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The Chemistry Department

of

The Ohio State University

Occupational Exposure to Hazardous Chemicals in Laboratories

Chemical Hygiene Plan

(CHP)

#### Template Prepared by the Department Safety Committee

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Amended by:

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1.0 **PURPOSE**

The purpose of this Chemical Hygiene Plan (CHP) is to provide guidance and protocols for the protection of laboratory employees of the Department of Chemistry of Ohio State University from health hazards potentially associated with chemicals used in the laboratory. The facilities and precautions in this CHP are compatible with current knowledge and regulations.

2.0 **SCOPE**

The CHP applies to all laboratory employees working on laboratory scale operations involving laboratory use of hazardous chemicals.

3.0 **DEFINITIONS** (As excerpted from 29 CFR 1910.1450)

**Action Level** -‑ A concentration designated in 29 CFR part 1910.1450 for a specific substance, calculated as an 8‑hour time weighted average (TWA), that initiates certain required activities. The Action Level is generally considered to be one half of the Permissible Exposure Limit (PEL).

**Bloodborne Pathogen --** Pathogenic micro-organisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to, Hepatitis B Virus (HBV) and Human Immune Deficiency Virus (HIV).

**Chemical Hygiene Officer** ‑‑ An employee who is qualified, by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan (CHP).

**Chemical Hygiene Plan**‑‑ A written program developed and implemented that sets forth procedures, equipment, personal protective equipment and work practices that are capable of protecting employees from the health hazards presented by hazardous chemicals used in the laboratory. This plan shall be reviewed and updated at least annually by the Chemistry Department Safety Committee.

**Combustible --** A material that has a Flash Point at or above 1400 F.

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

**Flammable Liquid--** A material that has a flash point below 1400 F and a vapor pressure not exceeding 40 pounds per square inch, absolute (psia) at 1000 F.

**Hazardous Chemical**‑‑ A chemical for which there is statistically significant evidence, based on at least one study conducted in accordance with established scientific principles, that acute or chronic health effects may occur in exposed employees. The term “health hazard” includes chemicals that are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents that act on the hematopoietic systems and agents that damage the lungs, skin, eyes or mucous membranes.

**Laboratory** ‑‑ It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

**Laboratory Scale** -‑ Work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person. Also may be called Bench Scale.

**Laboratory Standard** -- The procedures and standards encompassed by 29 Code of Federal Regulations (CFR) 1910.1450; also known as the Occupational Exposure to Hazardous Chemicals in the Laboratory Chemical Hygiene Plan.

**Laboratory Use of Hazardous Chemicals** ‑- Handling or use of such chemicals in which all of the following conditions are met.

1. Chemical manipulations are carried out on a laboratory scale.

2. Multiple chemical procedures or chemicals are used.

3. The procedures involved are not part of a production process nor in any way simulate a production process.

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

**Laboratory Employee --** An individual paid by the Department of Chemistry or a Principal Investigator who is a laboratory worker, this may include faculty, staff, post-doctoral students, graduate students, and student employees.

**Laboratory Worker**‑‑ An individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.

**Permissible Exposure Limit (PEL)** – For laboratory uses of OSHA regulated substances, the employer shall assure that laboratory employees’ exposures to such substances do no exceed the permissible exposure limits specified in 29 CFR 1910, Subpart Z (Appendix III, Table 16 of this CHP).

**Reproductive Toxins**‑‑ Chemicals that affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogens).

**Select Carcinogen** -‑ Any substance that meets one of the following criteria:

1. It is regulated by OSHA as a carcinogen; or

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

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

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

a. After inhalation exposure of 6‑7 hours per day, 5 days per week, for a significant portion of a lifetime, to dosages of less then 10 mg/m3.

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

c. After oral dosages of less that 50 mg/kg of body weight per day.

1. See Appendix III, Table 10 of this CHP.

**Shall / Should** -- In this document, "shall" indicates a required condition or action; "should" indicates a preferred laboratory practice.

**Common Acronyms**

ACGIH American Conference of Governmental Industrial Hygienists

ANSI American National Standards Institute

CFR Code of Federal Regulations

DOT Department of Transportation

EHS OSU Division of Environmental Health and Safety

EPA Environmental Protection Agency

IARC International Agency for Research on Cancer

IUPAC International Union of Pure and Applied Chemistry

LD50 Lethal Dose for 50% Mortality

MSDS Material Safety Data Sheets

NFPA National Fire Protection Association

NIOSH National Institute of Occupational Safety and Health

NTP National Toxicology Program

OSHA Occupational Safety and Health Administration

SOP Standard Operating Procedure

TLV Threshold Limit Value

4.0 **RIGHTS and RESPONSIBILITIES**

4.1 EMPLOYEE RIGHTS

The University and the Department of Chemistry are required to advise laboratory employees of their rights regarding the Chemical Hygiene Plan. It is to your advantage to understand your rights.

1. Employees shall receive training on the hazards associated with chemicals and on the measures they can take to protect themselves from those hazards.

2. Employees, who may be exposed to hazardous chemicals, shall have access to the following information:

* Chemical exposure information,
* Workplace chemical inventory, and
* Material Safety Data Sheets.

3. The employer must provide employees with appropriate personal protective equipment free of charge.

4. Employees who have been exposed to hazardous chemicals shall have access to:

* Medical Consultation and Examinations
* Records of their Medical Consultations and Examinations
* Results of Environmental Monitoring

This shall be provided upon request through the Chemical Hygiene Officer.

5. Employees have a right to file a complaint against the University regarding alleged violations of the Laboratory Standard without fear of retribution.

Questions about employee rights under the Laboratory Standard or about the contents of any part of the Chemical Hygiene Plan should be directed to the Laboratory Supervisor, the Chemical Hygiene Officer, or EHS for clarification or more information.

4.2 RESPONSIBILITIES

**President of The Ohio State University** ‑‑The President of The Ohio State University has ultimate responsibility for the University Chemical Hygiene Plan and shall provide endorsement and budgetary support through the appropriate Vice Presidents and University Offices for its implementation at the Departmental level.

**Division of Environmental Health and Safety (EHS)** -- The Division of Environmental Health and Safety is responsible for determining the minimum requirements of the CHP that all laboratories must follow.

The Division of EHS is responsible for working with the faculty, staff, student, and others to develop and implement appropriate chemical hygiene practices and procedures. To accomplish this, the Division of Environmental Health and Safety shall:

1. Establish procedures to monitor the procurement, use, and disposal of chemicals used in the laboratory.

2. Establish procedures to perform quarterly inspections of laboratories to insure that appropriate laboratory chemical hygiene and housekeeping are conducted and that adequate records are maintained.

3. Help Departments and Laboratory Supervisors to develop adequate precautions and facilities.

4. Know and communicate the current legal requirements for regulated substances.

**College Dean** -- The Dean of the College of Mathematics and Physical Sciences shall provide endorsement and budgetary support for the implementation of the Chemical Hygiene Plan.

**Department Chairman** ‑- The Department Chairman and the Administrative Officer have responsibility for implementing the Chemical Hