2	—	—	—	—	—
Chlorobenzene	108-90-7	75	350	—	75	350	—	—	—	—	—
o-Chlorbenzylidene malonitrile	2698-41-1	0.05	0.4	—	—	—	—	—	0.05	0.4	X
Chlorobromomethane	74-97-5	200	1050	—	200	1050	—	—	—	—	—
2-Chloro-1,3-butadiene; see b-Chloroprene	—	—	—	—	—	—	—	—	—	—	—
Chlorodifluoromethane	75-45-6	—	—	—	1000	3500	—	—	—	—	—



TABLE Z-1-A. Limits For Air Contaminants

Substance	CAS No.	Transitional Limits PEL*		Skin Designation	Final Rule Limits**						Skin Designation
		PEL*			TWA		STEL <sup>c</sup>		CEILING		
		ppm <sup>a</sup>	mg/m <sup>3</sup> <sup>b</sup>		ppm <sup>a</sup>	mg/m <sup>3</sup> <sup>b</sup>	ppm <sup>a</sup>	mg/m <sup>3</sup> <sup>b</sup>	ppm <sup>a</sup>	mg/m <sup>3</sup> <sup>b</sup>	
Chlorodiphenyl (42% Chlorine) (PCB)	53469-21-9	—	1	X	—	1	—	—	—	—	X
Chlorodiphenyl (54% Chlorine) (PCB)	11097-69-1	—	0.5	X	—	0.5	—	—	—	—	X
1-Chloro, 2,3-epoxypropane; see Epichlorohydrin											
2-Chloroethanol; see Ethylene chlorohydrin											
Chloroethylene; see Vinyl Chloride											
Chloroform (Trichloromethane)	67-66-3	(C)50	(C)240	—	2	9.78	—	—	—	—	—
bis(Chloromethyl) ether; see 1910.1008	542-88-1										
Chloromethyl methyl ether; see 1910.1006	107-30-2										
1-Chloro-1-nitropropane	600-25-9	20	100	—	2	10	—	—	—	—	—
Chloropentafluoroethane	76-15-3	—	—	—	1000	6320	—	—	—	—	—
Chloropicrin	76-06-2	0.1	0.7	—	0.1	0.7	—	—	—	—	—
beta-Chloroprene	126-99-8	25	90	X	10	35	—	—	—	—	X
o-Chlorostyrene	2039-87-4	—	—	—	50	285	75	428	—	—	—
o-Chlorotoluene	95-49-8	—	—	—	50	250	—	—	—	—	—
2-Chloro-6-trichloromethyl pyridine	1929-82-4										
Total dust		—	15	—	—	15	—	—	—	—	—
Respirable fraction		—	5	—	—	5	—	—	—	—	—
Chlorpyrifos	2921-88-2	—	—	—	—	0.2	—	—	—	—	X
Chromic acid and chromates (as CrO <sub>3</sub> )	Varies with compound	See Table Z-2			—	—	—	—	—	0.1	—
Chromium (II) compounds (as Cr)	7440-47-3	—	0.5	—	—	0.5	—	—	—	—	—
Chromium (III) compounds (as Cr)	7440-47-3	—	0.5	—	—	0.5	—	—	—	—	—
Chromium metal (as Cr)	7440-47-3	—	1	—	—	1	—	—	—	—	—
Chrysene; see Coal tar pitch volatiles											
Clopidol	2971-90-6										
Total dust		—	15	—	—	15	—	—	—	—	—
Respirable fraction		—	5	—	—	5	—	—	—	—	—
Coal dust (less than 5% SiO <sub>2</sub> ), Respirable fraction	—	See Table Z-3			—	2	—	—	—	—	—
Coal dust (greater than or equal to 5% SiO <sub>2</sub> ), Respirable quartz fraction	—	See Table Z-3			—	0.1	—	—	—	—	—
Coal tar pitch volatiles (benzene soluble fraction), anthracene, BaP, phenanthrene, acridine, chrysene, pyrene	65966-93-2	—	0.2	—	—	0.2	—	—	—	—	—
Cobalt metal, dust, and fume (as Co)	7440-48-4	—	0.1	—	—	0.05	—	—	—	—	—
Cobalt carbonyl (as Co)	10210-68-1	—	—	—	—	0.1	—	—	—	—	—
Cobalt hydrocarbonyl (as Co)	16842-03-8	—	—	—	—	0.1	—	—	—	—	—
Coke oven emissions; see 1910.1029	—										

TABLE Z-1-A. Limits For Air Contaminants

Substance	CAS No. <sup>f</sup>	Transitional Limits PEL <sup>a</sup>		Skin Designation	Final Rule Limits**						
		ppm <sup>a</sup>	b mg/m <sup>3</sup>		TWA		STEL <sup>c</sup>		CEILING		Skin Designation
					ppm <sup>a</sup>	b mg/m <sup>3</sup>	ppm <sup>a</sup>	b mg/m <sup>3</sup>	ppm <sup>a</sup>	b mg/m <sup>3</sup>	
Copper	7440-50-8										
Fume (as Cu)			0.1			0.1					
Dusts and mists (as Cu)			1			1					
Cotton dust (raw)			1			1					
This 8-hour TWA applies to respirable dust as measured by a vertical elutriator cotton dust sampler or equivalent instrument. The time-weighted average applies to the cotton waste processing operations of waste recycling (sorting, blending, cleaning, and willowing) and garretting. See also 1910.1043 for cotton dust limits applicable to other sectors.											
Crag herbicide (Sesone)	136-78-7										
Total dust			15			10					
Respirable fraction			5			5					
Cresol, all isomers	1319-77-3;	5	22	X	5	22					X
Crotonaldehyde	123-73-9;	2	6		2	6					
	4170-30-3										
Crufomate	299-86-5					5					
Cumene	98-82-8	50	245	X	50	245					X
Cyanamide	420-04-2					2					
Cyanides (as CN)	Varies with compound		5			5					
Cyanogen	460-19-5					10					
Cyanogen chloride	506-77-4							0.3	0.6		
Cyclohexane	110-82-7	300	1050		300	1050					
Cyclohexanol	108-93-0	50	200		50	200					X
Cyclohexanone	108-94-1	50	200		25	100					X
Cyclohexene	110-83-8	300	1015		300	1015					
Cyclohexylamine	108-91-8				10	40					
Cyclonite	121-82-4					1.5					X
Cyclopentadiene	542-92-7	75	200		75	200					
Cyclopentane	287-92-3				600	1720					
Cyhexatin	13121-70-5					5					
2,4-D (Dichlorophenoxy-acetic acid)	94-75-7		10			10					
Decaborane	17702-41-9	0.05	0.3	X	0.05	0.3	0.15	0.9			X
Demeton (Systox <sup>®</sup> )	8065-48-3		0.1	X		0.1					X
Dichlorodiphenyltrichloroethane (DDT)	50-29-3		1	X		1					X
Dichlorvos (DDVP)	62-73-7		1	X		1					X
Diacetone alcohol (4-Hydroxy-4-methyl-2-pentanone)	123-42-2	50	240		50	240					
1,2-Diaminoethane; see Ethylenediamine											
Diazinon	333-41-5					0.1					X
Diazomethane	334-88-3	0.2	0.4		0.2	0.4					
Diborane	19287-45-7	0.1	0.1		0.1	0.1					
1,2-Dibromo-3-chloropropane; see 1910.1044	96-12-8										
2-N-Dibutylaminoethanol	102-81-8				2	14					
Dibutyl phosphate	107-66-4	1	5		1	5	2	10			
Dibutyl phthalate	88-74-2		5			5					
Dichloroacetylene	7572-29-4								0.1	0.4	
o-Dichlorobenzene	95-50-1	(c)50	(c)300						50	300	
p-Dichlorobenzene	106-46-7	75	450		75	450	110	675			
3,3'-Dichlorobenzidine; see 1910.1007	91-94-1										
Dichlorodifluoro-methane	75-71-8	1000	4950		1000	4950					
1,3-Dichloro-5,5-dimethylhydantoin	8-52-5		0.2			0.2		0.4			
1,1-Dichloroethane	75-34-3	100	400		100	400					



TABLE Z-1-A. Limits For Air Contaminants

Substance	CAS No.	Transitional Limits PEL*		Skin Designation	Final Rule Limits**						
		PEL*			TWA		STEL <sup>c</sup>		CEILING		Skin Designation
		ppm <sup>a</sup>	b mg/m <sup>3</sup>		ppm <sup>a</sup>	b mg/m <sup>3</sup>	ppm <sup>a</sup>	b mg/m <sup>3</sup>	ppm <sup>a</sup>	b mg/m <sup>3</sup>	
1,2-Dichloroethylene	540-59-0	200	790	—	200	790	—	—	—	—	—
Dichloroethyl ether	111-44-4	(C)15	(C)90	X	5	30	10	60	—	—	X
Dichloromethane; see Methylene chloride											
Dichloromonofluoro-methane	75-43-4	1000	4200	—	10	40	—	—	—	—	—
1,1-Dichloro-1-nitro-ethane	594-72-9	(C)10	(C)60	—	2	10	—	—	—	—	—
1,2-Dichloropropane; see Propylene dichloride											
1,3-Dichloropropene	542-75-6	—	—	—	1	5	—	—	—	—	X
2,2-Dichloropropionic acid	75-99-0	—	—	—	1	6	—	—	—	—	—
Dichlorotetrafluoroethane	76-14-2	1000	7000	—	1000	7000	—	—	—	—	—
Dicrotophos	141-66-2	—	—	—	—	0.25	—	—	—	—	X
Dicyclopentadiene	77-73-6	—	—	—	5	30	—	—	—	—	—
Dicyclopentadienyl iron	102-54-5	—	—	—	—	—	—	—	—	—	—
Total dust		—	15	—	—	10	—	—	—	—	—
Respirable fraction		—	5	—	—	5	—	—	—	—	—
Dieldrin	60-57-1	—	0.25	X	—	0.25	—	—	—	—	X
Diethanolamine	111-42-2	—	—	—	3	15	—	—	—	—	—
Diethylamine	109-89-7	25	75	—	10	30	25	75	—	—	—
2-Diethylaminoethanol	100-37-8	10	50	X	10	50	—	—	—	—	X
Diethylene triamine	111-40-0	—	—	—	1	4	—	—	—	—	—
Diethyl ether; see Ethyl ether											
Diethyl ketone	96-22-0	—	—	—	200	705	—	—	—	—	—
Diethyl phthalate	84-66-2	—	—	—	—	5	—	—	—	—	—
Difluorodibromomethane	75-61-6	100	860	—	100	860	—	—	—	—	—
Diglycidyl ether (DGE)	2238-07-5	(C)0.5	(C)2.8	—	0.1	0.5	—	—	—	—	—
Dihydroxybenzene; see Hydroquinone											
Diisobutyl ketone	108-83-8	50	290	—	25	150	—	—	—	—	—
Diisopropylamine	108-18-9	5	20	X	5	20	—	—	—	—	X
4-Dimethylaminoazobenzene; see 1910.1015	60-11-7										
Dimethoxymethane; see Methylal											
Dimethyl acetamide	127-19-5	10	35	X	10	35	—	—	—	—	X
Dimethylamine	124-40-3	10	18	—	10	18	—	—	—	—	—
Dimethylaminobenzene; see Xylidine											
Dimethylaniline (N-Dimethyl-aniline)	121-69-7	5	25	X	5	25	10	50	—	—	X
Dimethylbenzene; see Xylene											
Dimethyl-1,2-dibromo-2,2-dichloroethyl phosphate	300-76-5	—	3	—	—	3	—	—	—	—	X
Dimethylformamide	68-12-2	10	30	X	10	30	—	—	—	—	X
2,6-Dimethyl-4-heptanone; see Diisobutyl ketone											
1,1-Dimethylhydrazine	57-14-7	0.5	1	X	0.5	1	—	—	—	—	X
Dimethylphthalate	131-11-3	—	5	—	—	5	—	—	—	—	—
Dimethyl sulfate	77-78-1	1	5	X	0.1	0.5	—	—	—	—	X
Dinitolmide (3,5-Dinitro-o-toluamide)	148-01-6	—	—	—	—	5	—	—	—	—	—
Dinitrobenzene (all isomers)	528-29-0 99-65-0 100-25-4	—	1	X	—	1	—	—	—	—	X
Dinitro-o-cresol	534-52-1	—	0.2	X	—	0.2	—	—	—	—	X
Dinitrotoluene	25321-14-6	—	1.5	X	—	1.5	—	—	—	—	X
Dioxane (Diethylene dioxide)	123-91-1	100	360	X	25	90	—	—	—	—	X
Dioxathion (Deinav)	78-34-2	—	—	—	—	0.2	—	—	—	—	X

TABLE Z-1--A. Limits For Air Contaminants

Substance	CAS No.	Transitional Limits PEL*			Final Rule Limits**						
		PEL*		Skin Designation	TWA		STEL <sup>c</sup>		CEILING		Skin Designation
		ppm <sup>a</sup>	b mg/m <sup>3</sup>		ppm <sup>a</sup>	b mg/m <sup>3</sup>	ppm <sup>a</sup>	b mg/m <sup>3</sup>	ppm <sup>a</sup>	b mg/m <sup>3</sup>	
Diphenyl (Biphenyl)	92-52-4	0.2	1	—	0.2	1	—	—	—	—	—
Diphenylamine	122-39-4	—	—	—	—	10	—	—	—	—	—
Diphenylmethane diisocyanate; see Methylene bisphenyl isocyanate											
Dipropylene glycol methyl ether	34590-94-8	100	600	X	100	600	150	900	—	—	X
Dipropyl ketone	123-19-3	—	—	—	50	235	—	—	—	—	—
Diquat	86-00-7	—	—	—	—	0.5	—	—	—	—	—
Di-sec octyl phthalate (Di-2-ethylhexyl-phthalate)	117-81-7	—	5	—	—	5	—	10	—	—	—
Disulfiram	97-77-8	—	—	—	—	2	—	—	—	—	—
Disulfoton	298-04-4	—	—	—	—	0.1	—	—	—	—	X
2,6-Di-tert-butyl-p-cresol	128-37-0	—	—	—	—	10	—	—	—	—	—
Diuron	330-54-1	—	—	—	—	10	—	—	—	—	—
Divinyl benzene	1321-74-0	—	—	—	10	50	—	—	—	—	—
Emery	112-62-9	—	—	—	—	—	—	—	—	—	—
Total dust		—	15	—	—	10	—	—	—	—	—
Respirable fraction		—	5	—	—	5	—	—	—	—	—
Endosulfan	115-29-7	—	—	—	—	0.1	—	—	—	—	X
Endrin	72-20-8	—	0.1	X	—	0.1	—	—	—	—	X
Epichlorohydrin	106-89-8	5	19	X	2	8	—	—	—	—	X
EPN	2104-64-5	—	0.5	X	—	0.5	—	—	—	—	X
1,2-Epoxypropane; see Propylene oxide											
2,3-Epoxy-1-propanol; see Glycidol											
Ethanethiol; see Ethyl mercaptan											
Ethanolamine	141-43-5	3	6	—	3	8	6	15	—	—	—
Ethion	563-12-2	—	—	—	—	0.4	—	—	—	—	X
2-Ethoxyethanol	110-80-5	200	740	X	200	740	—	—	—	—	X
2-Ethoxyethyl acetate (Cellosolve acetate)	111-15-9	100	540	X	100	540	—	—	—	—	X
Ethyl acetate	141-78-6	400	1400	—	400	1400	—	—	—	—	—
Ethyl acrylate	140-88-5	25	100	X	5	20	25	100	—	—	X
Ethyl alcohol (Ethanol)	64-17-5	1000	1900	—	1000	1900	—	—	—	—	—
Ethylamine	75-04-7	10	18	—	10	18	—	—	—	—	—
Ethyl amyl ketone (5-Methyl-3-heptanone)	541-85-5	25	130	—	25	130	—	—	—	—	—
Ethyl benzene	100-41-4	100	435	—	100	435	125	545	—	—	—
Ethyl bromide	74-96-4	200	890	—	200	890	250	1110	—	—	—
Ethyl butyl ketone (3-Heptanone)	106-35-4	50	230	—	50	230	—	—	—	—	—
Ethyl chloride	75-00-3	1000	2600	—	1000	2600	—	—	—	—	—
Ethyl ether	60-29-7	400	1200	—	400	1200	500	1500	—	—	—
Ethyl formate	109-94-4	100	300	—	100	300	—	—	—	—	—
Ethyl mercaptan	75-08-1	(C)10	(C)25	—	0.5	1	—	—	—	—	—
Ethyl silicate	78-10-4	100	850	—	10	85	—	—	—	—	—
Ethylene chlorohydrin	107-07-3	5	16	X	—	—	—	—	1	3	X
Ethylenediamine	107-15-3	10	25	—	10	25	—	—	—	—	—
Ethylene dibromide	106-93-4	See Table Z-2	See Table Z-2	—	—	—	See Table Z-2	—	—	—	—
Ethylene dichloride	107-06-2	See Table Z-2	See Table Z-2	—	1	4	2	8	—	—	—
Ethylene glycol	107-21-1	—	—	—	—	—	—	—	50	125	—
Ethylene glycol dinitrate	628-96-6	(C)0.2	(C)1	X	—	—	—	0.1	—	—	X
Ethylene glycol methyl acetate; see Methyl cellosolve acetate											
Ethyleneimine; see 1910.1012	151-56-4										





TABLE Z-1-A. Limits For Air Contaminants

Substance	CAS No.	Transitional Limits PEL*		Skin Designation	Final Rule Limits**						
		PEL*			TWA		STEL <sup>c</sup>		CEILING		Skin Designation
		ppm <sup>a</sup>	mg/m <sup>3</sup>		ppm <sup>a</sup>	mg/m <sup>3</sup>	ppm <sup>a</sup>	mg/m <sup>3</sup>	ppm <sup>a</sup>	mg/m <sup>3</sup>	
2-Hexanone (Methyl n-butyl ketone)	591-78-6	100	410	—	5	20	—	—	—	—	—
Hexone (Methyl isobutyl ketone)	108-10-1	100	410	—	50	205	75	300	—	—	—
sec-Hexyl acetate	108-84-9	50	300	—	50	300	—	—	25	125	—
Hexylene glycol	107-41-5	—	—	—	—	—	—	—	—	—	X
Hydrazine	302-01-2	1	1.3	X	0.1	0.1	—	—	—	—	—
Hydrogenated terphenyls	61788-32-7	—	—	—	0.5	5	—	—	—	—	—
Hydrogen bromide	10035-10-6	3	10	—	—	—	—	—	3	10	—
Hydrogen chloride	7647-01-0	(C)5	(C)7	—	—	—	—	—	5	7	—
Hydrogen cyanide	74-90-8	10	11	X	—	—	4.7	5	—	—	X
Hydrogen fluoride (as F)	7664-39-3	See Table Z-2	—	—	3	—	6	—	—	—	—
Hydrogen peroxide	7722-84-1	1	1.4	—	1	1.4	—	—	—	—	—
Hydrogen selenide (as Se)	7783-07-5	0.05	0.2	—	0.05	0.2	—	—	—	—	—
Hydrogen sulfide	7783-06-4	See Table Z-2	—	—	10	14	15	21	—	—	—
Hydroquinone	123-31-9	—	2	—	—	2	—	—	—	—	—
2-Hydroxypropyl acrylate	999-61-1	—	—	—	0.5	3	—	—	—	—	X
Indene	96-13-6	—	—	—	10	45	—	—	—	—	—
Indium and compounds (as in)	7440-74-6	—	—	—	—	0.1	—	—	—	—	—
Iodine	7553-56-2	(C)0.1	(C)1	—	—	—	—	—	0.1	1	—
Iodoform	75-47-8	—	—	—	0.6	10	—	—	—	—	—
Iron oxide dust and fume	1309-37-1	—	10	—	—	10	—	—	—	—	—
Total particulate	—	—	—	—	0.1	0.8	0.2	1.6	—	—	—
Iron pentacarbonyl (as Fe)	13463-40-6	—	—	—	—	—	—	—	—	—	—
Iron salts (soluble) (as Fe)	Varies with compound	—	—	—	—	1	—	—	—	—	—
Isomyl acetate	123-92-2	100	525	—	100	525	—	—	—	—	—
Isomyl alcohol (primary and secondary)	123-51-3	100	360	—	100	360	125	450	—	—	—
Isobutyl acetate	110-19-0	150	700	—	150	700	—	—	—	—	—
Isobutyl alcohol	78-83-1	100	300	—	50	150	—	—	—	—	—
Isooctyl alcohol	26952-21-6	—	—	—	50	270	—	—	—	—	X
Isophorone	78-59-1	25	140	—	4	23	—	—	—	—	—
Isophorone diisocyanate	4098-71-9	—	—	—	0.005	—	0.02	—	—	—	X
2-Isopropoxyethanol	109-59-1	—	—	—	25	105	—	—	—	—	—
Isopropyl acetate	108-21-4	250	950	—	250	950	310	1185	—	—	—
Isopropyl alcohol	67-63-0	400	980	—	400	980	500	1225	—	—	—
Isopropylamine	75-31-0	5	12	—	5	12	10	24	—	—	—
N-Isopropylaniline	768-52-5	—	—	—	2	10	—	—	—	—	X
Isopropyl ether	108-20-3	500	2100	—	500	2100	—	—	—	—	—
Isopropyl glycidyl ether (IGE)	4016-14-2	50	240	—	50	240	75	360	—	—	—
Kaolin	—	—	15	—	—	10	—	—	—	—	—
Total dust	—	—	5	—	—	5	—	—	—	—	—
Respirable fraction	—	—	—	—	—	—	1.5	3	—	—	—
Ketene	463-51-4	0.5	0.9	—	0.5	0.9	1.5	3	—	—	—
Lead inorganic (as Pb); see 1910.1025	7439-92-1	—	—	—	—	—	—	—	—	—	—
Limestone	1317-65-3	—	15	—	—	15	—	—	—	—	—
Total dust	—	—	5	—	—	5	—	—	—	—	—
Respirable fraction	—	—	—	—	—	—	—	—	—	—	X
l.lindane	58-89-9	—	0.5	X	—	0.5	—	—	—	—	—
l.lithium hydride	7580-67-8	—	0.025	—	—	0.025	—	—	—	—	—

TABLE Z-1-A. Limits For Air Contaminants

Substance	CAS No.	Transitional Limits PEL*		Skin Designation	Final Rule Limits**						
		PEL*			TWA		STEL <sup>c</sup>		CEILING		Skin Designation
		ppm <sup>a</sup>	b mg/m <sup>3</sup>		ppm <sup>a</sup>	b mg/m <sup>3</sup>	ppm <sup>a</sup>	b mg/m <sup>3</sup>	ppm <sup>a</sup>	b mg/m <sup>3</sup>	
L.P.G. (Liquified petroleum gas)	68476-85-7	1000	1800	—	1000	1800	—	—	—	—	—
Magnesite	546-93-0	—	15	—	—	15	—	—	—	—	—
Total dust		—	15	—	—	15	—	—	—	—	—
Respirable fraction		—	5	—	—	5	—	—	—	—	—
Magnesium oxide fume		—	15	—	—	15	—	—	—	—	—
Total Partionlate	1309-48-4	—	15	—	—	10	—	—	—	—	—
Malathion	121-75-5	—	15	X	—	10	—	—	—	—	X
Total dust		—	15	X	—	10	—	—	—	—	X
Maleic anhydride	108-31-6	0.25	1	—	0.25	1	—	—	—	—	—
Manganese compounds (as Mn)	7439-96-5	—	(C)5	—	—	—	—	—	—	5	—
Manganese fume (as Mn)	7439-96-5	—	(C)5	—	—	1	—	3	—	—	—
Manganese cyclopentadienyl tricarbonyl (as Mn)	12079-65-1	—	—	—	—	0.1	—	—	—	—	X
Manganese tetroxide (as Mn)	1317-35-7	—	—	—	—	1	—	—	—	—	—
Marple	1317-65-3	—	15	—	—	15	—	—	—	—	—
Total dust		—	15	—	—	15	—	—	—	—	—
Respirable fraction		—	5	—	—	5	—	—	—	—	—
Mercury (aryl and inorganic) (as Hg)	7439-97-6	See Table Z-2	—	—	—	—	—	—	—	0.1	X
Mercury (organo) alkyl compounds (as Hg)	7439-97-6	See Table Z-2	—	—	—	0.01	—	0.03	—	—	X
Mercury (vapor) (as Hg)	7439-97-6	See Table Z-2	—	—	—	0.05	—	—	—	—	X
Mesityl oxide	141-79-7	25	100	—	15	60	25	100	—	—	—
Methacrylic acid	79-41-4	—	—	—	20	70	—	—	—	—	X
Methanethiol; see Methyl mercaptan											
Methomyl (Lannate)	16752-77-5	—	—	—	—	2.5	—	—	—	—	—
Methoxychlor	72-43-5	—	15	—	—	10	—	—	—	—	—
Total dust		—	15	—	—	10	—	—	—	—	—
2-Methoxyethanol; see Methyl cellosolve											
4-Methoxyphenol	150-76-5	—	—	—	—	5	—	—	—	—	—
Methyl acetate	79-20-9	200	610	—	200	610	250	760	—	—	—
Methyl acetylene (Propyne)	74-99-7	1000	1650	—	1000	1650	—	—	—	—	—
Methyl acetylene propadiene mixture (MAPP)	—	1000	1800	—	1000	1800	1250	2250	—	—	—
Methyl acrylate	96-33-3	10	35	X	10	35	—	—	—	—	X
Methylacrylonitrile	126-98-7	—	—	—	1	3	—	—	—	—	X
Methylal (Dimethoxymethane)	109-87-5	1000	3100	—	1000	3100	—	—	—	—	—
Methyl alcohol	67-56-1	200	260	—	200	260	250	325	—	—	X
Methylamine	74-89-5	10	12	—	10	12	—	—	—	—	—
Methyl amyl alcohol; see Methyl Isobutyl carbinol											
Methyl n-amyl ketone	110-43-0	100	465	—	100	465	—	—	—	—	—
Methyl bromide	74-83-9	(C)20	(C)80	X	5	20	—	—	—	—	X
Methyl butyl ketone; see 2-Hexanone											
Methyl cellosolve (2-Methoxyethanol)	109-86-4	25	80	X	25	80	—	—	—	—	X
Methyl cellosolve acetate (2-Methoxyethyl acetate)	110-49-6	25	120	X	25	120	—	—	—	—	X
Methyl chloride	74-87-3	See Table Z-2	—	—	50	105	100	210	—	—	—
Methyl chloroform (1,1,1-Trichloroethane)	71-55-6	350	1900	—	350	1900	450	2450	—	—	—
Methyl 2-cyanoacrylate	137-05-3	—	—	—	2	8	4	16	—	—	—
Methylcyclohexane	108-87-2	500	2000	—	400	1600	—	—	—	—	—
Methylcyclohexanol	25639-42-3	100	470	—	50	235	—	—	—	—	—

TABLE Z-1-A. Limits For Air Contaminants

Substance	CAS No.	Transitional Limits PEL*			Skin Designation	Final Rule Limits**						
		PEL*		b		TWA		STEL <sup>c</sup>		CEILING		Skin Designation
		ppm <sup>a</sup>	mg/m <sup>3</sup>			ppm <sup>a</sup>	mg/m <sup>3</sup>	ppm <sup>a</sup>	mg/m <sup>3</sup>	ppm <sup>a</sup>	mg/m <sup>3</sup>	
<i>o</i> -Methylcyclohexanone	583-60-8	100	460	—	X	50	230	75	345	—	—	X
Methylcyclopentadienyl manganese tricarbonyl (as Mn)	12108-13-3	—	—	—	—	—	0.2	—	—	—	—	X
Methyl demeton	8022-00-2	—	—	—	—	—	0.5	—	—	—	—	X
4,4'-Methylene bis(2-chloroaniline) (MBOCA)	101-14-4	—	—	—	—	0.02	0.22	—	—	—	—	—
Methylene bis(4-cyclohexylisocyanate)	5124-30-1	—	—	—	—	—	—	—	—	0.01	0.11	X
Methylene chloride	75-09-2	See Table Z-2			—	—	—	—	See Table Z-2		—	—
Methyl ethyl ketone (MEK); see 2-Butanone												
Methyl ethyl ketone peroxide (MEKP)	1338-23-4	—	—	—	—	—	—	—	—	0.7	5	—
Methyl formate	107-31-3	100	250	—	—	100	250	150	375	—	—	—
Methyl hydrazine (Monomethyl hydrazine)	60-34-4	(C)0.2	(C)0.35	—	X	—	—	—	—	0.2	0.35	X
Methyl iodide	74-88-4	5	28	—	X	2	10	—	—	—	—	X
Methyl isoamyl ketone	110-12-3	—	—	—	—	50	240	—	—	—	—	—
Methyl isobutyl carbinol	108-11-2	25	100	—	X	25	100	40	165	—	—	X
Methyl isobutyl ketone; see Hexone												
Methyl isocyanate	624-83-9	0.02	0.05	—	X	0.02	0.05	—	—	—	—	X
Methyl isopropyl ketone	563-80-4	—	—	—	—	200	705	—	—	—	—	—
Methyl mercaptan	74-93-1	(C)10	(C)20	—	—	0.5	1	—	—	—	—	—
Methyl methacrylate	80-62-6	100	410	—	—	100	410	—	—	—	—	—
Methyl parathion	298-00-0	—	—	—	—	—	0.2	—	—	—	—	X
Methyl propyl ketone; see 2-Pentanone												
Methyl silicate	681-84-5	—	—	—	—	1	6	—	—	—	—	—
alpha-Methyl styrene	98-83-9	(C)100	(c)480	—	—	50	240	100	485	—	—	—
Methylene bisphenyl isocyanate (MDI)	101-68-8	(C)0.02	(C)0.2	—	—	—	—	—	—	0.02	0.2	—
Metribuzin	21087-64-9	—	—	—	—	—	5	—	—	—	—	—
Mica; see Silicates												
Molybdenum (as Mo)	7439-98-7	—	5	—	—	—	5	—	—	—	—	—
Soluble compounds												
Insoluble compounds												
Total dust			15	—	—	—	10	—	—	—	—	—
Monocrotophos (Azodrin <sup>®</sup> )	6923-22-4	—	—	—	—	—	0.25	—	—	—	—	—
Monomethyl aniline	100-61-8	2	9	—	X	0.5	2	—	—	—	—	X
Morpholine	110-91-8	20	70	—	X	20	70	30	105	—	—	X
Maphtha (Coal tar)	8030-30-6	100	400	—	—	100	400	—	—	—	—	—
Maphthalene	91-20-3	10	50	—	—	10	50	15	75	—	—	—
alpha-Maphthylamine; see 1910.1004	134-32-7											
beta-Maphthylamine; see 1910.1009	91-59-8											
Nickel carbonyl (as Ni)	13463-39-3	0.001	0.007	—	—	0.001	0.007	—	—	—	—	—
Nickel, metal and insoluble compounds (as Ni)	7440-02-0	—	1	—	—	—	1	—	—	—	—	—
Nickel, soluble compounds (as Ni)	7440-02-0	—	1	—	—	—	0.1	—	—	—	—	—
Nicotine	54-11-5	—	0.5	—	X	—	0.5	—	—	—	—	X
Nitric acid	7697-37-2	2	5	—	—	2	5	4	10	—	—	—
Nitric oxide	10102-43-9	25	30	—	—	25	30	—	—	—	—	—
p-Nitroaniline	100-01-6	1	6	—	X	—	3	—	—	—	—	X
Nitrobenzene	98-95-3	1	5	—	X	1	5	—	—	—	—	X
p-Nitrochlorobenzene	100-00-5	—	1	—	X	—	1	—	—	—	—	X
4-Nitrodiphenyl; see 1910.1003	92-93-3											



TABLE Z-1-A. Limits For Air Contaminants

Substance	CAS No.	Transitional Limits PEL*		Skin Designation	Final Rule Limits**						
		PEL*			TWA		STEL <sup>c</sup>		CEILING		Skin Designation
		ppm <sup>a</sup>	mg/m <sup>3</sup>		ppm <sup>a</sup>	mg/m <sup>3</sup>	ppm <sup>a</sup>	mg/m <sup>3</sup>	ppm <sup>a</sup>	mg/m <sup>3</sup>	
Nitroethane	79-24-3	100	310	—	100	310	—	—	—	—	—
Nitrogen dioxide	10102-44-0	(C)5	(C)9	—	—	—	1	1.8	—	—	—
Nitrogen trifluoride	778-54-2	10	29	—	10	29	—	—	—	—	—
Nitroglycerin	53-63-0	(C)0.2	(C)2	X	—	—	—	0.1	—	—	X
Nitromethane	75-52-5	100	250	—	100	250	—	—	—	—	—
1-Nitropropane	108-03-2	25	90	—	25	90	—	—	—	—	—
2-Nitropropane	79-46-9	25	90	—	10	35	—	—	—	—	—
N-Nitrosodimethylamine; see 1910.1016	62-79-9	—	—	—	—	—	—	—	—	—	—
Nitrotoluene	—	—	—	—	—	—	—	—	—	—	—
o-isomer	88-72-2;	—	—	—	—	—	—	—	—	—	—
m-isomer	99-08-1;	5	30	X	2	11	—	—	—	—	X
p-isomer	99-99-0	—	—	—	—	—	—	—	—	—	—
Nitrotrichloromethane; see Chloropicrin	—	—	—	—	—	—	—	—	—	—	—
Nonane	111-84-2	—	—	—	200	1050	—	—	—	—	—
Octachloronaphthalene	2234-13-1	—	0.1	X	—	0.1	—	0.3	—	—	X
Octane	111-65-9	500	2350	—	300	1450	375	1800	—	—	—
Oil mist, mineral	8012-95-1	—	5	—	—	5	—	—	—	—	—
Osmium tetroxide (as Os)	20816-12-0	—	0.002	—	0.0002	0.002	0.0006	0.006	—	—	—
Oxalic acid	144-62-7	—	1	—	—	1	—	2	—	—	—
Oxygen difluoride	7783-41-7	0.05	0.1	—	—	—	—	—	0.05	0.1	—
Ozone	10028-15-6	0.1	0.2	—	0.1	0.2	0.3	0.6	—	—	—
Paraffin wax fume	8002-74-2	—	—	—	—	2	—	—	—	—	—
Paraquat, respirable dust	1910-42-5 2074-50-2	—	—	—	—	—	—	—	—	—	—
4685-14-7	—	—	0.5	X	—	0.1	—	—	—	—	X
56-38-2	—	—	0.1	X	—	0.1	—	—	—	—	X
Parathion	56-38-2	—	0.1	X	—	0.1	—	—	—	—	X
Particulates not otherwise regulated	—	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	—	15	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—
Pentaborane	19624-22-7	0.005	0.01	—	0.005	0.01	0.015	0.03	—	—	—
Pentachloronaphthalene	1321-64-8	—	0.5	X	—	0.5	—	—	—	—	X
Pentachlorophenol	87-86-5	—	0.5	X	—	0.5	—	—	—	—	X
Pentaerythritol	115-77-5	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	—	10	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—
Pentane	109-66-0	1000	2950	—	600	1800	750	2250	—	—	—
2-Pentanone (Methyl propyl ketone)	107-87-9	200	700	—	200	700	250	875	—	—	—
Perchloroethylene (Tetrachloroethylene)	127-18-4	—	See Table Z-2	—	25	170	—	—	—	—	—
Perchloromethyl mercaptan	594-42-3	0.1	0.8	—	0.1	0.8	—	—	—	—	—
Perchloryl fluoride	7616-94-6	3	13.5	—	3	14	6	28	—	—	—
Perlite	—	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	—	15	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—
Petroleum distillates (Naphtha)	8002-05-9	500	2000	—	400	1600	—	—	—	—	—
Phenol	108-95-2	5	19	X	5	19	—	—	—	—	X
Phenothiazine	92-84-2	—	—	—	—	5	—	—	—	—	X
p-Phenylene diamine	106-50-3	—	0.1	X	—	0.1	—	—	—	—	X
Phenyl ether, vapor	101-84-8	1	7	—	1	7	—	—	—	—	—
Phenyl ether-biphenyl mixture, vapor	—	1	7	—	1	7	—	—	—	—	—
Phenylethylene; see Styrene	—	—	—	—	—	—	—	—	—	—	—
Phenyl glycidyl ether (PGE)	122-60-1	10	60	—	1	6	—	—	—	—	—

TABLE Z-1-A. Limits For Air Contaminants

Substance	CAS No.	Transitional Limits PEL*		Skin Designation	Final Rule Limits**						
		PEL*			TWA		STEL <sup>c</sup>		CEILING		Skin Designation
		ppm <sup>a</sup>	b mg/m <sup>3</sup>		ppm <sup>a</sup>	b mg/m <sup>3</sup>	ppm <sup>a</sup>	b mg/m <sup>3</sup>	ppm <sup>a</sup>	b mg/m <sup>3</sup>	
Phenyldiazine	100-63-0	5	22	X	5	20	10	45	—	—	X
Phenyl mercaptan	108-98-5	—	—	—	0.5	2	—	—	—	—	—
Phenylphosphine	638-21-1	—	—	—	—	—	—	—	0.05	0.25	—
Phorate	298-02-2	—	—	—	—	0.05	—	0.2	—	—	X
Phosdrin (Mevinphos <sup>®</sup> )	7786-34-7	—	0.1	X	0.01	0.1	0.03	0.3	—	—	X
Phosgene (Carbonyl chloride)	75-44-5	0.1	0.4	—	0.1	0.4	—	—	—	—	—
Phosphine	7803-51-2	0.3	0.4	—	0.3	0.4	1	1	—	—	—
Phosphoric acid	7664-38-2	—	1	—	—	1	—	3	—	—	—
Phosphorus (yellow)	7723-14-0	—	0.1	—	—	0.1	—	—	—	—	—
Phosphorous oxychloride	10025-87-3	—	—	—	0.1	0.6	—	—	—	—	—
Phosphorus pentachloride	10026-13-8	—	1	—	—	1	—	—	—	—	—
Phosphorus pentasulfide	1314-80-3	—	1	—	—	1	—	3	—	—	—
Phosphorus trichloride	7719-12-2	0.5	3	—	0.2	1.5	0.5	3	—	—	—
Phthalic anhydride	85-44-9	2	12	—	1	6	—	—	—	—	—
m-Phthalodinitrile	626-17-5	—	—	—	—	5	—	—	—	—	—
Pictoram	1918-02-1	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	—	10	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—
Picric acid	88-89-1	—	0.1	X	—	0.1	—	—	—	—	X
Piperazine dihydrochloride	142-64-3	—	—	—	—	5	—	—	—	—	—
Pindone (2-Pivalyl-1,3-Indandione)	83-26-1	—	0.1	—	—	0.1	—	—	—	—	—
Plaster of Paris	26499-65-0	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	—	15	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—
Platinum (as Pt)	7440-06-4	—	—	—	—	—	—	—	—	—	—
Metal	—	—	—	—	—	1	—	—	—	—	—
Soluble salts	—	—	0.002	—	—	0.002	—	—	—	—	—
Portland cement	65997-15-1	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	See Table Z-3	—	—	10	—	—	—	—	—
Respirable fraction	—	—	See Table Z-3	—	—	5	—	—	—	—	—
Potassium hydroxide	1310-58-3	—	—	—	—	—	—	—	—	2	—
Propane	74-98-6	1000	1800	—	1000	1800	—	—	—	—	—
Propargyl alcohol	107-19-7	—	—	—	1	2	—	—	—	—	X
beta-Propiolactone; see 1910.1013	57-57-8	—	—	—	—	—	—	—	—	—	—
Propionic acid	79-09-4	—	—	—	10	30	—	—	—	—	—
Propoxur (Baygon)	114-26-1	—	—	—	—	0.5	—	—	—	—	—
n-Propyl acetate	109-60-4	200	840	—	200	840	250	1050	—	—	—
n-Propyl alcohol	71-23-8	200	500	—	200	500	250	625	—	—	—
n-Propyl nitrate	627-13-4	25	110	—	25	105	40	170	—	—	—
Propylene dichloride	78-87-5	75	350	—	75	350	110	510	—	—	—
Propylene glycol dinitrate	6423-43-4	—	—	—	0.05	0.3	—	—	—	—	—
Propylene glycol monomethyl ether	107-98-2	—	—	—	100	360	150	540	—	—	—
Propylene imine	75-55-8	2	5	X	2	5	—	—	—	—	X
Propylene oxide	75-56-9	100	240	—	20	50	—	—	—	—	—
Propyne; see Methyl acetylene	—	—	—	—	—	—	—	—	—	—	—
Pyrethrum	8003-34-7	—	5	—	—	5	—	—	—	—	—
Pyridine	110-86-1	5	15	—	5	15	—	—	—	—	—
Quinone	106-51-4	0.1	0.4	—	0.1	0.4	—	—	—	—	—
Resorcinol	108-46-3	—	—	—	10	45	20	90	—	—	—
Rhodium (as RH), metal fume and insoluble compounds	7440-16-6	—	0.1	—	—	0.1	—	—	—	—	—
Rhodium (as RH), soluble compounds	7440-16-6	—	0.001	—	—	0.001	—	—	—	—	—

TABLE Z-1-A. Limits For Air Contaminants

Substance	CAS No.	Transitional Limits PEL*		Skin Designation	TWA		Final Rule Limits** STEL*		CEILING		Skin Designation
		ppm <sup>a</sup>	mg/m <sup>3</sup>		ppm <sup>a</sup>	mg/m <sup>3</sup>	ppm <sup>a</sup>	mg/m <sup>3</sup>	ppm <sup>a</sup>	mg/m <sup>3</sup>	
Ronnel	299-84-3	—	15	—	10	—	—	—	—	—	—
Rosin core solder pyrolysis products, as formaldehyde	—	—	—	—	0.1	—	—	—	—	—	—
Rotenone	83-79-4	—	5	—	5	—	—	—	—	—	—
Rouge	—	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	10	—	—	—	—	—	—
Respirable fraction	—	—	5	—	5	—	—	—	—	—	—
Selenium compounds (as Se)	7782-49-2	—	0.2	—	0.2	—	—	—	—	—	—
Selenium hexafluoride (as Se)	7783-79-1	0.05	0.4	—	0.05	0.4	—	—	—	—	—
Silica, amorphous, precipitated and gel	—	—	See Table Z-3	—	6	—	—	—	—	—	—
Silica, amorphous, diatomaceous earth, containing less than 1% crystalline silica	61790-53-2	—	See Table Z-3	—	6	—	—	—	—	—	—
Silica, crystalline cristobalite (as quartz), respirable dust	14464-46-1	—	See Table Z-3	—	0.05	—	—	—	—	—	—
Silica, crystalline quartz (as quartz), respirable dust	14808-60-7	—	See Table Z-3	—	0.1	—	—	—	—	—	—
Silica, crystalline tripoli (as quartz), respirable dust	1317-95-9	—	See Table Z-3	—	0.1	—	—	—	—	—	—
Silica, crystalline tridymite (as quartz), respirable dust	15468-32-3	—	See Table Z-3	—	0.05	—	—	—	—	—	—
Silica, fused, respirable dust	60676-86-0	—	See Table Z-3	—	0.1	—	—	—	—	—	—
Silicates (less than 1% crystalline silica)	—	—	—	—	—	—	—	—	—	—	—
Mica (respirable dust)	12001-26-2	—	See Table Z-3	—	3	—	—	—	—	—	—
Soapstone, total dust	—	—	See Table Z-3	—	6	—	—	—	—	—	—
Soapstone, respirable dust	—	—	See Table Z-3	—	3	—	—	—	—	—	—
Talc (containing asbestos): use asbestos limit	—	—	See Table Z-3	—	See 29 CFR 1910.1001	—	—	—	—	—	—
Talc (containing no asbestos), respirable dust	14807-96-6	—	See Table Z-3	—	2	—	—	—	—	—	—
Tremolite	—	—	See Table Z-3	—	See 29 CFR 1910.1101	—	—	—	—	—	—
Silicon	7440-21-3	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	10	—	—	—	—	—	—
Respirable fraction	—	—	5	—	5	—	—	—	—	—	—
Silicon carbide	409-21-2	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	10	—	—	—	—	—	—
Respirable fraction	—	—	5	—	5	—	—	—	—	—	—
Silicon tetrahydride	7803-62-5	—	—	—	5	7	—	—	—	—	—
Silver, metal and soluble compounds (as Ag)	7440-22-4	—	0.01	—	0.01	—	—	—	—	—	—
Soapstone; see Silicates	—	—	—	—	—	—	—	—	—	—	—
Sodium azide (as HN <sub>3</sub> )	26628-22-8	—	—	—	—	—	—	0.1	—	—	X
(as NaN <sub>3</sub> )	—	—	—	—	—	—	—	—	0.3	—	X
Sodium bisulfite	7631-90-5	—	—	—	5	—	—	—	—	—	—
Sodium fluoracetate	62-74-8	—	0.05	X	0.05	—	0.15	—	—	—	X
Sodium hydroxide	1310-73-2	—	2	—	—	—	—	—	2	—	—
Sodium metabisulfite	7681-57-4	—	—	—	5	—	—	—	—	—	—
Starch	9006-25-8	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	15	—	—	—	—	—	—
Respirable fraction	—	—	5	—	5	—	—	—	—	—	—
Stibine	7803-52-3	0.1	0.5	—	0.1	0.5	—	—	—	—	—
Stoddard solvent	8052-41-3	500	2900	—	100	525	—	—	—	—	—
Strychnine	57-24-9	—	0.15	—	—	0.15	—	—	—	—	—
Styrene	100-42-5	—	See Table Z-2	—	50	215	100	425	—	—	—



TABLE Z-1-A. Limits For Air Contaminants

Substance	CAS No.	Transitional Limits PEL*		Skin Designation	TWA		Final Rule Limits** STEL <sup>c</sup>		CEILING		Skin Designation
		ppm <sup>a</sup>	b mg/m <sup>3</sup>		ppm <sup>a</sup>	b mg/m <sup>3</sup>	ppm <sup>a</sup>	b mg/m <sup>3</sup>	ppm <sup>a</sup>	b mg/m <sup>3</sup>	
Subtilisins (Proteolytic enzymes)	9014-01-1	—	—	—	—	—	—	—	—	—	—
Sucrose	57-50-1	—	—	—	—	—	0.00006 (60min.) <sup>d</sup>	—	—	—	—
Total dust	—	—	15	—	—	15	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—
Sulfur dioxide	7446-09-5	5	13	—	2	5	5	10	—	—	—
Sulfur hexafluoride	2551-62-4	1000	6000	—	1000	6000	—	—	—	—	—
Sulfuric acid	7664-93-9	—	1	—	—	1	—	—	—	—	—
Sulfur monochloride	10025-67-9	1	6	—	—	—	—	1	6	—	—
Sulfur pentafluoride	5714-22-7	0.025	0.25	—	—	—	—	0.01	0.1	—	—
Sulfur tetrafluoride	7783-60-0	—	—	—	—	—	—	0.1	0.4	—	—
Sulfuryl fluoride	2699-79-8	5	20	—	5	20	10	40	—	—	—
Sulprofos	35400-43-2	—	—	—	—	1	—	—	—	—	—
Systox <sup>®</sup> , see Demetron 2,4,5-1	93-76-5	—	10	—	—	10	—	—	—	—	—
Talc; see Silicates	—	—	—	—	—	—	—	—	—	—	—
Tantalum, metal and oxide dust	7440-25-7	—	5	—	—	5	—	—	—	—	—
TEDP (Sulfotep)	3689-24-5	—	0.2	X	—	0.2	—	—	—	—	X
Tellurium and compounds (as Te)	13494-80-9	—	0.1	—	—	0.1	—	—	—	—	—
Tellurium hexafluoride (as Te)	7783-80-4	0.02	0.2	—	0.02	0.2	—	—	—	—	—
Temephos	3383-96-8	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	—	10	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—
TEPP	107-49-3	—	0.05	X	—	0.05	—	—	—	—	X
Terphenylis	26140-60-3	(C)1	(C)9	—	—	—	—	0.5	5	—	—
1,1,1,2-Tetrachloro-2,2-difluoroethane	76-11-9	500	4170	—	500	4170	—	—	—	—	—
1,1,2,2-Tetrachloro-1,2-difluoroethane	76-12-0	500	4170	—	500	4170	—	—	—	—	—
1,1,2,2-Tetrachloro-ethane	79-34-5	5	35	X	1	7	—	—	—	—	X
Tetrachloroethylene; see Perchloroethylene	—	—	—	—	—	—	—	—	—	—	—
Tetrachloromethane; see Carbon tetrachloride	—	—	—	—	—	—	—	—	—	—	—
Tetrachloronaphthalene	1335-88-2	—	2	X	—	2	—	—	—	—	X
Tetraethyl lead (as Pb) (as Pb)	78-00-2	—	0.075	X	—	0.075	—	—	—	—	X
Tetrahydrofuran	109-99-9	200	590	—	200	590	250	735	—	—	—
Tetramethyl lead, (as Pb)	75-74-1	—	0.075	X	—	0.075	—	—	—	—	X
Tetramethyl succino-nitrile	3333-52-6	0.5	3	X	0.5	3	—	—	—	—	X
Tetranitromethane	509-14-8	1	8	—	1	8	—	—	—	—	—
Tetrasodium pyro-phosphate	7722-88-5	—	—	—	—	5	—	—	—	—	—
Tetryl (2,4,6-Trinitrophenyl-methyl-nitramine)	479-45-8	—	1.5	X	—	1.5	—	—	—	—	X
Thallium, soluble compounds (as Tl)	7440-28-0	—	0.1	X	—	0.1	—	—	—	—	X
4,4'-Thiobis(6-tert, Butyl-m-cresol)	96-69-5	—	15	—	—	10	—	—	—	—	—
Total dust	—	—	15	—	—	10	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—
Thioglycolic acid	68-11-1	—	—	—	1	4	—	—	—	—	X
Thionyl chloride	7719-09-7	—	—	—	—	—	—	1	5	—	—
Thiram	137-26-8	—	5	—	—	5	—	—	—	—	—
Tin, inorganic compounds (except oxides) (as Sn)	7440-31-5	—	2	—	—	2	—	—	—	—	—
Tin, organic compounds (as Sn)	7440-31-5	—	0.1	—	—	0.1	—	—	—	—	X

TABLE Z-1-A. Limits For Air Contaminants

Substance	CAS No.	Transitional Limits PEL*		Skin Designation	Final Rule Limits**						
		PEL*			TWA		STEL <sup>c</sup>		CEILING		Skin Designation
		ppm <sup>a</sup>	b mg/m <sup>3</sup>		ppm <sup>a</sup>	b mg/m <sup>3</sup>	ppm <sup>a</sup>	b mg/m <sup>3</sup>	ppm <sup>a</sup>	b mg/m <sup>3</sup>	
Tin oxide (as Sn)	21651-19-4	—	—	—	2	—	—	—	—	—	
Titanium dioxide	13463-67-7	—	—	—	—	—	—	—	—	—	
Total dust	—	—	5	—	—	5	—	—	—	—	
Toluene	108-88-3	See Table Z-2		—	100	375	150	560	—	—	
Toluene-2,4-diisocyanate (TDI)	584-84-9	(C)0.02	(C)0.14	—	0.005	0.04	0.02	0.15	—	—	
m-Toluidine	108-44-1	—	—	—	2	9	—	—	—	X	
o-Toluidine	95-53-4	5	22	X	5	22	—	—	—	X	
p-Toluidine	106-49-0	—	—	—	2	9	—	—	—	X	
Toxaphene; see Chlorinated camphene	—	—	—	—	—	—	—	—	—	—	
Tremolite; see Silicates	—	—	—	—	—	—	—	—	—	—	
Tributyl phosphate	126-73-8	—	5	—	0.2	2.5	—	—	—	—	
Trichloroacetic acid	76-03-9	—	—	—	1	7	—	—	—	—	
1,2,4-Trichlorobenzene	120-82-1	—	—	—	—	—	—	5	40	—	
1,1,1-Trichloroethane; see Methyl chloroform	—	—	—	—	—	—	—	—	—	—	
1,1,1-Trichloroethane	79-00-5	10	45	X	10	45	—	—	—	X	
Trichloroethylene	79-01-6	See Table Z-2		—	50	270	200	1080	—	—	
Trichloromethane; see Chloroform	—	—	—	—	—	—	—	—	—	—	
Trichloronaphthalene	1321-65-9	—	5	X	—	5	—	—	—	X	
1,2,3-Trichloropropane	96-18-4	50	300	—	10	60	—	—	—	—	
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	1000	7600	—	1000	7600	1250	9500	—	—	
Triethylamine	121-44-8	25	100	—	10	40	15	60	—	—	
Trifluorobromomethane	75-63-8	1000	6100	—	1000	6100	—	—	—	—	
Trimellitic anhydride	552-30-7	—	—	—	0.005	0.04	—	—	—	—	
Trimethylamine	75-50-3	—	—	—	10	24	15	36	—	—	
Trimethyl benzene	25551-13-7	—	—	—	25	125	—	—	—	—	
Trimethyl phosphite	121-45-9	—	—	—	2	10	—	—	—	—	
2,4,6-Trinitrophenyl; see Picric acid	—	—	—	—	—	—	—	—	—	—	
2,4,6-Trinitrophenylmethyl nitramine; see Tetryl	—	—	—	—	—	—	—	—	—	—	
2,4,6-Trinitrotoluene (TNT)	118-96-7	—	1.5	X	—	0.5	—	—	—	X	
Triorthocresyl phosphate	78-30-8	—	0.1	—	—	0.1	—	—	—	X	
Triphenyl amine	603-34-9	—	—	—	—	5	—	—	—	—	
Triphenyl phosphate	115-86-6	—	3	—	—	3	—	—	—	—	
Tungsten (as W)	7440-33-7	—	—	—	—	—	—	—	—	—	
Insoluble compounds	—	—	—	—	—	5	—	10	—	—	
Soluble compounds	—	—	—	—	—	1	—	3	—	—	
Turpentine	8006-64-2	100	560	—	100	560	—	—	—	—	
Uranium (as U)	7440-61-1	—	—	—	—	—	—	—	—	—	
Soluble compounds	—	—	0.05	—	—	0.05	—	—	—	—	
Insoluble compounds	—	—	0.25	—	—	0.2	—	0.6	—	—	
n-Valeraldehyde	110-62-3	—	—	—	50	175	—	—	—	—	
Vanadium	1314-62-1	—	—	—	—	—	—	—	—	—	
Respirable dust (as V <sub>2</sub> O <sub>5</sub> )	—	—	(C)0.5	—	—	0.05	—	—	—	—	
Fume (as V <sub>2</sub> O <sub>5</sub> )	—	—	(C)0.1	—	—	0.05	—	—	—	—	
Vegetable oil mist	—	—	—	—	—	—	—	—	—	—	
Total dust	—	—	15	—	—	15	—	—	—	—	
Respirable fraction	—	—	5	—	—	5	—	—	—	—	
Vinyl acetate	108-05-4	—	—	—	10	30	20	60	—	—	
Vinyl benzene; see Styrene	—	—	—	—	—	—	—	—	—	—	
Vinyl bromide	593-60-2	—	—	—	5	20	—	—	—	—	
Vinyl chloride; see 1910.1017	75-01-4	—	—	—	—	—	—	—	—	—	



TABLE Z-1-A. Limits For Air Contaminants

Substance	CAS No.	Transitional Limits PEL*		Skin Designation	Final Rule Limits**						
		PEL*			TWA		STEL <sup>c</sup>		CEILING		Skin Designation
		ppm <sup>a</sup>	mg/m <sup>3</sup> <sup>b</sup>		ppm <sup>a</sup>	mg/m <sup>3</sup> <sup>b</sup>	ppm <sup>a</sup>	mg/m <sup>3</sup> <sup>b</sup>	ppm <sup>a</sup>	mg/m <sup>3</sup> <sup>b</sup>	
Vinylcyanide; see Acrylonitrile											
Vinyl cyclohexene dioxide	106-87-6	—	—	—	10	60	—	—	—	—	X
Vinylidene chloride (1,1-Dichloroethylene)	75-35-4	—	—	—	1	4	—	—	—	—	—
Vinyl toluene	25013-15-4	100	480	—	100	480	—	—	—	—	—
VM & P Naphtha	8032-32-4	—	—	—	300	1350	400	1800	—	—	—
Warfarin	81-81-2	—	0.1	—	—	0.1	—	—	—	—	—
Welding fumes (total particulate)***	—	—	—	—	—	5	—	—	—	—	—
Wood dust, all soft and hard woods, except Western red cedar	—	—	—	—	—	5	—	10	—	—	—
Wood dust, Western red cedar	—	—	—	—	—	2.5	—	—	—	—	—
Xylenes (o-, m-, p- isomers)	1330-20-7	100	435	—	100	435	150	655	—	—	—
m-Xylene alpha, alpha-diamine	1477-55-0	—	—	—	—	—	—	—	—	0.1	X
Xylidine	1300-73-8	5	25	X	2	10	—	—	—	—	X
Yttrium	7440-65-5	—	1	—	—	1	—	—	—	—	—
Zinc chloride fume	7646-85-7	—	1	—	—	1	—	2	—	—	—
Zinc chromate (as CrO <sub>3</sub> )	Varies with Compound	—	See Table Z-2	—	—	—	—	—	—	0.1	—
Zinc oxide fume	1314-13-2	—	5	—	—	5	—	10	—	—	—
Zinc oxide	1314-13-2	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	—	10	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—
Zinc stearate	557-05-1	—	—	—	—	—	—	—	—	—	—
Total dust	—	—	15	—	—	10	—	—	—	—	—
Respirable fraction	—	—	5	—	—	5	—	—	—	—	—

- \* The transitional PELs are 8-hour TWAs unless otherwise noted; a (C) designation denotes a ceiling limit.
- \*\* Unless otherwise noted, employers in General Industry (i.e., those covered by 29 CFR 1910) may use any combination of controls to achieve these limits until December 31, 1992 as set forth in 29 CFR 1910.1000(f).
- \*\*\* As determined from breathing-zone air samples.
- a Parts of vapor or gas per million parts of contaminated air by volume at 25°C and 760 torr.
- b Approximate milligrams of substance per cubic meter of air.
- c Duration is for 15 minutes, unless otherwise noted.
- d The final benzene standard in 1910.1028 applies to all occupational exposures to benzene except some subsegments of industry where exposures are consistently under the action level (i.e., distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures); for the excepted subsegments, the benzene limits in Table Z-2 apply.
- e Exposures under 10,000 ppm to be cited de minimus.
- f The CAS number is for information only. Enforcement is based on the substance name. For an entry covering more than one metal compound measured as the metal, the CAS number for the metal is given—not CAS numbers for the individual compounds.
- g Compliance with the subtilisin PEL is assessed by sampling with a high volume sampler (600–800 liters per minute) for at least 60 minutes.

TABLE Z-2

Material	8-hour time-weighted average	Acceptable ceiling concentration	Acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift	
			Concentration	Maximum duration
Benzene (Z37.40-1969) <sup>1</sup>	10 ppm	25 ppm	50 ppm	10 minutes.
Beryllium and Beryllium compounds (Z37.29-1970)	2 µg/m <sup>3</sup>	5µg/m <sup>3</sup>	25 µg/m <sup>3</sup>	30 minutes.
Cadmium fume (Z37.5-1970)	0.1 mg/m <sup>3</sup>	0.3 mg/m <sup>3</sup>		
Cadmium dust (Z37.5-1970)	0.2 mg/m <sup>3</sup>	0.6 mg/m <sup>3</sup>		
Carbon disulfide (Z37.3-1968)	20 ppm	30 ppm	100 ppm	30 minutes
Carbon Tetrachloride (Z37.17-1967)	10 ppm	25 ppm	200 ppm	5 minutes in any 4 hours.
Chromic acid and chromates (Z37-7-1971)		1 mg/10 m <sup>3</sup>		
Ethylene dibromide (Z37.31-1970)	20 ppm	30 ppm	50 ppm	5 minutes.
Ethylene dichloride (Z37.21-1969)	50 ppm	100 ppm	200 ppm	5 minutes in any 3 hours.
Formaldehyde (Z37.16-1967) <sup>2</sup>	3 ppm	5 ppm	10 ppm	30 minutes.
Hydrogen fluoride (Z37.28-1969)	3 ppm			
Hydrogen sulfide (Z37.2-1966)		20 ppm	50 ppm	10 minutes once only if no other measurable exposure occurs.
Fluoride as dust (Z37.38-1969)	25 mg/m <sup>3</sup>			
Mercury (Z37.8-1971)		1 mg/10 m <sup>3</sup>		
Methyl chloride(Z37.18-1969)	100 ppm	200 ppm	300 ppm	5 minutes in any 3 hours.
Methylene chloride (Z37.23-1969)	500 ppm	1,000 ppm	2,000 ppm	5 minutes in any 2 hours.
Organo (alkyl) mercury (Z37.30-1969)	0.01 mg/m <sup>3</sup>	0.04 mg/m <sup>3</sup>		
Styrene (Z37.15-1969)	100 ppm	200 ppm	600 ppm	5 minutes in any 3 hours.
Tetrachloroethylene (Z37.22-1967)	100 ppm	200 ppm	300 ppm	5 minutes in any 3 hours.
Toluene (Z37.12-1967)	200 ppm	300 ppm	500 ppm	10 minutes.
Trichloroethylene (Z37.19-1967)	100 ppm	200 ppm	300 ppm	5 minutes in any 2 hours.

<sup>1</sup>This standard applies to the industry segments exempt from the 1 ppm 8-hour TWA and 5 ppm STEL of the benzene standard at 1910.1028. This standard also applies to any industry for which 1910.1028 is stayed or otherwise not in effect.

<sup>2</sup>This standard applies to any industry for which 1910.1048 is stayed or otherwise not in effect.



TABLE Z-3 Mineral Dusts

Substance	mppcf <sup>a</sup>	mg/m <sup>3</sup>
<b>SILICA:</b>		
<b>CRYSTALLINE</b>		
QUARTZ (RESPIRABLE)*	250 <sup>c</sup>	10 mg/m <sup>3m</sup>
QUARTZ (TOTAL DUST)	%SiO <sub>2</sub> + 5	%SiO <sub>2</sub> + 2 30 mg/m <sup>3</sup> %SiO <sub>2</sub> + 2
CRISTOBALITE*: Use 1/2 the value calculated from the count or mass formulae for quartz		
TRIDYMITE*: Use 1/2 the value calculated from the formulae for quartz		
AMORPHOUS, including natural diatomaceous earth*	20	60 mg/m <sup>3</sup> %SiO <sub>2</sub>
<b>SILICATES (less than 1% crystalline silica):</b>		
Mica*	20	
Soapstone*	20	
Talc (not containing asbestos)*	20*	
Talc (containing asbestos). Use asbestos limit		
Tremolite (see 29 CFR 1910.1101)		
Portland cement*	50	
GRAPHITE (NATURAL)*	15	
COAL DUST (respirable fraction less than 5% SiO <sub>2</sub> )*		2.4 mg/m <sup>3</sup> or 10 mg/m <sup>3</sup> %SiO <sub>2</sub> + 2
For more than 5% SiO <sub>2</sub> *		
<b>INERT OR NUISANCE DUST:</b>		
Respirable fraction*	15	5 mg/m <sup>3</sup>
Total dust	50	15 mg/m <sup>3</sup>

Note.—Conversion factors—mppcf × 35.3 = million particles per cubic meter = particles per c.c.

\*Substances that are in Table Z-4 in this proposal.

<sup>c</sup>Millions of particles per cubic foot of air, based on impinger samples counted by light-field techniques.

The percentage of crystalline silica in the formula is the amount determined from airborne samples, except in those instances in which other methods have been shown to be applicable.

<sup>m</sup>Both concentration and percent quartz for the application of this limit are to be determined from the fraction passing a size-selector with the following characteristics:

Aerodynamic diameter (unit density sphere)	Percent passing selector	Aerodynamic diameter (unit density sphere)	Percent passing selector
2	90	3.5	50
2.5	75	5.0	25

Aerodynamic diameter (unit density sphere)	Percent passing selector
10	0

<sup>m</sup>Containing less than 1% quartz; if 1% quartz, use quartz limit.

The measurements under this note refer to the use of an AEC (now NRC) instrument. The respirable fraction of coal dust is determined with an MRE; the figure corresponding to that of 2.4 mg/m<sup>3</sup> in the table for coal dust is 4.5 mg/m<sup>3</sup>.

**Editorial note:** This Appendix will not appear in the Code of Federal Regulations.

**XI. Appendix—Sampling and Analytical Non-Mandatory Methods**

The sampling and analytical methods for the substances listed in this appendix are not mandatory. They are listed to

inform the public of methods and indicate that methods are available (or not available in 7 cases). They are categorized into three. These methods are indicated in the tables in this Appendix. The first table details fully validated methods, other methods, substances for which there are no identified methods, and detection limits. The second table identifies the most recent NIOSH Analytical methods.

**A. Fully Validated Methods**

Fully Validated methods were developed by either NIOSH or OSHA. The criteria used in validating these procedures were developed independently by each agency. There are some differences in validation protocol, but in general similar testing procedures were followed. These methods are widely accepted by the scientific community.

**B. Other Methods**

Methods in this category have not been subjected to all of the testing procedures required of fully validated methods. Some of

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these procedures have been taken directly from scientific literature and may not have been used by OSHA. Some are methods that were validated for a specific analyte and OSHA believes are applicable for similar analytes. OSHA has reviewed these methods and has concluded that they are of adequate quality to be used for assessing exposures and for enforcement.

*C. No. Methods*

These analytes do not have an adequate sampling method available at OSHA, nor has an appropriate method been found in the available scientific literature.

*D. Detection Limits*

The values listed under Detection Limits are the lowest air concentrations that can be monitored, based on recommended sample air volumes. Detection limits for the OSHA validated methods are determined during the evaluation. The detection limits listed for the in-house methods are the estimates of OSHA.

# **Appendix E**

## **Possible Peroxide Formers**

Acetal	Diethyl ether
Acrolein	Dimethyl ether
Acrylic Acid	Dimethyl isopropyl ether
Acrylonitrile	p-Dioxane
Aldehydes	Divinyl ether
Allyl ethyl ether	Ethylene Glycol Dimethyl Ether
Allyl phenyl ether	Ethyl methyl ether
Benzyl ether	Isopropyl Ether
Benzoyl-n-butyl ether	Methyl acetylene
Bromophenetole	Methyl Methacrylate
Butadiene	o-Methylanisole
p-Chloroanisole	m-Methylphenetole
Chloroprene	Phenetole
Chlorotrifluoroethylene	Sodium Amide
Cumene	Styrene
Cyclohexene	Tetrafluoroethylene
Cyclooctene	Tetrahydrofuran
Decahydronaphthalene	Tetrahydronaphthalene
Diacetylene	Vinyl Acetate
Dibutyl ether	Vinyl Chloride
Dicyclopentadiene	Vinyl ethers
Diethylene glycol	Vinyl Pyridine
Diethylene glycol diethyl ether	Vinylidene Chloride
Diethylene glycol mono-o-butyl ether	

# **Appendix F**

## **Chemicals for use in a Designated Area**

- A. Select Carcinogens (Required use in a designated area.)**
- B. Other Carcinogens (Recommended use in a designated area.)**
- C. Teratogens and Mutagens**
- D. Acutely Hazardous Chemicals**

## **A. Select Carcinogens**

2-Acetylaminofluorene  
Aflatoxins  
Aluminium production  
4-Aminobiphenyl  
4-Aminodiphenyl  
Analgesic Mixtures Containing Phenacetin  
Arsenic and Certain Arsenic Compounds  
Asbestos  
Auramine, manufacture of  
Azathioprine  
Benzene  
Benzidine  
Betel quid with tobacco  
Boot and shoe manufacture and repair  
1,4-Butanediol Dimethylsulfonate (Myleran)  
Chlorambucil  
1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (Methyl-CCNU)  
N,N-bis(2-chloroethyl)-2-naphthylamine Chlornaphazine)  
bis(chloromethyl)ether and chloromethyl methyl ether (technical grade)  
Chromium and Certain Chromium Compounds  
Chromium compounds, hexavalent  
Coal gasification  
Coal-tar pitches  
Coal-tars  
Coke production  
Conjugated Estrogens  
Cyclophosphamide  
3,3'-Dichlorobenzidine (and its salts)  
Diethylstilboestrol  
4-Dimethylaminoazobenzene  
Erionite  
Ethylene oxide  
Ethyleneimine  
Formaldehyde  
Furniture and cabinet making  
Haematite mining, underground, with exposure to radon  
Inorganic arsenic  
Iron and steel founding  
Isopropyl alcohol manufacture, strong-acid process  
Magenta, manufacture of  
Melphalan



Methoxsalen with Ultra-violet A Therapy (PUVA)  
8-Methoxypsoralen (Methoxsalen) plus ultraviolet radiation  
Methyl chloromethyl ether  
Mineral oils, untreated and mildly-treated  
MOPP (combined therapy with nitrogen mustard, vincristine, procarbazine and prednisone) and  
    other combined chemotherapy including alkylating agents  
Mustard gas (Sulphur mustard)  
2-Naphthylamine  
alpha-Naphthylamine  
beta-Naphthylamine  
Nickel and nickel compounds  
4-Nitrobiphenyl  
N-Nitrosodimethylamine  
Oestrogen replacement therapy  
Oestrogens, nonsteroidal  
Oestrogens, steroidal  
Oral contraceptives, combined  
Oral contraceptives, sequential  
beta-Propiolactone  
Rubber industry  
Shale-oils  
Soots  
Talc containing asbestiform fibres  
Thorium Dioxide  
Tobacco products, smokeless  
Tobacco smoke  
Treosulphan  
Vinyl chloride

## **B. Other Carcinogens**

A-a-C (2-Amino-9H-pyrido[2,3-b]indole)  
Acetaldehyde  
Acetamide  
2-Acetylaminofluorene  
Acrylamide  
Acrylonitrile  
Adriamycin  
AF-2[2-(2-Furyl)-3-(5-nitro-2-furyl)acrylamide]  
Aflatoxins  
1-Amino-2-methylantraquinone  
2-Amino-5-(5-nitro-2-furyl)-1,3,4-thiadiazole  
2-Aminoanthraquinone  
para-Aminoazobenzene  
ortho-Aminoazotoluene  
Amitrole  
Androgenic (anabolic) steroids  
o-Ansidine Hydrochloride  
ortho-Anisidine  
Aramite  
Auramine,technical-grade  
Azaserine  
Benz[a]anthracene  
Benzidine-based dyes  
Benzo[b]fluoranthene  
Benzo[f]fluoranthene  
Benzo[k]fluoranthene  
Benzo[a]pyrene  
Benzotrichloride  
Benzyl violet 4B  
Beryllium and beryllium compounds  
Bischloroethyl nitrosourea (BCNU)  
Bitumens, extracts of steam-refined and air-refined  
Bleomycins  
Bracken fern  
1,3-Butadiene  
Butylated hydroxyanisole (BHA)  
B-Butyrolactone  
Cadmium and cadmium compounds  
Carbon-black extracts  
Carbon tetrachloride  
Carpentry and joinery

Carrageenan, degraded  
Chloramphenicol  
Chlordecone (Kepone)  
Chlorendic Acid  
Chlorinated Paraffins (C<sub>12</sub> 60% Chlorine)  
a-Chlorinated toluenes  
3-Chloro-2-methylpropene  
4-Chloro-ortho-phenylenediamine  
para-Chloro-ortho-toluidine  
1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea (CCNU)  
Chloroform  
Chlorophenols  
Chlorophenoxy herbicides  
C.I. Basic Red 9 Monohydrochloride  
Cisplatin  
Citrus Red No. 2  
para-Cresidine  
Cresotes  
Cupferron  
Cycasin  
Dacarbazine  
Daunomycin  
DDT  
Di(2-ethylhexyl)phthalate  
N,N'-Diacetylbenzidine  
2,4-Diaminoanisole  
2,4-Diaminoanisole Sulfate  
4,4'-Diaminodiphenyl ether  
2,4-Diaminotoluene  
Dibenz[a,h]acridine  
Dibenz[a,j]acridine  
Dibenz[a,h]anthracene  
7H-Dibenzo[c,g]carbazole  
Dibenzo[a,e]pyrene  
Dibenzo[a,h]pyrene  
Dibenzo[a,l]pyrene  
1,2-Dibromo-3-chloropropane  
1,2-Dibromoethane (EDB)  
3,3'-Dichloro-4,4'-diaminodiphenyl ether  
1,4-Dichlorobenzene  
para-Dichlorobenzene  
3,3'-Dichlorobenzidine  
1,2-Dichloroethane

Dichloromethane (Methylene Chloride)  
1,3-Dichloropropene (technical grade)  
Diepoxybutane  
Diethyl sulphate  
1,2-Diethylhydrazine  
Diglycidyl resorcinol ether  
Dihydrochloride  
Dihydrosafrole  
3,3'-Dimethoxybenzidine (ortho-Dianisidine)  
Dimethyl sulphate  
trans-2-[(Dimethylamino)methylimino]-5-[2-(5-nitro-2-furyl)vinyl]-1,3,4-oxadiazole  
para-Dimethylaminoazobenzene  
3,3'-Dimethylbenzidine (ortho-Tolidine)  
Dimethylcarbamoyl chloride  
1,1-Dimethylhydrazine  
1,2-Dimethylhydrazine  
Dimethylvinyl Chloride  
1,4-Dioxane  
Direct Black 38  
Direct Blue 6  
Epichlorohydrin  
Estrogens (Not Conjugated): Estradiol-17B  
Estrogens (Not Conjugated): Estrone  
Estrogens (Not Conjugated): Ethinylestradiol  
Estrogens (Not Conjugated): Mestranol  
Ethyl acrylate  
Ethyl methanesulphonate  
N-Ethyl-N-nitrosourea  
Ethylene dibromide  
Ethylene oxide  
Ethylene thiourea  
Formaldehyde (Gas)  
2-(2-Formylhydrazino)-4-(5-nitro-2-furyl)thiazole  
Glu-P-1 (2-Amino-6-methyldipyrido[1,2-a:3',2'-d]imidazole)  
Glu-P-2 (2-Aminodipyrido[1,2-a:3',2'-d]imidazole)  
Glycidaldehyde  
Griseofulvin  
Hexachlorobenzene  
Hexachlorocyclohexanes  
Hexamethylphosphoramide  
Hydrazine  
Hydrazine Sulfate  
Hydrazobenzene

Indeno[1,2,3-cd]pyrene  
IQ (2-Amino-3-methylimidazo[4,5-f]quinoline)  
Iron-dextran complex  
Kepone (Chlordecone)  
Lasiocarpine  
Lead and lead compounds, inorganic  
Lead Acetate and Lead Phosphate  
Lindane and Other Hexachlorocyclohexane Isomers  
MeA-a-C (2-Amino-3-methyl-9H-pyrido[2,3-b]indole)  
Medroxyprogesterone acetate  
Merphalan  
5-Methoxypsoralen  
Methyl methanesulphonate  
N-Methyl-N'-nitro-N-nitrosoguanidine (MNNG)  
2-Methyl-1-nitroanthraquinone (uncertain purity)  
N-Methyl-N-nitrosourea  
N-Methyl-N-nitrosourethane  
2-Methylaziridine (Propyleneimine)  
Methylazoxymethanol and its acetate  
5-Methylchrysene  
4,4'-Methylene bis (2-chloroaniline) (MOCA)  
4,4'-Methylene bis(2-methylaniline)  
4,4'-Methylenebis(2-chloroaniline) (MBOCA)  
4,4'-Methylenebis(N,N-dimethyl)benzenamine  
4,4'-Methylenedianiline and its Dihydrochloride  
Methylthiouracil  
Metronidazole  
Michler's Ketone  
Mirex  
Mitomycin C  
Monocrotaline  
5-(Morpholinomethyl)-3-[(5-nitrofurfurylidene)amino]-2-oxazolidinone  
Nafenopin  
Nickel and Certain Nickel Compounds  
Niridazole  
Nitrilotriacetic Acid  
5-Nitro-o-anisidine  
N-[4-(5-Nitro-2-furyl)-2-thiazolyl]acetamide  
5-Nitroacenaphthene  
Nitrofen (technical-grade)  
1-[(5-Nitrofurfurylidene)amino]-2-imidazolidinone  
Nitrogen mustard  
Nitrogen Mustard Hydrochloride

Nitrogen mustard N-oxide  
2-Nitropropane  
N-Nitroso-N-ethylurea  
N-Nitroso-N-methylurea  
N-Nitrosodi-n-butylamine  
N-Nitrosodi-n-propylamine  
N-Nitrosodiethanolamine  
N-Nitrosodiethylamine  
N-Nitrosodimethylamine  
p-Nitrosodiphenylamine  
3-(N-Nitrosomethylamino)propionitrile  
4-(N-Nitrosomethylamino)-1-(3-pyridyl)-1-butanone (NNK)  
N-Nitrosomethylethylamine  
N-Nitrosomethylvinylamine  
N-Nitrosomorpholine  
N'-Nitrosornicotine  
N-Nitrosopiperidine  
N-Nitrosopyrrolidine  
N-Nitrososarcosine  
Norethisterone  
Oil Orange SS  
4,4'-Oxydianiline  
Oxymetholone  
Panfuran S (containing dihydroxymethylfuratrizine)  
Phenacetin  
Phenazopyridine hydrochloride  
Phenobarbital  
Phenoxybenzamine hydrochloride  
Phenytoin  
Polybrominated biphenyls  
Polychlorinated biphenyls  
Ponceau MX  
Ponceau 3R  
Potassium bromate  
Procarbazine hydrochloride  
Progesterone  
Progestins  
1,3-Propane sultone  
B-Propiolactone  
Propylene oxide  
Propylthiouracil  
Reserpine  
Saccharin

Safrole  
Selenium Sulfide  
Silica, crystalline  
Sodium ortho-phenylphenate  
Sterigmatocystin  
Streptozotocin  
Styrene  
Styrene oxide  
Sulfallate  
2,3,7,8-Tetrachlorodibenzo-para-dioxin (TCDD)  
Tetrachloroethylene (Perchloroethylene)  
Thioacetamide  
4,4'-Thiodianiline  
Thiourea  
Toluene diisocyanates  
ortho-Toluidine and o-Toluidine Hydrochloride  
Toxaphene (Polychlorinated camphenes)  
2,4,6-Trichlorophenol  
Tris(1-aziridinyl)phosphine sulphide (Thiotepa)  
Tris(2,3-dibromopropyl) phosphate  
Uracil mustard  
Urethane  
Vinyl bromide  
Trp-P-1 (3-Amino-1,4-dimethyl-5H-pyrido[4,3-b]indole)  
Trp-P-2 (3-Amino-1-methyl-5H-pyrido[4,3-b]indole)  
Trypan blue

### **C. Teratogens and Mutagens**

Acetaminophen  
Acetylpromazine  
Amantadine Hydrochloride (1-Adamantanamine Hydrochloride)  
p-Aminobenzoic Acid  
Aminopterin (4-Aminoteroylglatamic Acid)  
Amitriptyline (Elavil-R)  
Anesthetics (Halothane, Enflurane, and Nitrous Oxide)  
Barbituric Acids and Derivatives  
Bromine  
Caffeine  
Calcium Carbonate  
Chlorambucil (alpha-(N-N-di-2-chlorethyl)aminophenyl butyric Acid)  
Chlorobenzene  
Chlorobiphenyls  
Chloroquine  
Chlorpromazine  
Cortisone  
Diazepam (Valium-R)  
Diethylstilbestrol (Stilbestrol-R)  
Diphenylhydantoin  
2-Ethoxyethanol  
Mercury  
Methotrexate (Methylaminopterin)  
Methotrimeprazine  
Methyl Chloride  
Methyl Ethyl Ketone  
Methyltestosterone  
Oxomemazine  
Phenylalanine  
Phenylpropanolamine  
Pipamazine  
Prochlorpromazine  
Promazine  
Promethazine  
Thalidomide  
Toluene  
Trichloroethylene  
Tricresol  
Trimeprazine  
Trimethadione (3,5,5-Trimethyl-2,4-oxazolidinedione)  
Valproic Acid



Vinyl Chloride  
Xylene

## **D. Acutely Hazardous Chemicals**

Arsenic pentoxide  
Arsenic oxide  
Arsenic trioxide  
Arsine, diethyl-  
Aziridine  
Barium cyanide  
Benzenamine, 4-chloro-  
Benzenamine, 4-nitro-  
Benzene, (chloromethyl)- 1,2-  
Benzenediol, 4-[1-hydroxy-  
2-(methylamino)ethyl]-  
Benzenethiol  
Benzyl chloride  
Beryllium dust  
Bis (chloromethyl) ester  
Bromoacetone  
Brucine  
Calcium cyanide  
Camphrene, octachloro-  
Carbamimidoseleonic acid  
Carbon bisulfide  
Carbon disulfide  
Carbon chloride  
Chlorine cyanide  
Chloroacetaldehyde  
p-Chloroaniline  
1-(o-Chlorophenyl)thiourea  
3-Chloropropionitrile  
Copper cyanides  
Cyanides (soluble cyanide salts),  
not elsewhere specified  
Cyanogen Famphur  
Cyanogen chloride  
Dichlorophenylarsine  
Dieldrin  
Diethylarsine  
(,-Diethyl S-[2-(ethylthio)  
ethyl] phosphorodithioate  
Diethyl-p-nitrophenyl phosphate  
1,4,4a,4,5,6,7,8,8a-octahydro-  
endo, endo-1,4:5,8-  
O,O-Diethyl O-pyrazinyl  
phosphorothioate  
Diisopropyl fluorophosphate  
Dimethoate  
3,3-Dimethyl-1-(methylthio)  
-2-butanone, O-[(methyl-amino)  
carbonyl] oxime  
O,O-Dimethyl O-p-nitrophenyl  
phosphorothioate  
Dimethylnitrosamine  
alpha, alpha  
-Dimethylphenethylamine  
4,6-Dinitro-o-cresol and salts  
4,6-Dinitro-o-cyclohexylphenol  
2,4-Dinitrophenol  
Dinoseb  
Diphosphoramidate, octamethyl-  
Disulfoton  
2,4-Dithiobiuret  
Dithiopyrophosphoric acid,  
tetraethyl ester  
Endosulfan  
Endothall  
Endrin  
Epinephrine  
Ethanamine, 1,1-dimethyl-  
2-phenyl  
Ethenamine, N-methyl-N-  
nitroso-  
Ethyl cyanide  
Ethylenimine  
  
Fluorine  
Fluoroacetamide  
Fluoroacetic acid, sodium salt  
Fulminic acid, mercury salt  
Heptachlor  
1,2,3,4,10,10-Hexachloro-  
6,7-epoxy-  
N-Nitrosodimethylamine  
N-Nitrosomethylvinylamine

dimethanonaphthalene  
 1,2,3,4,10,10-Hexachloro-6,7-  
 epoxy,1,4,4a,5,6,7,8,8a-  
 octahydro-endo-exo-  
 1,4:5,8-dimethanoaphthalene  
 1,2,3,4,10,10-Hexachloro-1,4,4a,  
 5,8,8a-hexahydro-1,4:5,8-endo,  
 endo-  
 dimethanonaphthalene  
 1,2,3,4,10,10-Hexachloro-1,4,4a  
 5,8,8a-dinitro-  
 hexahydro-1,4:5,8-endo,exo-  
 dimethanonaphthalene  
 Hexachlorohexahydro-exo,exo-  
 dimethanonaphthalene  
 Hexaethyl tetraphosphate  
 Hydrazinecarbothioamide  
 Hydrazine, methyl-  
 Hydrocyanic acid  
 Hydrogen cyanide  
 Hydrogen phosphide  
 Isocyanic acid, methyl ester  
 3(2H)-Isoxazolone, 5-  
 (aminomethyl)-  
 Mercury  
 Mercury fulminate  
 Methane, oxybis(chloro-  
 Methane, tetranitro-  
 Methanethiol, trichloro-  
 4,7-Methano-1H-indene,1,4,5,7,  
 8,8-  
 heptachloro-3a,4,7,7a-tetrahydro-diethyl S-  
 Methomyl  
 2-Methylaziridine  
 Methyl hydrazine  
 Methyl isocyanate  
 2-Methylactonitrile  
 Methyl parathion  
 alpha-Naphthylthiourea  
 Nickel carbonyl  
 Nickel cyanide  
 Nickel tetracarbonyl  
 Nicotine and salts

5-Norbornene-2,3-dimethanol,  
 1,4,5,6,7,7-  
 Hexachloro cyclic sulfite  
 Octamethylpyrophosphoramidate  
 Osmium oxide  
 Osmium tetroxide  
 7-Oxabicyclo[2.2.1]heptane-2,  
 3-dicarboxylic acid  
 Parathion  
 Phenol, 2-cyclohexyl-4,6-  
  
 Phenol, 2,4-dinitro-  
 Phenol, 2,4-dinitro-6-methyl-  
 Phenol, 2,4-dinitro-6-(1-  
 methylpropyl)-  
 Phenol, 2,4,6-trinitro-,  
 ammonium salt  
 Phenyl dichloroarsine  
 Phenylmercuric acetate  
 N-Phenylthiourea  
 Phorate  
 Phosgene  
 Phosphine  
 Phosphoric acid, diethyl p-  
 (acetato-O)phenyl-nitrophenyl ester  
 Phosphorodithioic acid, 0,0-  
 dimethyl S-[2-(methyl-amino)  
 -2-oxoethyl]ester  
 Phosphorofluoric acid, bis(1  
 methylethyl)ester  
 Phosphorothioic acid, O,O-  
 (ethylthio)methyl ester  
 Phosphorothioic acid, O,O-  
 diethyl O-(p-nitro-phenyl)  
 ester  
 Phosphorothioic acid, O,O-  
 diethyl O-  
 pyrazinyl ester  
 Phosphorothioic acid, O,O-  
 dimethyl O-[p-((dimethyl-  
 amino)-sulfonyl)phenyl] ester  
 Plumbane, tetraethyl-

Nitric oxide	Polychlorinated Biphenyls
p-Nitroaniline	(PCB's)
Nitrogen dioxide	Potassium cyanide
Nitrogen oxide	Potassium silver cyanide
Nitroglycerine	
Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino) carbonyl] oxime	
Propanenitrile	
Propanenitrile, 3-chloro-	
Propanenitrile, 2-hydroxy-2-methyl-	
1,2,3-Propanetriol, trinitrate	
2-Propanone, 1-bromo-	
Propargyl alcohol	
2-Propenal	
2-Propen-1-ol	
1,2-Propylenimine	
2-Propyn-1-ol	
4-Pyridinamine	
Pyridine, (S)-3-(1-methyl-2-pyrrolidinyl)-, and salts	
Pyrophosphoric acid, tetraethyl ester	
Selenourea	
Silver cyanide	
Sodium azide	
Sodium cyanide	
Strontium sulfide	
Strychnidin-10-one, and salts	
Strychnidin-10-one, 2,3-dimethoxy-	
Strychnine and salts	
Sulfuric acid, thallium salt	
Tetraethyldithiopyrophosphate	
Tetraethyl lead	
Tetraethylpyrophosphate	
Tetranitromethane	
Tetraphosphoric acid, hexaethyl ester	
Thallic oxide	
Thallium oxide	
Thallium sulfate	
Thiofanox	
Thiomidodicarbonic diamide	
Thiophenol	
Thiosemicarbazide diamide	
Thiourea, (2-chlorophenyl)-	
Thiourea, 1-naphthalenyl-	
Thiourea, phenyl-	

Toxaphene  
Trichloromethanethiol  
Vanadic acid, ammonium salt  
Vanadium pentoxide  
Vanadium oxide  
Warfarin  
Zinc cyanide  
Zinc phosphide

# **Appendix G**

## **Incompatible Chemicals**

**Generally,  
Do not contact:**

**With:**

Acids (Strong)

Bases (Strong)

Alkali Metals

Water, Carbon Dioxide, Carbon Tetrachloride, and other chlorinated hydrocarbons

Arsenical Materials

Any reducing agent

Azides

Acids, Heavy Metals and their salts, oxidizing agents

Chlorates

Ammonium Salts, Acids, Metal Powders, Sulfur, Carbon, finely divided organics or combustibles

Cyanides

Acids, Strong bases

Flammable Liquids

Ammonium Nitrate, Chromic Acid, Hydrogen Peroxide, Nitric Acid, Sodium Peroxide, Halogens

Hydrocarbons

Fluorine, Chlorine, Bromine, Chromic Acid, Sodium Peroxide

Hypochlorites

Acids, Activated Carbon

Nitrates

Sulfuric Acid, Reducing Agents, Other Acids

Nitrites

Acids, Oxidizing Agents

Nitroparaffins

Inorganic Bases, Amines

Organic Peroxides

Acids (Organic or mineral)

Oxidizers

Metal Powders, Ammonium Salts, Phosphorous, Flammable Liquids, Acids, Sulfur, Sulfides, Sulfites

Oxidizing Agents

Reducing Agents



Selenides Any reducing agents

Sulfides Acids

Tellurides Any reducing agents

**Specifically,  
Do not contact:**

**With:**

Acetic Acid Chromic Acid, Nitric Acid, Hydroxyl-containing compounds, Ethylene Glycol, Perchloric acid, Peroxides, and Permanganates

Acetone Concentrated Sulfuric and Nitric Acid Mixtures

Acetyl Bromide Water, Alcohols

Acetyl Chloride Water, Alcohols, Acetic Acid, Phosphorous trichloride

Acetylene Copper (tubing), Bromine, Fluorine, Chlorine, Iodine, Silver, Mercury, and their salts

Ammonia, anhydrous Mercury, Iodine, Chloride, Bromine, Calcium Hypochlorite, and Hydrofluoric Acid, Silver

Ammonium Nitrate Acids, Metal Powders, Flammable Liquids, Chlorates, Nitrates, Sulfur, and finely divided organics or combustibles

Aniline Nitric Acid, Hydrogen Peroxide, and other strong oxidizers

Bromine Ammonia, Acetylene, Butadiene, Butane, Hydrogen, Sodium Carbide, Turpentine, Benzene, and finely divided metals

Calcium Oxide Water

Carbon, activated	Calcium hypochlorites, all oxidizing agents
Carbon Tetrachloride	Alkali metals
Chromic Acid	Acetic Acid, Naphthalene, Camphor, Alcohols, Glycerine, Turpentine, Benzaldehyde, Ethyl Acetate, Acetic Anhydride, and other flammable liquids
Chromium Trioxide	Metals
Chlorine	Ammonia, Acetylene, Butadiene, Butane, Methane, Propane, Benzene and other petroleum fractions, Hydrogen, Sodium Carbide, Turpentine, and finely divided powdered metals.
Chlorine Dioxide	Ammonia, Methane, Phosphine, Hydrogen Sulfide
Copper	Acetylene, Hydrogen Peroxide
Cumene Hydroperoxide	Acids (Organic or Inorganic)
Fluorine	Anything
Hydrocyanic Acid	Nitric Acid
Hydrofluoric Acid,	Ammonia (Aqueous or Anhydrous)
Hydrogen Peroxide	Copper, Chromium, Iron, Phosphorous, other metals and their salts, Alcohols, Acetone, Organic Materials, Aniline, Nitromethane, Flammable Liquids, Combustibles
Hydrogen Sulfide	Fuming Nitric Acid, Oxidizing Gases
Iodine	Ammonia, Acetylene, Butadiene, Benzene and other petroleum fractions, Hydrogen, Sodium Carbide, Turpentine, and finely divided powdered metals

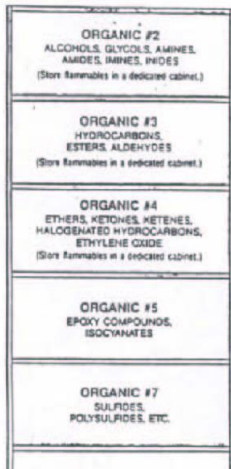
Lithium Aluminum Hydride	Water
Mercury	Acetylene, Fulminic Acid, Hydrogen, Ammonia, Halogens
Nitric Acid, concentrated	Acetic Acid, Chromic Acid, Hydrocyanic Acid, Hydrazine, Zinc, Aluminum, Magnesium, Aniline, Carbon, Hydrogen Sulfide, Flammable Liquids or Gases, Bases, Chromates, Metals, Permanganates Reducing Agents, Sulfides, Sulfuric Acid and substances that are readily nitrated
Oxalic Acid	Silver, Mercury, and their salts
Oxygen	Oils, Grease, Hydrogen, Flammable Liquids, Solids or Gases
Perchloric Acid	Sulfuric Acid, Acetic Anhydride, Bismuth and its alloys, Alcohols, Paper, Wood and other organic materials
Phosphorous (White)	Air, Oxygen, Alkali Metals, reducing agents, Strong bases
Phosphorous Anhydride	Water
Phosphorous Oxychloride	Water
Phosphorous Pentoxide	Water, Alcohols, Strong bases
Potassium	Carbon Tetrachloride, Carbon Dioxide, Water
Potassium Chlorate and Perchlorate	Sulfuric and other acids (See Chlorates)
Potassium Permanganate	Glycerine, Ethylene Glycol, Benzaldehyde, Sulfuric Acid

Silver	Acetylene, Oxalic Acid, Tartaric Acid, Ammonium compounds
Sodium	Carbon Tetrachloride, Carbon Dioxide, Water, Organic Halides, Warm Alcohols
Sodium Nitrite	Ammonium Nitrate and other Ammonium Salts
Sodium Peroxide	Any oxidizable substance (e.g. Methanol, Glacial Acetic Acid, Acetic Anhydride, Benzaldehyde, Carbon Disulfide, Glycerine, Ethylene Glycol, Ethyl Acetate, and Furfural)
Sulfuric Acid	Chlorates, Perchlorates, Permanganates, Water, Bases
Water	Alkali metals, Acetyl Bromide, Acetyl Chloride, Benzoyl Chloride, Boron Hydride, Calcium, Barium Peroxide, Concentrated Sulfuric Acid, Sodium Hydroxide, Potassium Hydroxide, Sodium Peroxide, Sodium Amide, Phosphorous Oxychloride, Phosphorous Trichloride, Phosphorous Anhydride, Sulfuryl Chloride, Thionyl Chloride, Chlorosulfonic Acid.

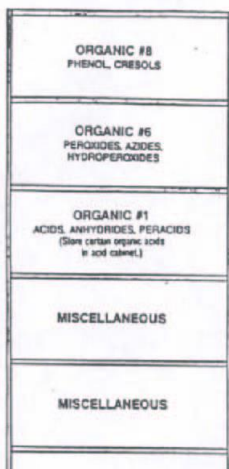
# **Appendix H**

## **Chemical Storage for Shelves**

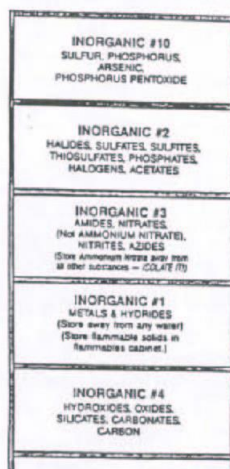
**SUGGESTED SHELF STORAGE PATTERN — ORGANIC**



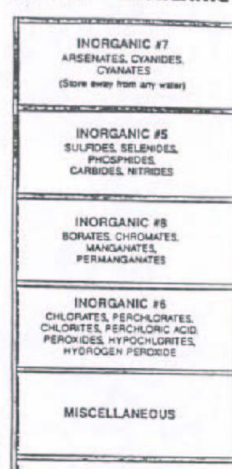
If possible  
avoid  
using the  
floor.



**SUGGESTED SHELF STORAGE PATTERN — INORGANIC**

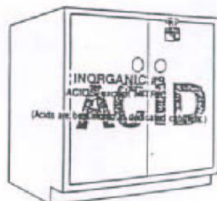


If possible  
avoid  
using the  
floor.

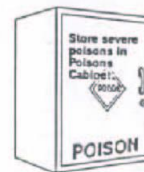


**STORAGE SUGGESTIONS**

1. Avoid floor chemical storage (even temporary)
  2. No top shelf chemical storage
  3. No chemicals stored above eye level
  4. Shelf assemblies are firmly secured to walls. Avoid stand shelf assemblies.
  5. Promote anti-rust kits on all shelves
  6. loosely shelving assemblies would be of wood construction
  7. Avoid metal, adjustable shelf supports and clips. Better: fixed, wooden supports.
  8. Store acids in dedicated acid cabinet. Store nitric acid in their same cabinet only if isolated from other acids. Store both inorganic and some organic acids in the acid cabinet.
  9. Store flammables in a dedicated flammables cabinet.
  10. Store severe poisons in a dedicated poisons cabinet.
- OTHER STORAGE SUGGESTIONS ARE CONTAINED THROUGHOUT THIS CATALOG/REFERENCE MANUAL.



Store Nitric Acid away from other acids unless your acid cabinet provides a separate compartment for Nitric Acid.



# **Appendix I**

## **List of Hazardous Wastes**



## HAZARD DETERMINATION

Compounds or solutions which meet one or more of the following criteria or are specifically named on one of the following lists are regarded as hazardous by the EPA.

### I. CRITERIA

#### A. Ignitability

1. Liquids with a flash point less than 140 degrees F (60 degrees C). This covers most common laboratory solvents. The Aldrich Chemical Catalog and Material Safety Data Sheets (MSDS) list flash points for most liquids.
2. Flammable solids.
3. Oxidizers.
4. Ignitable compressed gas.

#### B. Corrosivity

1. Liquids with a pH less than 2 or greater than 12.5.

#### C. Reactivity

1. Reacts violently with water or air.
2. Cyanide or sulfide bearing compounds.
3. Shock-sensitive compounds (e.g. old picric acid, old anhydrous ether).
4. Explosives.

#### D. Toxicity

The criteria for toxicity is fulfilled if one or more of the following metals are present in a solution or compound:

Arsenic	Hexachlorobutadiene
Barium	Hexachloroethane
Benzene	Lead
Cadmium	Lindane
Carbon Tetrachloride	Mercury
Chlordane	Methoxychlor
Chlorobenzene	Methyl Ethyl Ketone
Chloroform	Nitrobenzene
Chromium	Pentachlorophenol
o-, m-, and p-Cresol	Pyridine
2,4-D	Selenium
1,4-dichlorobenzene	Silver
1,2-dichloroethane	Tetrachloroethylene
1,1-dichloroethylene	Toxaphene
2,4-Dinitrotoluene	Trichloroethylene

Endrin	2,4,5- and 2,4,6- Trichlorophenol
Heptachlor (and its hydroxide)	2,4,5-TP (Silvex)
Hexachlorobenzene	Vinyl Chloride

## II. LISTS (See Note)

### A. Solutions which contain the following halogenated solvents are hazardous:

Carbon Tetrachloride	Methylene chloride
Chlorinated Fluorocarbons	Tetrachloroethylene
Chlorobenzene	(Perchloroethylene)
o-Dichlorobenzene	Trichloroethane
	Trichloroethylene

### B. Solutions which contain the following non-halogenated solvents are hazardous:

Acetone	Ethyl Ether
iso-Butanol	Methanol
n-Butanol	Methyl Ethyl Ketone
Carbon Disulfide	Methyl Isobutyl Ketone
Cresols and Cresylic Acid	Nitrobenzene
Cyclohexanone	Pyridine
Ethyl Acetate	Toluene
Ethyl Benzene	Xylene

### C. The following chemicals and all formulations in which these chemicals are the sole active ingredient are considered hazardous:

Acetaldehyde	Auramine
Acetaldehyde, trichloro-	Azaserine
Acetamide, N-(4-ethoxyphenyl)-	Benz[j] aceanthrylene, 1,2-
Acetamide, N-9H-fluoren-2-yl-	dihydro-3-methyl-
Acetic acid, ethyl ester	Benz [c] acridine
Acetic acid, lead salt	3,4-Benzacridine
Acetic acid, thallium salt	Benzal chloride
Acetone	Benz [a] anthracene
Acetonitrile	1,2-Benzanthracene
3-(alpha-Acetylbenzyl)-4-	1,2-Benzanthracene,7,12-
hydroxycoumarin and salts, when	dimethyl-
present at concentrations of	Benzenamine
0.3% or less	Benzenamine, 4,4'-
Acetophenone	carbonimidoylbis (N,N-

2-Acetylaminofluorene  
 Acetyl chloride  
 Acrylamide  
 Acrylic acid  
 Acrylonitrile  
 Alanine, 3-[p-bis(2-chloroethyl) amino]phenyl-, L-  
 Amitrole  
 Aniline  
 Benzenamine, 2-methyl-5-nitro  
 Benzene  
 Benzeneacetic acid, 4-chloro-alpha-(4-chlorophenyl)-alpha-hydroxy, ethyl ester  
 Benzene, 1-bromo-4-phenoxy-  
 Benzene, chloro-  
 1,2-Benzenedicarboxylic acid anhydride  
 1,2-Benzenedicarboxylic acid, [bis(2-ethyl-hexyl)] ester  
 1,2-Benzenedicarboxylic acid, dibutyl ester  
 1,2-Benzenedicarboxylic acid, diethyl ester  
 1,2-Benzenedicarboxylic acid, dimethyl ester  
 1,2-Benzenedicarboxylic acid, di-n-octyl ester  
 Benzene, 1,2-dichloro-  
 Benzene, 1,3-dichloro-  
 Benzene, 1,4-dichloro-  
 Benzene (dichloromethyl)-  
 Benzene, 1,3-diisocyanatomethyl-  
 Benzene, dimethyl-  
 1,3-Benzenediol  
 Benzene, hexachloro-  
 Benzene, hydroxy-  
 Benzene, methyl-  
 Benzene, 1-methyl-1,2,4-dinitro-  
 Benzene, 1-methyl-2,6-dinitro-  
 Benzene, 1,2-methylenedioxy-4-allyl- n-Butyl alcohol  
 Benzene, 1,2-methylenedioxy-4-dimethyl-)  
 Benzenamine, 4-chloro-2-methyl-  
 Benzenamine, N,N'-dimethyl-4-phenylazo-  
 Benzenamine, 4,4'-methylenebis(2-chloro-)  
 Benzenamine, 2-methyl-, hydrochloride  
 Benzo [a] pyrene  
 3,4-Benzopyrene  
 p-Benzoquinone  
 Benzotrichloride  
 1,2-Benzphenanthrene  
 2,2'-Bioxirane  
 (1,1'-Biphenyl)-4,4'-diamine  
 (1,1'-Biphenyl)-4,4'-diamine, 3,3'-dichloro-  
 (1,1'-Biphenyl)-4,4'-diamine, 3,3'-dimethoxy-  
 (1,1'-Biphenyl)-4,4'-diamine, 3,3'-dimethyl-  
 Bis(2-chloroethoxy) methane  
 Bis(2-chloroisopropyl)ether  
 Bis(dimethylthiocarbamoyl) disulfide  
 Bis(2-ethylhexyl) phthalate  
 Bromine cyanide  
 Bromoform  
 4-Bromophenyl phenyl ether  
 1,3-Butadiene, 1,1,2,3,4,4-hexachloro-  
 1-Butanamine, N-butyl-N-nitroso-  
 Butanoic acid, 4-[Bis(2-chloroethyl)amino]benzene-  
 1-Butanol  
 2-Butanol  
 2-Butanone peroxide  
 2-Butenal  
 2-Butene, 1,4-dichloro-  
 Cacodylic acid

propenyl-  
 Benzene, 1,2-methylenedioxy-4-  
 propyl-  
 Benzene, (1-methylethyl)-  
 Benzene, nitro-  
 Benzene, pentachloro-  
 Benzene, pentachloro-nitro-  
 Benzenesulfonic acid chloride  
 Benzenesulfonyl chloride  
 Benzene, 1,2,4,5-tetrachloro-  
 Benzene, (trichloromethyl)-  
 Benzene, 1,3,5-trinitro-  
 Benzidine  
 1,2-Benzisothiazolin-3-one,  
 1,1-dioxide  
 Benzo [j,k] fluorene  
 Chlornaphazine  
 Chlorobenzene  
  
 1-Chloro-2,3-epoxypropane  
 2-Chloroethyl vinyl ether  
 Chloroform-  
 Chloromethyl methyl ether  
 beta-Chloroaphthalene  
 o-Chlorophenol  
 4-Chloro-o-toluidine, hydrochloride  
 Chromic acid, calcium salt  
 Chrysene  
 Creosote  
 Cresols  
 Cresylic acid  
 Crotonaldehyde  
 Cumene  
 Cyanogen bromide  
 1,4-Cyclohexadienedione  
 Cyclohexane  
 Cyclohexanone  
 1,3-Cyclopentadiene, 1,2,3,4,5,5-  
 hexa- chloro-  
 Cyclophosphamide  
 2,4-D, salts and esters  
 Daunomycin  
 DDD  
  
 Calcium chromate  
 Carbamic acid, ethyl ester  
 Carbamide, N-ethyl-N-nitroso  
 Carbamide, N-methyl-N-  
 nitroso-  
 Carbamide, thio-  
 Carbamoyl chloride, dimethyl  
 Carbonic acid, dithallium salt  
 Carbonochloridic acid, methyl  
 ester  
 Carbon oxyfluoride  
 Carbon tetrachloride  
 Carbonyl fluoride  
 Chloral  
 Chlorambucil  
 Chlordane, technical-  
 Dichlorodifluoromethane  
 3,5-Dichloro-N-(1,1-dimethyl-4-Chloro-m-  
 cresol2-propynyl) benzamide  
 Dichloro diphenyl dichloroethane  
 Dichloro diphenyl  
 dichloroethane  
 Dichloro diphenyl  
 trichloroethane  
 1,1-Dichloroethylene  
 1,2-Dichloroethylene  
 Dichloroethyl ether  
 2,4-Dichlorophenol  
 2,6-Dichlorophenol  
 2,4-Dichlorophenoxyacetic acid,  
 salts and esters  
 1,2-Dichloropropane  
 1,3-Dichloropropane  
 1,2:3,4-Diepoxybutane  
 1,4-Diethylene dioxide  
 N,N-Diethylhydrazine  
 O,O-Diethyl-S-methyl-  
 dithiophosphate  
 Diethyl phthalate  
 Diethylstilbestrol  
 1,2-Dihydro-3,6-pyridazinedione  
 Dihydrosafrole  
 3,3'-Dimethoxybenzidine

DDT  
 Decachlorooctahydro-1,3,4-metheno-  
 2H-cyclobuta[c,d]-pentalen-2-one  
 Diallate  
 Diamine  
 Diaminotoluene  
 Dibenz[a,h]anthracene  
 1,2:5,6-Dibenzanthracene  
 1,2:7,8-Dibenzanthracene  
 Dibenz[a,i]pyrene  
 Dibenz[a,h]anthracene  
 1,2:5,6-Dibenzanthracene  
 1,2:7,8-Dibenzopyrene  
 Dibenz [a,i] pyrene  
 1,2-Dibromo-3-chloropropane  
 Dibutyl phthalate  
 S-(2,3-Dichloroallyl)  
 diisopropylthiocarbamate  
 o-Dichlorobenzene  
 m-Dichlorobenzene  
 p-Dichlorobenzene  
 3,3'-Dichlorobenzidine  
 1,4-Dichloro-2-butene  
 Ethane, 1,2-dichloro-  
 1,2-Ethanediylobis(oxo)thioic  
 acid  
 Ethane, 1,1,1,2,2,2-hexachloro-  
 Ethane, 1,1'-[methylenebis(oxy)]  
 bis[2-chloro-  
 Ethanenitrile  
 Ethane, 1,1'-oxybis-  
 Ethane, 1,1'-oxybis[2-chloro-  
 Ethane, pentachloro-  
 Ethane, 1,1,1,2-tetrachloro-  
 Ethane, 1,1,2,2-tetrachloro-  
 Ethanethioamide  
 Ethane, 1,1,1,-trichloro-2,2-  
 bis(p-methoxy-phenyl)  
 Ethane, 1,1,2-trichloro-  
 Ethene, chloro-  
 Ethane, 2-chloroethoxy-  
 Ethene, 1,1-dichloro-  
 Ethene, trans-1,2-dichloro-  
 Dimethylamine  
 Dimethylaminoazobenzene  
 7,12-Dimethylbenz [a]anthracene  
 3,3'-Dimethylbenzidine alpha,  
 alpha  
 Dimethylbenzylhydroperoxide  
 Dimethylcarbonyl chloride  
 1,1-Dimethylhydrazine  
 1,2-Dimethylhydrazine  
 2,4-Dimethylphenol  
 Dimethyl phthalate  
 Dimethyl sulfate  
 2,4-Dinitrotoluene  
 2,6-Dinitrotoluene  
 Di-n-octyl phthalate  
 1,4-Dioxane  
 1,2-Diphenylhydrazine  
 Dipropylamine  
 Di-N-propylnitrosamine  
 Ethanal  
 Ethanamine,N-ethyl-N-nitroso  
 Ethane, 1,2-dibromo-  
 Ethane, 1,1-dichloro-  
 Guanidine, N-nitroso-N-  
 methyl-N'-nitro-  
 Hexachlorobenzene  
 Hexachlorobutadiene  
 Hexachlorocyclohexane (gamma  
 isomer)  
 Hexachlorocyclopentadiene  
 Hexachloroethane  
 Hexachlorophene  
 Hexachlorobutadiene  
 Hexachlorocyclohexane (gamma  
 isomer)  
 Hexachlorocyclopentadiene  
 Hexachloroethane  
 Hexachlorophene  
 Hexachloropropene  
 Hydrazine  
 Hydrazine, 1,2-diethyl-  
 Hydrazine, 1,1-dimethyl-  
 Hydrazine, 1,2-dimethyl-

Ethene, 1,1,2,2-tetrachloro-	Hydrazine, 1,2-diphenyl-
Ethanol, 2,2'-(nitrosoimino)bis-	Hydrofluoric acid
Ethanone, 1-phenyl-	Hydrogen fluoride
Ethanoyl chloride	Hydrogen sulfide
Ethyl acetate	Hydroperoxide, 1-methyl-1-
Ethyl acrylate	phenylethyl-
Ethyl carbamate (urethan)	Hydroxydimethylarsine oxide
Ethyl 4,4'-dichlorobenzilate	2-Imidazolidinethione
Ethylenebis(dithiocarbamic acid)	Indeno[1,2,3-cd] pyrene
Ethylene dibromide	Iron dextran
Ethylene dichloride	Isobutyl alcohol
Ethylene oxide	Isosafrole
Ethylene thiourea	Kepone
Ethyl ether	Lasiocarpine
Ethylidene dichloride	Lead acetate
Ethylmethacrylate	Lead phosphate
Ethyl methanesulfonate	Lead subacetate
Ferric dextran	Lindane
Fluoranthene	Maleic anhydride
Formaldehyde	Maleic hydrazide
Formic acid	Malononitrile
Furan	Melphalan
2-Furancarboxaldehyde	Mercury
2,5-Furandione	Methacrylonitrile
Furan, tetrahydro-	Methanamine, N-methyl-
Furfural Methane, bromo-	
Furfuran Methane, chloro-	Methane, chloromethoxy-
D-Glucopyranose,2-deoxy-2	Methane, dibromo-
(3-methyl-3-nitro-soureido)-	Methane, dichloro-
Glycidylaldehyde	

Methane, dichlorodifluoro-	2,7-Naphthalenedisulfonic
Methane, iodo-	acid, 3,3'-[(3,3'-dimethyl
Methanesulfonic acid, ethyl ester	(1,1'-biphenyl)-4,4'diyl]-bis(azo)bis(5-
	amino-4-
Methane, tetrachloro-	hydroxyl)-,tetrasodium salt
Methane, trichlorofluoro-	1,4,Naphthaquinone
Methanethiol	1-Naphthylamine
Methane, tribromo-	2-Naphthylamine
Methane, trichloro-	alpha-Naphthylamine
Methane, trichlorofluoro-	beta-Naphthylamine
Methanoic acid	2-Naphthylamine, N,N'-bis
4,7-Methanoindan, 1,2,4,5,6,7,8,	(2-chloromethyl)-
8-octachloro- 3a,4,7,7a-	Nitrobenzene
tetrahydro-	p-Nitrophenol
Methanol	2-Nitropropane
Methapyrilene	N-Nitrosodi-n-butylamine
Methoxychlor	N-Nitrosodiethanolamine
Methyl alcohol	N-Nitrosodiethylamine
Methyl bromide	N-Nitroso-N-propylamine
1-Methylbutadiene	N-Nitroso-N-ethylurea
Methyl chloride	N-Nitroso-N-methylurea
Methyl chlorocarbonate	N-Nitroso-N-methylurethane
Methylchloroform	N-Nitrosopiperidine
3-Methylcholanthrene	N-Nitrosopyrrolidine
4,4'Methylenebis (2-chloroaniline)	5-Nitro-o-toluidine
2,2'-Methylenebis (3,4,6-	1,2-Oxathiolane,2,2'-dioxide
trichlorophenol)	2H-1,3,2-Oxazaphosphorine, 2
Methylene bromide	[bis(2-chloro-ethyl)amino]
Methylene chloride	tetrahydro-,oxide 2-
Methylene oxide	Pentachloronitrobenzene
Methyl ethyl ketone	Oxirazne
Methyl ethyl ketone peroxide	Oxirane, 2-(chloromethyl)-
Methyl iodide	Paraldehyde
Methyl isobutyl ketone	Pentachlorobenzene
Methyl methacrylate	Pentachloroethane
N-Methyl-N'-nitro-N-	Pentachlorophenol
nitrosoguanidine	1,3-Pentadiene
4-Methyl-2-pentanone	Phenacetin
Methylthiouracil	Phenol
Mitomycin C	Phenol, 2-chloro-
5,12-Naphthacenedione, (8S-cis)	Phenol, 4-chloro-3-methyl-
-8-acetyl-10-[(3-amino-2,3,6-	Phenol, 2,4-dichloro-
trideoxy-alpha-L-lyxo-	Phenol, 2,6-dichloro-



hexopyranosyl)oxy]-7,8,9,10-  
tetrahydro-6,8,11-trihydroxyl  
-1-methoxy-  
Naphthalene  
Naphthalene, 2-chloro-  
1,4-Naphthalenedione  
1,10-(1,2-phenylene)pyrene  
Phosphoric acid, Lead salt  
Phosphorodithioic acid, 0,0-  
diethyl-, S-methyl- ester  
Phosphorous sulfide  
Phthalic anhydride  
2-Picoline  
Pronamide  
1-Propanamine  
1-Propanamine, N-propyl-  
Propane, 1,2-dibromo-3-chloro-  
Propanedinitrile  
Propane, 2-nitro-  
Propane, 2,2'oxybis [2-chloro-  
1,3-Propane sultone  
1-Propanol, 2,3-dibromo-,  
phosphate  
1-Propanol, 2,3-epoxy-  
1-Propanol, 2-methyl-  
2-Propanone  
2-Propanamide  
Propene, 1,3-dichloro-  
1-Propene, 1,1,2,3,3,3-  
hexachloro-  
2-Propenenitrile  
2-Propenenitrile,2-methyl-  
2-Propenoic acid  
2-Propenoic acid,ethyl ester  
2-Propenoic acid, 2-methyl-,  
ethyl ester  
2-Propenoic acid, 2-methyl-,  
methyl ester  
Propionic acid, 2-(2,4,5-  
trichlorophenoxy)-  
n-Propylamine  
Propylene dichloride  
Pyridine

Phenol, 2,4-dimethyl  
Phenol, 4-nitro-  
Phenol, pentachloro-  
Phenol, 2,3,4,6-tetrachloro-  
Phenol, 2,4,5-trichloro-  
Phenol, 2,4,6-trichloro-  
Selenium disulfide  
L-Serine, diazoacetate (ester)  
Silvex  
4,4'-Stilbenediol, alpha,  
alpha'-diethyl-  
Streptozotocin  
Sulfur hydride  
Sulfuric acid, dimethyl ester  
Sulfur phosphide  
Sulfur selenide  
2,4,5-T  
1,2,4,5-Tetrachlorobenzene  
1,1,1,2-Tetrachloroethane  
1,1,2,2-Tetrachloroethane  
Tetrachloroethylene  
Tetrahydrofuran  
Thallium acetate  
Thallium carbonate  
Thallium chloride  
Thallium nitrate  
Thioacetamide  
Thiomethanol  
Thiourea  
Thiram  
Toluene  
Toluenediamine  
Toluene diisocyanate  
O-Toluidine hydrochloride  
1H-1,2,4-Triazol-3-amine  
1,1,1-Trichloroethane  
1,1,2-Trichloroethane  
Trichloroethane  
Trichloroethylene  
Trichloromonofluoromethane  
2,4,5-Trichlorophenol  
2,4,6-Trichlorophenol  
2,4,5-Trichlorophenoxyacetic

Pyridine, 2-[(2-dimethylamino)-2-phenylamino]-	acid
Pyridine, hexahydro-N-nitroso-	sym-Trinitrobenzene
Pyridine, 2-methyl-	1,3,5-Trioxane, 2,4,5-trimethyl-
4(1H)-Pyrimidinone, 2,3-dihydro-6-methyl-2-thioxo-	Tris(2,3-dibromopropyl)phosphate
Pyrrole, tetrahydro-N-nitroso-	Trypan blue
Reserpine	Uracil, 5[bis(2-chloromethyl)amino]-
Resorcinol	Uracil mustard
Saccharin and salts	Vinyl chloride
Safrole	Warfarin, when present at concentrations of 0.3% or less
Selenious acid	Zinc Phosphide, when present at concentrations of 10% or less
Selenium dioxide	
Xylene	
Yohimban-16-carboxylic acid, 11,17-dimethoxy-18-[(3,4,5-trimethoxybenzoyl)oxy]-methyl ester	

D. The following chemicals and all formulations in which these chemicals are the sole active ingredient are considered acutely hazardous:

Arsenic pentoxide	O,O-Diethyl O-pyrazinyl phosphorothioate
Arsenic oxide	Diisopropyl fluorophosphate
Arsenic trioxide	Dimethoate
Arsine, diethyl-	3,3-Dimethyl-1-(methylthio)-2-butanone, O-[(methyl-amino)carbonyl] oxime
Aziridine	O,O-Dimethyl O-p-nitrophenyl phosphorothioate
Barium cyanide	Dimethylnitrosamine
Benzenamine, 4-chloro-	alpha, alpha
Benzenamine, 4-nitro-	-Dimethylphenethylamine
Benzene, (chloromethyl)- 1,2-	4,6-Dinitro-o-cresol and salts
Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-	4,6-Dinitro-o-cyclohexylphenol
Benzenethiol	2,4-Dinitrophenol
Benzyl chloride	Dinoseb
Beryllium dust	Diphosphoramidate, octamethyl-
Bis (chloromethyl) ester	Disulfoton
Bromoacetone	2,4-Dithiobiuret
Brucine	Dithiopyrophosphoric acid, tetraethyl ester
Calcium cyanide	
Camphrene, octachloro-	
Carbamimidoseleonic acid	
Carbon bisulfide	

Carbon disulfide	Endosulfan
Carbon chloride	Endothall
Chlorine cyanide	Endrin
Chloroacetaldehyde	Epinephrine
p-Chloroaniline	Ethanamine, 1,1-dimethyl-2-phenyl
1-(o-Chlorophenyl)thiourea	Ethenamine, N-methyl-N-nitroso-
3-Chloropropionitrile	Ethyl cyanide
Copper cyanides	Ethylenimine
Cyanides (soluble cyanide salts), not elsewhere specified	Famphur
Cyanogen	Fluorine
Cyanogen chloride	Fluoroacetamide
Dichlorophenylarsine	
Dieldrin Fluoroacetic acid, sodium salt	Fulminic acid, mercury salt
Diethylarsine	Heptachlor
(,(-Diethyl S-[2-(ethylthio)ethyl] phosphorodithioate	1,2,3,4,10,10-Hexachloro-6,7-epoxy-
Diethyl-p-nitrophenyl phosphate	N-Nitrosodimethylamine
1,4,4a,4,5,6,7,8,8a-octahydro-endo, endo-1,4:5,8-dimethanonaphthalene	N-Nitrosomethylvinylamine
1,2,3,4,10,10-Hexachloro-6,7-epoxy,1,4,4a,5,6,7,8,8a-octahydro-endo-exo-1,4:5,8-dimethanonaphthalene	5-Norbornene-2,3-dimethanol, 1,4,5,6,7,7-
1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-1,4:5,8-endo, endo-dimethanonaphthalene	Hexachloro cyclic sulfite
1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-1,4:5,8-endo,exo-dimethanonaphthalene	Octamethylpyrophosphoramide
Hexachlorohexahydro-exo,exo-dimethanonaphthalene	Osmium oxide
Hexaethyl tetraphosphate	Osmium tetroxide
Hydrazinecarbothioamide	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid
Hydrazine, methyl-	Parathion
Hydrocyanic acid	Phenol, 2-cyclohexyl-4,6-dinitro-
Hydrogen cyanide	Phenol, 2,4-dinitro-
Hydrogen phosphide	Phenol, 2,4-dinitro-6-methyl-
Isocyanic acid, methyl ester	Phenol, 2,4-dinitro-6-(1-methylpropyl)-
	Phenol, 2,4,6-trinitro-, ammonium salt
	Phenyl dichloroarsine
	Phenylmercuric acetate
	N-Phenylthiourea
	Phorate
	Phosgene

3(2H)-Isoxazolone, 5-(aminomethyl)-  
 Mercury, (acetato-O)phenyl-  
 Mercury fulminate  
 Methane, oxybis(chloro-  
 Methane, tetranitro-  
 Methanethiol, trichloro-  
 4,7-Methano-1H-indene,1,4,5,7,  
 8,8-  
 heptachloro-3a,4,7,7a-tetrahydro-  
 Methomyl  
 2-Methylaziridine  
 Methyl hydrazine  
 Methyl isocyanate  
 2-Methylactonitrile  
 Methyl parathion  
 alpha-Naphthylthiourea  
 Nickel carbonyl  
 Nickel cyanide  
 Nickel tetracarbonyl  
 Nicotine and salts  
 Nitric oxide  
 p-Nitroaniline  
 Nitrogen dioxide  
 Nitrogen oxide  
 Nitroglycerine  
  
 [(methylamino) carbonyl] oxime  
 Propanenitrile  
 Propanenitrile, 3-chloro-  
 Propanenitrile, 2-hydroxy-2-  
 methyl-  
 1,2,3-Propanetriol, trinitrate  
 2-Propanone, 1-bromo-  
 Propargyl alcohol  
 2-Propenal  
 2-Propen-1-ol  
 1,2-Propylenimine  
 2-Propyn-1-ol  
 4-Pyridinamine  
 Pyridine, (S)-3-(1-methyl-  
 2-pyrrolidinyl)-, and salts  
  
 Phosphine  
 Phosphoric acid, diethyl p-  
 nitrophenyl ester  
 Phosphorodithioic acid, 0,0-  
 dimethyl S-[2-(methyl-amino)  
 -2-oxoethyl]ester  
 Phosphorofluoric acid, bis(1  
 methylethyl)ester  
 Phosphorothioic acid, O,O-  
 diethyl S-  
 (ethylthio)methyl ester  
 Phosphorothioic acid, O,O-  
 diethyl O-(p-nitro-phenyl)  
 ester  
 Phosphorothioic acid, O,O-  
 diethyl O-  
 pyrazinyl ester  
 Phosphorothioic acid, O,O-  
 dimethyl O-[p-((dimethyl-  
 amino)-sulfonyl)phenyl] ester  
 Plumbane, tetraethyl-  
 Polychlorinated Biphenyls  
 (PCB's)  
 Potassium cyanide  
 Potassium silver cyanide  
 Propanal, 2-methyl-2-  
 (methylthio)-, O-  
 Sulfuric acid, thallium salt  
 Tetraethyldithiopyrophosphate  
 Tetraethyl lead  
 Tetraethylpyrophosphate  
 Tetranitromethane  
 Tetrphosphoric acid, hexaethyl  
 ester  
 Thallic oxide  
 Thallium oxide  
 Thallium sulfate  
 Thiofanox  
 Thiomidodicarbonic diamide  
 Thiophenol  
 Thiosemicarbazide diamide  
 Thiourea, (2-chlorophenyl)-

Pyrophosphoric acid, tetraethyl  
ester  
Selenourea  
Silver cyanide  
Sodium azide  
Sodium cyanide  
Strontium sulfide  
Strychnidin-10-one, and salts  
Strychnidin-10-one, 2,3-  
dimethoxy-  
Strychnine and salts

Thiourea, 1-naphthalenyl-  
Thiourea, phenyl-  
Toxaphene  
Trichloromethanethiol  
Vanadic acid, ammonium salt  
Vanadium pentoxide  
Vanadium oxide  
Warfarin  
Zinc cyanide  
Zinc phosphide

**Note:** This list applies to discarded commercial chemical products. When there are solutions or mixtures that contain any of these components, sampling and analysis will be needed to determine if the waste exhibits a characteristic of a hazardous waste (See Criteria Section)

# **Appendix J**

## **Hazardous Waste Pickup Request Form**

[www.towson.edu/ehs/forms/index.html](http://www.towson.edu/ehs/forms/index.html)

# **Appendix K**

## **Laboratory Inspection Forms**



**Laboratory Safety Inspection**

**General**

Principal Investigator: \_\_\_\_\_

Building (#): \_\_\_\_\_

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

Inspector(s): \_\_\_\_\_

Date of Inspection: \_\_\_\_\_

Equipment used during inspection:

Type	Make	Model	Serial num

**Inspection:**

**Safety Equipment**

	<b>Adequate</b>	<b>Inadequate</b>	<b>Inaccessible</b>	<b>Missing</b>
1. First Aid Kit				
2. Emergency Shower				
3. Emergency Eyewash				
4. Fire Extinguisher				
5. Fire Blanket				
6. Smoke Detector				
7. Fire Alarm				
8. Personal Protective Equipment				
Lab coat/apron				
Proper eye protection				
Closed-tip shoes				
Gloves				
Respirator				

## **Housekeeping**

1. Containers stored on floor
2. Chemicals spills present
3. Exit(s) or aisle(s) blocked
4. Storage in hallways
5. Hazard warning signs missing

## **Laboratory Practices**

### General

1. Mouth pipetting
2. Improper labeling of chemicals
3. No use of secondary containers
4. Unsafe work practices
5. Unattended experiments
6. Gas cylinders not secured
7. Unsafe laboratory apparatus being used
8. Evidence of smoking, eating, or drinking

### Electrical Safety

1. Overloading electrical outlets
2. Improper grounding of electrical circuits
3. Electrical cords wearing

### Storage

1. Excessive amounts of hazardous chemicals
2. Degradation of container(s)
3. Old, outdated chemicals present
4. Unsafe storage conditions:
  - Chemicals stored above shoulder height
  - Chemicals stored with food
  - Overcrowded shelves
  - Incompatibles stored together
  - More than 10 gallons of a flammable or combustible liquid stored outside a flammable liquids safety cabinet
  - Flammables stored in regular refrigerator
  - Storage in fume hood
  - Improper shelving material



**Engineering Controls Inspection**

**Date of Inspection:**   /   /

**Building (#):**

**Inspector(s):**

**Equipment:**

<b>Make</b>	<b>Model</b>	<b>Serial Number</b>	<b>Last Calibration</b>
-------------	--------------	----------------------	-------------------------

_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

**Room #:**

**Type of Hood:** Fume \_\_\_ Biological

**Class of Hood:** A \_\_\_ B \_\_\_ C \_\_\_ I \_\_\_ II \_\_\_ III \_\_\_ **Sash Type:** Vertical \_\_\_ Horizontal

**Average Linear Face Velocity:** \_\_\_\_\_ lfpm

**Other tests performed:**

_____
_____
_____

**Ventilation Problems Affecting Hood Performance:** (i.e. Number of hoods in room, dead space in hood, or too much equipment in hood)

_____
_____
_____

**Emergency Safety Equipment Inspection**

**Date of Inspection:**   /   /

**Building (#):**

**Inspector(s):**

**Equipment:**

Make	Model	Serial Number	Last Calibration

**Room #:**

**Emergency Shower:**    Plumbed    Self-Contained

Control Valve Operation:	<b>Adequate</b> _____	<b>Inadequate</b> _____	Flow: _____ <b>gal/min</b>
--------------------------	--------------------------	----------------------------	----------------------------

Effluent  
Temp: \_\_\_\_\_ °F  
Pressure:  
pH:  
Purity:

**Emergency Eye/Face wash:**    Plumbed    Self-Contained

Control Valve Operation:	<b>Adequate</b> _____	<b>Inadequate</b> _____	Flow: _____ <b>gal/min</b>
--------------------------	--------------------------	----------------------------	----------------------------

Streams contact both eyes  
simultaneously:

Effluent  
Temp: \_\_\_\_\_ °F  
Pressure:  
pH:  
Purity:



**FLAMMABLE AND COMBUSTIBLE LIQUID INVENTORY**

Date:  
 Building (#):  
 Room:  
 Inspector(s):

**Outside a safety cabinet**

Container: Size:		Class:					
		IA	IB	IC	II	IIIA	IIIB
Glass	Pint						
	Quart						
	Gallon						
Metal	Pint						
	Quart						
	Gallon						
Safety	Pint						
	Quart						
	Gallon						

**Inside a safety cabinet**

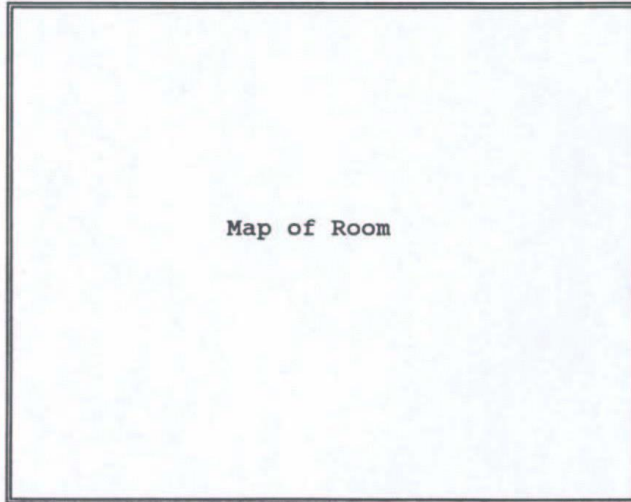
Container: Size:		Class:					
		IA	IB	IC	II	IIIA	IIIB
Glass	Pint						
	Quart						
	Gallon						
Metal	Pint						
	Quart						
	Gallon						
Safety	Pint						
	Quart						
	Gallon						

Size of Containers:			Comments:
	Class: I or II	Class III	
Non-safety	> 1 Gallon	> 5 Gallon	
	> 2 Gallon	> 5 Gallon	
Safety			



**TOWSON UNIVERSITY RADIATION SAFETY SURVEY**

<b>INSPECTOR(S)</b>	<b>DATE</b>	<b>PRINCIPAL INVESTIGATOR</b>	<b>AUTH #</b>
<b>BUILDING</b>	<b>ROOM #</b>	<b>DEPARTMENT</b>	



INSTRUMENTATION USED		
MAKE	MODEL	SERIAL#

LOCATION	METER READING (mR/hr)	LOCATION	METER READING (mR/hr)

## Radiation Safety Inspection: Unsealed Sources

### General

Date: \_\_\_\_\_

Principal Investigator: \_\_\_\_\_

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

Building: \_\_\_\_\_

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

Date of Survey: \_\_\_\_\_

Inspector(s): \_\_\_\_\_

### Inspection

#### Postings

A. Authorized room for the use of radioactive material does not have:

1. "Caution Radioactive Material" sign (1)
2. Radiation Emergency Procedures (1)
3. Notice to Employees (1)
4. No Smoking, Eating, or Drinking Permitted in this Area (1)
5. "Caution Radiation Area" sign (5)
6. "Caution High Radiation Area" sign (10)
7. "Caution Airborne Radioactivity Area" sign (10)

B. Unrestricted area, within a restricted area, not properly posted (5)

#### Approved User Practices

- A. Use of unauthorized radioactive material (20)
- B. Use or storage of radioactive material in an unauthorized area (10)
- C. Unauthorized transfer of radioactive material off-campus (20)
- D. Unauthorized ordering and/or receiving of radioactive material (20)
- E. Unauthorized personnel using radioactive material (20)

## **Labeling**

- A. Improper labeling of:
  - 1. Source vials (3)
  - 2. Storage area (3)
  - 3. Liquid Scintillation Vials (3)
  - 4. Waste container (5)
  - 5. Contaminated equipment (5)
  - 6. Fixed contamination (5)

## **Recordkeeping**

- A. Inadequate wipe log (5)
- B. Wipe log not updated (15)
- C. Wipe test results not in disintegration per minute (10)
- D. Present (updated) radioisotope inventory forms not available (10)

## **Radioactive Waste Management**

- A. Inventory sheet not updated (10)
- B. Waste types mixed (10)
- C. Improper isotope separation (5)
- D. Improper storage of sharp objects (5)
- E. Improper shielding of waste (5)

## **Laboratory Practices**

- A. Proper dosimetry not being used (10)
- B. Evidence of eating, drinking, or smoking (15)
- C. Mouth pipetting of radioactive material (40)  
Mouth pipetting of chemicals (20)
- D. Protective clothing not being used when working with radioactive material (5)
- E. Not using hood or glove box as required in protocols (10)
- F. Contaminated area (15)
- G. Improper use of shielding for an experiment (10)
- H. Laboratory, with radioactive material present, left unsecured (10)
- I. Appropriate survey meter not available (5)
- J. No use of secondary containers (5)

K. Other unsafe laboratory practices (5)

Remarks: \_\_\_\_\_

**Miscellaneous**

A. Fume hood with inadequate airflow (5)

B. Unreturned quarterly inventory form (10)

C. Unreturned dosimetry (5)

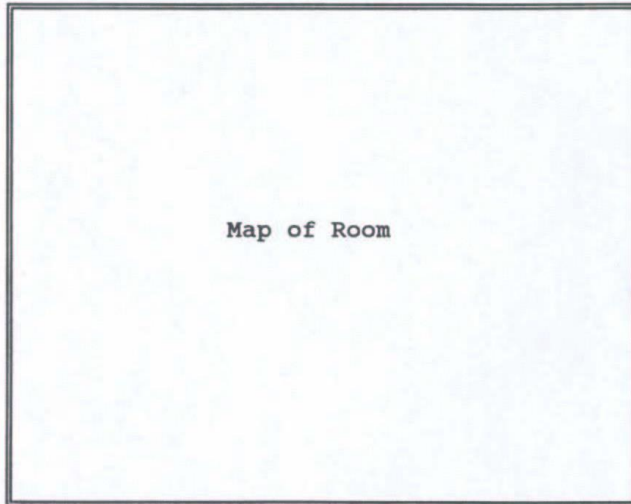
TOTAL \_\_\_\_\_

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
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\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Signature/Title: \_\_\_\_\_ Date: \_\_\_\_\_

**TOWSON UNIVERSITY RADIATION SAFETY SURVEY**

<b>INSPECTOR(S)</b>	<b>DATE</b>	<b>PRINCIPAL INVESTIGATOR</b>	<b>AUTH #</b>
<b>BUILDING</b>	<b>ROOM #</b>	<b>DEPARTMENT</b>	



INSTRUMENTATION USED		
MAKE	MODEL	SERIAL#

LOCATION	METER READING (mR/hr)	LOCATION	METER READING (mR/hr)

## Radiation Safety Inspection: Radiation Producing Devices

### General

Date: \_\_\_\_\_  
Principal Investigator: \_\_\_\_\_  
Department: \_\_\_\_\_  
Building: \_\_\_\_\_  
Room: \_\_\_\_\_  
Date of last survey: \_\_\_\_\_  
Inspector(s): \_\_\_\_\_  
Device Information: \_\_\_\_\_  
    A. Manufacturer: \_\_\_\_\_  
    B. Model: \_\_\_\_\_  
    C. Serial Number: \_\_\_\_\_  
    D. Type of Device: \_\_\_\_\_  
    E. Maximum MeV output: \_\_\_\_\_  
    F. KVP: \_\_\_\_\_  
    G. mA: \_\_\_\_\_  
    H. Registration #: \_\_\_\_\_

### Inspection

#### Warning Labels and Devices

A. Authorized room for the use of the device does not have:

1. "Caution X-ray Equipment"
2. "Caution - High Intensity X-ray Beam"
3. "Caution Radiation - This equipment produces radiation when energized"
4. "Caution Radioactive Material"
5. "Notice to Employees"

B. The open-beam device does not have the following warning devices:

1. X-ray tube "on/off" status indicator
2. Shutter "open/closed" status indicator
3. Device is present, but is bypassed







## **Right to Know Work Area Survey Sheet Key**

1. Chemical Name-It is the name listed on the bottle  
-ID#- is the reference number
2. Quantity- Under normal circumstances  
-key:
  - G = Gallon
  - Q = Quart
  - P = Pint
  - L = Liter
  - M = milliliter
  - LB= Pound
  - K = Kilogram
  - G = gram
  - O = ounce
3. Type of container-key:
  - M = Metal
  - G = Glass
  - P = Plastic
  - C = Cardboard
4. How the chemical is used-key:
  - C = Cleaning
  - R = Research

OCCUPATIONAL HEALTH AND FIRE SAFETY INSPECTION REPORT

DATE OF INSPECTION: \_\_\_\_\_ TIME: \_\_\_\_\_

OCCUPANCY: \_\_\_\_\_ PHONE: \_\_\_\_\_

INSPECTING COORDINATOR OR REPRESENTATIVE: \_\_\_\_\_

DATE OF LAST INSPECTION: \_\_\_\_\_ INSPECTOR: \_\_\_\_\_

MAINTENANCE REPRESENTATIVE: \_\_\_\_\_

AN OCCUPATIONAL HEALTH AND FIRE SAFETY SURVEY HAS BEEN CONDUCTED AT THIS FACILITY. DURING THIS INSPECTION, CONDITIONS AFFECTING EMPLOYEE/OCCUPANT SAFETY THROUGHOUT THE PREMISES WERE NOTED.

IN ACCORDANCE WITH THE RECOGNIZED SAFE PRACTICES OF OCCUPATIONAL SAFETY AND/OR FIRE PREVENTION, IT IS NECESSARY THAT THE ITEMS LISTED BELOW BE GIVEN YOUR IMMEDIATE ATTENTION. VIOLATIONS NOTED ARE REFERENCED FROM THE LIFE SAFETY CODES, NFPA CODES, AND THE OSHA GENERAL INDUSTRY STANDARDS.

\*\*\*\*\*

1. HOUSEKEEPING

- A. Remove combustible waste and debris from, in, and around \_\_\_\_\_
- B. Remove weeds, leaves, brush, waste or trash from around exterior or building.
- C. Store rags, soiled with oils or oil base paints, in approved metal containers with self closing tops.
- D. Improve general housekeeping conditions in \_\_\_\_\_

- F. Clean exhaust hood, ducts, and filters free of all grease.
- G. Provide approved smoke detectors in the following areas: \_\_\_\_\_

2. EXITS AND EXITWAYS

- A. Keep all exit doors unlocked and unobstructed.
- B. Repair or activate exit lights.
- C. Install illuminated exit signs for or over the following exits: \_\_\_\_\_
- D. Repair exit doors, locks, and hardware for easy operation.
- E. Keep emergency lighting units in working condition.
- F. Install approved emergency exit lighting in the following areas: \_\_\_\_\_
- G. Door opens in the wrong direction.
- H. Direction signs needed.

5. FLAMMABLE GASES

- A. Segregate storage of empty gas bottles from full bottles.
- B. Keep all flammable gas bottles not in use outside of building.
- C. Protect outside gas bottle storage from heat and weather.
- D. Keep all gas bottles in upright position and properly secured, and protective valve covers in place if not in use.

6. FLAMMABLE LIQUIDS

- A. Store all flammable and combustible liquids in approved safety cans.
- B. Store all flammable paints, lacquers, thinners, etc. in approved metal cabinets.
- C. Keep all flames, sparks and hot surfaces away from areas where flammable liquids are used and stored.
- D. Provide adequate ventilation for the storage vault in accordance with NFPA Standard 30 "Flammable and Combustible Liquids".

3. ELECTRICAL

- A. Provide cover plates for open receptacles and junction boxes.
- B. Repair loose fixtures, wiring and switches.
- C. Remove extension cords and replace with permanent wiring.
- D. Clean lint and dust from electric motors or machinery.
- E. Overloaded circuit.

7. STORAGE

- A. Keep all storage 36" away from all electrical control panels, gas shut off valves, sprinkler valve stand-pipe hose cabinets and fire extinguishers.
- B. Keep all storage 18" below sprinkler heads and for stock piles exceeding 12' in height, maintain a 3' distance in sprinklered buildings.
- C. Keep all storage 36" below the ceiling in non-sprinklered buildings and for stock piles exceeding 20' in height maintain a 72" distance.
- D. Maintain \_\_\_\_\_ foot aisles in all storage rooms.
- E. Keep combustible storage 48" away from heating appliances, 18" from vent pipes, 6" from steam pipes and heating ducts.

4. FIRE PROTECTION EQUIPMENT

- A. Maintain a 5 foot distance to sprinkler and/or standpipe connection.
- B. Clean/replace all sprinkler heads free from dust, paint, and corrosion.
- C. Spare sprinkler heads and/or sprinkler wrench not provided.
- D. Movable equipment must be positioned under air intake hood.
- E. Hood range extinguishing systems must be checked every 6 months.

8. FIRE EXTINGUISHERS

- A. Have a qualified licensed person service, tag and date all fire extinguishers or extinguishing system on a yearly basis or after each use.

- ( ) B. Mount all fire extinguishers on the wall with the top not over 5 feet above the door.
- ( ) C. Provide approved portable fire extinguishers in accordance with NFPA Standard No. 10 "Portable Fire Extinguishers" in the following areas:  
\_\_\_\_\_

- ( ) D. Remove all materials obstructing fire extinguishers.
- ( ) E. Sign(s) indicating location when not readily visible.

9. HEATING APPLIANCES

- ( ) A. Defective appliance or system
- ( ) B. Combustibles too near heater or heat producing device.

10. MISCELLANEOUS

- ( ) A. Install self closing devices on fire door/s  
\_\_\_\_\_
- ( ) B. Keep fire door/s closed at all times.
- ( ) C. Repair or replace self closing device/s on fire door/s.
- ( ) D. Post no smoking sign/s in the following area/s  
\_\_\_\_\_

\*\*\*\*\*

REMARKS: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

ENCLOSED WITH THIS REPORT IS A COPY OF THE BUILDING FLOOR PLAN. INSPECTED AREA ARE IDENTIFIED. THIS REPORT DOCUMENTS DEFECTIVE ITEMS FOR CORRECTION AS NOTED BY THE UNDERSIGNED AND DOES NOT LABEL THE ENTIRE FACILITY AS HEALTH AND FIRE SAFE. IT IS THE RESPONSIBILITY OF THE BUILDING SAFETY COORDINATOR AND THE EMPLOYEES TO IDENTIFY POTENTIAL SAFETY HAZARDS. THIS DISCLAIMER APPLIES TO ALL PAST INSPECTION OF THIS FACILITY.

REINSPECTIONS WILL BE MADE IN \_\_\_\_\_ DAYS/MONTHS

SIGNATURE OF REPRESENTATIVE \_\_\_\_\_

REINSPECTION REPRESENTATIVE: \_\_\_\_\_ DATE: \_\_\_\_\_

VIOLATIONS CORRECTED: \_\_\_\_\_ NOT CORRECTED: \_\_\_\_\_

COMMENTS: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

HITE - SAFETY FILE  
 BELLOWS - BUILDING COORDINATOR  
 INK - PHYSICAL PLANT

SIGNATURE OF INSPECTOR \_\_\_\_\_ DATE \_\_\_\_\_

# **Appendix L**

## **Flammable and Combustible Liquid Categories**



acatal	IB	anesthesia ether	IA	caprylaldehyde	II	1,2-dichloropropane	IB
acetaldehyde	IA	aniline	IIIA	caprylic alcohol	IIIA	dichloroether	II
p-acetaldehyde	IC	anisole	II	cellulose	IIIB	dichloroethyloxide	II
acetic acid	II	antracene	IIIB	cellulose acetate	II	1,1-dichloro-1-nitroethane	IIIA
acetic acid n-propyl ester	IB	aziridine	IB	chloroacetaldehyde	IIIA	dicyclopentadiene	IC
acetic anhydride	II			chloroaldehyde	IIIA	1,1-dithoxyethane	IB
acetic ether	IB	benzaldehyde	IIIA	2-chloro-1,3-butadiene	IB	dichylamine	IB
acetic oxide	II	benzamine	IB	1-chlorobutene	IB	2-diethyl-amino ethanol	II
acetone	IB	benzene	IB	2-chlorobutane	IB	diethylcarbonate	IC
acetone cyanohydrin	IIIA	Benzene carbonyl chloride	IIIA	chloroethane	IA	diethylene oxide	IB
acetoneitrile	IB	benzoic aldehyde	IIIA	β-chloroethyl alcohol	II	diethyl ketone	IB
acetylacetone	II	benzoic ether	IIIB	chloroethylane	IA	3,4-dihydro-2H-pyran	IB
acetyl chloride	IB	benzol	IB	2-chloromethyl propane	IB	diisobutyl ketone	IB
acetyl hydroperoxide	II	benzotrifluoride	IB	1-chloro-1-nitropropane	IIIA	diisopropyl butane	IB
acetyl oxide	II	benzyl chloride	IIIA	chloronitrobenzene	IIIB	diisopropyl ether	IB
acetyl phenol	IIIA	benzyl acetate	IIIB	o-chlorophenol	IIIA	dimethoxy ethane	IB
acetylene dichloride	IB	benzyl alcohol	IIIB	chloropropane	IB	dimethoxy propane	IB
acroleic acid	II	benzyl chloride	IIIA	chloropropane	IB	4,4-dimethylpentane	IIIA
acrolein	IB	benzyl amine	IIIA	chloropropane	IB	2,2-dimethyl butane	IB
acrylic acid	II	benzyl benzoate	IIIB	chloropropane	IB	dimethyl carbonate	IB
acrylic acid methyl ester	IB	bromobenzene	IB	o-chlorotoluene	IIIA	dimethyl dichlorosilane	IB
acrylic aldehyde	IB	bromobutane	IB	cinene	II	dimethyl diketone	IC
acrylonitrile	IB	bromopentane	IC	cinnamaldehyde	II	dimethylene imine	IB
adipic acid	IC	bromotoluene	IIIA	cinnamic aldehyde	II	dimethylformamide	II
aldria	IIIA	butanal	IB	croosote (mixed phenols)	IIIA	2,6-dimethyl-4-heptanone	II
allyl acetate	IB	butane dione	IC	m-cresol	IB	0,0-dimethyl-o,p-nitro	II
allyl alcohol	IB	2-butanone	IB	crotonaldehyde	IB	phenylphosphorothionate	II
allyl aldehyde	IB	butanethiols	IB	crotonic aldehyde	IB	dimethyl sulfate	IIIA
allyl amine	IB	butanoyl chloride	IB	crotonitrile	IIIB	dimethyl sulfide	IA
allyl bromide	IB	butyl alcohol	IC	cumene	IB	DMF	II
allyl chloride	IB	butyl amine	IB	cycloheptane	IB	1,4-dioxane	IB
allyl chlorocarbonate	IC	tert-butyl benzene	II	cyclohexane	IB	dipentene	II
allyl chloroformate	IC	n-butyl bromide	IB	cyclohexanol	IIIA	dipropylene glycol methyl ether	IIIA
allyl glycidyl ether	II	sec-butyl bromide	IB	cyclohexanone	II	divinyl ether	IB
l-aminobutane	IB	n-butyl chloride	IB	cyclohexene	IB	divinyl oxide	IB
amine cyclohexane	IC	sec-butyl chloride	IB	cyclopentane	II	downol	IIIA
aminodimethylbenzene	IIIB	tert-butyl chloride	IB	cyclotetramethyleneoxide	IB	downlor	II
aminomethane	IA	butyl ethanoate	IB	1,4-epoxy butane	IB		
aminomethane	IA	n-butyl ether	IC	p-cymene	II		
l-amino heptane	II	butyl ethylene	IB	decahydronaphthalene	II	epichlorohydrin	II
l-amino pentane	IB	butyl formate	IB	decyl hydride	II	1,2-epoxypropane	IA
amine propane	IB	butyl formate in heptane	IB	n-decane	II	1,2-ethane diamine	II
aminotoluene	IIIA	butyl formate in hexane	IB	diacetyl	IC	ethanenitrile	IB
amyl acetate	IC	butyl mercaptans	IB	diamine	II	ethanoic acid	IA
amylacetic ester	IC	butyl methacrylate	II	1,2-diamino ethane	II	ethanol	IB
amylamine	IB	butyl methanote	II	dibutyl amine	II	ethanolamine	IIIA
n-amyl alcohol	IC	butyl vinyl ether	II	di-n-butyl ether	IC	ethanoyl chloride	IB
2-amyl alcohol	IC	butyric aldehyde	IB	dibutyl peroxide	IB	ethanochiol	IB
amyl bromide	IC	butyric acid	IC	dibutyl phosphite	II	ethenoxy ethane	IA
amyl carbimol	II	n-butyric acid	IIIA	1,4-dichlorobutane	II	ethenoxyethylene	IB
amylene in pentane	IA	butyric anhydride	IIIA	sym-dichlorobutane	II	ethoxyacetylene	IB
n-amyl ether	II	butyric aldehyde	IB	1,3-dichloro-2-butane	IC	2-ethoxyethanol	IIIB
iso-amyl formate	IB	n-butyronitrile	IC	dichloroacetyl chloride	IIIA	N-ethyl acetanilide	II
amyl hydride	IA	butyryl chloride	IB	dichloroethanoyl chloride	IIIA	ethylacetate	IB
n-amyl methyl ketone	II			dichlorodimethylsilane	IB	ethyl acetone	IB
amyl mercaptan	IB			1,1-dichloroethane	IB	ethyl acrylate	IB
iso-amyl nitrile	IB			1,2-dichloroethylene	IB	ethyl alcohol	IB
						ethylaldehyde	IA

ethyl amine	IA	fuel oil #1	II	methanethiol	IA	methyl sulfide	IA
ethyl sec-amyi ketone	II	fural	II	methanol	IB	methyl styrene	II
n-ethyl anilene	IIIA	2-furaldehyde	II	methoxy benzene	II	2-methyl styrene	II
ethyl benzene	IB	furan	IA	methyl acetate	II	methyl vinyl ether	IA
ethyl benzol	IB	furancarboxal	II	methyl acetic acid	II	monochlorobenzene	IC
ethyl benzoate	IIIB	furfural	II	methyl acrylate	II	monoethanolamine	IIIA
ethyl bromoacetate	II	furfural alcohol	IIIA	methyl alcohol	IB	monomethylamine	IA
ethyl bromoethanoate	II	furfurane	IA	methyl amyl acetate	II	monomethyl hydrazine	IC
ethyl butanoate	IC	furfuryl alcohol	IIIA	methyl amyl alcohol	II	morpholine	II
ethyl butyrate	IC	gasoline	IB	methyl n-amyi ketone	II	Naphtha (coal tar)	II
ethyl carbinol	IC	glyceroltrichlorohydrin	IIIA	methyl benzene	IB	naphtha safety solvent	II
ethyl chloroacetate	IIIA	heptane	IB	methyl benzoate	IIIA	n-naphthalene	IIIB
ethyl chlorocarbonates	IB	1,1,3,4,10,10-hexamchloro-8,8e-	IB	n-methyl benzyi alcohol	IIIB	nitrlic acid n-propyl ester	IIIB
ethyl chloroformate	IB	naphthalene	IIIA	methyl borate	IC	nitrobenzene	IIIA
ethyl crotonate	IB	hexahydrobenzene	IB	2-methyl-1,3-butadiene	IA	nitrobenzol	IIIA
ethyl cyanide	IB	hexahydrophenol	IIIA	2-methyl-1-butene	IB	p-nitrochlorobenzene	IIIB
ethylamine chloride	II	hexahydropyridine	IB	methyl-2-butene	IA	n-nitrotoluene	IIIB
ethylamine chlorohydrin	II	hexahydrotoluene	IB	n-methyl butylamine	IB	o-nitrotoluene	IIIB
ethylamine diamine	II	hexahydroxycresol	IIIA	methyl butyl ketone	IC	nitrothiane	IC
ethylamine dichloride	IB	hexamethylene	IB	methyl butyrate	IB	nitrothiane	IC
ethylamine glycol dimethyl ether	II	hexane	IB	methyl carbonate	IB	nitroterpene	IC
ethylamine glycol monomethyl ether	IIIB	1-hexanol	II	methyl carboxylic acid	II	1-nitropropane	II
ethylamine glycol monomethyl ether acetate	II	hexahydroaniline	IC	methyl cellosolve	II	2-nitropropane	II
ethylamine imine	IB	2-hexanone	IC	methyl cellosolve acetate	II	nitrous ether	IA
ethyl ester	IB	hexene	IC	methyl chloroformate	IB	Octa Klor	II
ethyl ether	IA	n-hexyl alcohol	II	methyl chloromethanoate	IB	octalene	IIIA
ethyl formate	IB	hexylene	IB	methyl cyanide	IB	octane	IB
ethyl hexanal	IIIB	hydrazine	II	methyl cyclohexane	IB	iso-octane	IB
ethyl hydrosulfide	IA	hydrazine base	II	n-methyl cyclohexane	II	paraaldehyde	IC
ethyl-2-hydroxypropionate	II	hydroquinone	IIIA	4-methyl cyclohexane	IIA	pentaborane	IC
ethyl lactate	II	hydrocyanic acid	IA	methyl ethyl ether	IB	2,4-pentanedione	IB
ethyl succinate	IA	hydrogen cyanide	IA	methyl ethyl ketone	IB	n-pentane	IA
ethyl methacrylate	IB	hydroxybenzaldehyde	IIIA	methyl formate	IB	pentamethiol	IB
ethyl methanoate	IB	n-by. oxyisobutyronitrile	IIIA	2-methyl furan	II	1-pentanol	IC
ethyl methyl ether	IA	2-hydroxyethylmercaptan	IIIA	methylene glycol monomethyl ether acetate	II	2-pentanol	IC
n-ethyl morpholine	IC	hydroxymethylphenol	IIIA	methyl hydrazine	IC	3-pentanone	IB
ethyl nitrile	IA	2-hydroxypropene nitrile	IIIA	1-methyl-3-heptanone	II	pentanone-2	IB
ethyl oxalate	IIIA	isamyl nitrate	IB	methyl isobutyl ketone	IB	pentacetic acid	II
ethyl phenylacetamide	II	isoprene	IA	methyl isobutyrate	IB	pentylowpantane	II
ethyl phenyl amine	IIIA	isopropyl benzene	IB	methyl mercaptan	IA	petrol	IB
ethylpropenoate	IB	isopropyl ether	IB	methyl methacrylate	IB	petroleum ethers	IA
2-ethyl-3-propyl acrolein	IIIA	isopropyl toluene	II	methyl methanoate	IA	petroleum benzene	IA
ethyl silicate	II	ketosene	II	methyl parathion	II	petroleum naphtha	IA
ethyl vinyl ether	IA	ketohexamethylene	II	4-methyl-2-pentone	IC	petroleum spirite	IA
formaldehyde (commer. soln.)	II	lacquer diluent	IB	4-methylpentyl-2-acetate	II	phenyl acetate	IIIA
formaldehyde solution	IIIA	lactonitrile	IIIA	methyl methyl phenol	IIIB	phenyl amine benzene	IIIA
formalin (37% formaldehyde not in alcohol)	IIIA	2-mercaptoethanol	IIIA	2-methyl-2-phenyl propane	II	phenyl bromide	II
formalin (37% formaldehyde in 15% methanol)	II	mesityl oxide	IC	methyl propionate	IIIB	phenyl butane	IIIA
formic acid	IIIA	metacresone	IB	methyl propylamine	II	phenyl carbinal	IC
o-formic ester	IC	o-methacrylic acid	IIIA	methyl pyridine	II	phenyl chloride	IB
formic ether	IB			1-methyl pyrrole	IB	phenyl chloroform	IB
				methyl pyrrole-n	IB	phenyl ethane	IB
				methyl sulfate	IIA	phenyl hydrazine	IIIA
						phenyl hydride	IB
						1-phenyl propane	IC

3-phenyl 1	II	tetramethylene dichloride	II
phenyl methane thiol	IIIA	tetramethyl lead	II
phenyl methyl carbiccol	IIIB	thiopene	IB
phosgene soln in ether	IA	thiofur-a	IB
o-picoline	II	toluene	IB
2-picoline	II	toluene-2,4-diisocyanate	IIIB
pinelic ketone	II	o-toluene thiol	IIIB
pinene	IC	toluol	IB
pipericline	IB	2,4-tolylene diisocyanate	IIIB
piperylene	IB	tri-n-butyl amine	IIIB
propamal	IB	trichlorobenzene	IIIB
1,3-propane diamine	IB	one-trichlorobenzene	IIIB
propenenitrile	IB	1,2,3-trichloropropane	IIIA
1-propanol	IC	trichlorosilane	IA
propamona	IB	trichlorotoluene	IB
propenal	IB	tri ethoxymethane	IC
propene acid	II	triethylamine	IB
propene nitrile	IB	triethylbutyl aluminum	IB
isopropenyl acetate	IB	2,2,4-trimethylpentane	IB
2-propenyl amine	IB	trimethoxyborane	IC
2-propenyl methacrylate	IB	trimethyl borate	IC
2-propen-1-ol	IB	trimethyl o-formate	IC
propionaldehyde	IB	2,2,4-trimethyl pentane	IB
propionic acid	II	2,4,6-trimethyl-1,3,5-trioxane	IC
propionitrile	IB	sym-trioxane	II
propionyl chloride	IB	m-trioxymethylene	II
iso-propyl acetate	IB	tripropyl amine	II
propylacetone	IB	turpentine	IC
propylamine	IB		
n-propyl alcohol	IC	varnoline	II
isopropyl alcohol	IC	vinegar acid	II
n-propyl benzene	IC	vinyl acetate	IB
propyl carbimol	IC	vinyl benzene	IC
propyl chloride	IB	vinyl carbimol	IB
propyl cyanide	IC	vinyl chloride	IA
propylene dichloride	IB	vinyl cyanide	IB
propylene glycol	IIIB	vinyl ether	IB
propylene oxide	IA	vinyl methyl ether	IA
n-propyl formate	IB		
propyl formic acid	IIIA	xylene	IC
propyl methanol	IC	m, o, or p-xylol	IC
propyl nitrate	IB	xylydine	IIIB
pyridine	IB		
pyrrolidine	IB		
safety solvent	II		
salicylaldehyde	IIIA		
salicylic aldehyde	IIIA		
silicocchloroform	IA		
Stoddard solvent	II		
styrene	IC		
suberane	IB		
tetraethyl lead	IIIB		
tetraethyl-o-silicate	II		
1,2,3,4-tetrahydrobenzene	IB		
tetrahydroindane	II		
tetrahydro-2H-1,4-oxazine	II		
tetrahydronaphthalene	IIIB		
teralin	IIIB		

# **Appendix M**

## **Additional Resource Materials**



## **General Laboratory Safety**

Industrial Hygiene Handbook (Miller)

Fundamentals of Industrial Hygiene (National Safety Council)

Managing Safety in the Chemical Laboratory (Dux)

Safety in the Artroom (Qualley)

Hazardous Materials: Storage and Handling Handbook (Defense Logistics Agency)

Prudent Practices for Handling Hazardous Chemicals in Laboratories (National Academy Press)

Bretherick's Handbook of Reactive Chemical Hazards (Bretherick)

CRC Handbook of Laboratory Safety (CRC)

Safety in Academic Chemistry Laboratories (American Chemical Society)

Guidelines for the Selection of Chemical Protective Clothing, 3<sup>rd</sup> Edition (ACGIH)

## **Hazardous Waste Management**

Hazardous Chemicals: Information and disposal guide (Armour)

Handbook of Laboratory Waste Disposal (Pitt)

Prudent Practices for Disposal of Chemicals from Laboratories (National Academy Press)

Hazardous Waste Management at Educational Institutions (NACUBO)

The Waste Management Manual for Laboratory Personnel (American Chemical Society)

## **Chemical Exposure Information**

Material Safety Data Sheets

Pocket Guide to Chemical Hazards (NIOSH)

Dangerous Properties of Industrial Materials (Sax)

Hazardous Chemicals Desk Reference (Sax)

Threshold Limit Values for Chemical Substances and Physical and Biological Exposure Indices  
(ACGIH)

Guide to Occupational Exposure Values-1990 (ACGIH)

### **Emergency Response**

Hazards in the Chemical Laboratory (Bretherick)

Chemical Hazards Response Information System (CHRIS Manual) (Coast Guard)

Emergency Response Guidebook (Department of Transportation)

### **Biological Safety**

CDC/NIH Biosafety in Microbiological and Biomedical Laboratories (U.S. Department of Health and Human Resources)

### **Radiation Safety**

TU Radiation Safety Manual

### **Fire Protection/Life Safety**

TU Fire/Life Safety Manual

### **Carcinogens**

Potentially Carcinogenic Chemicals: Information and Disposal Guide (Armour)

Annual Report on Carcinogens Summary (U.S. Department of Health and Human Resources)

Chemical Carcinogens: Some Guidelines for Handling and Disposal in the Laboratory  
(Castegnaro)

NIH Guidelines for the Laboratory Use of Chemical Carcinogens (U.S. Department of Health and Human Resources)

## **Standards and Regulations**

American National Standard practice for occupational and educational eye and face protection (ANSI Z87.1)

Title 29 Code of Federal Regulations

Title 40 Code of Federal Regulations

Title 26 Code of Maryland Regulations

American National Standard for the safe use of lasers (ANSI Z136.1)

American National Standard for Emergency Eyewash and Shower Equipment (ANSI Z358.1)

National Fire Protection Association Codes (NFPA)

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American Conference of Governmental Industrial Hygienists Guide to Occupational Exposure Values-1990. ACGIH 1990.

ANSI Z136.1-1986 American National Standard for the safe use of lasers. The Laser Institute of America. Orlando, FL 1986.

ANSI Z87.1-1989 American National Standard practice for occupational and educational eye and face protection. American Society of Safety Engineers, 1989.

ANSI Z358.1-1990 American National Standard for Emergency Eyewash and Shower Equipment. 1990.

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National Fire Protection Association NFPA 30: Flammable and Combustible Liquids Code. NFPA Boston, MA 1987.

OSHA Title 29 Code of Federal Regulations Part 1910.1000 Air Contaminants-Permissible Exposure Limits 1989.

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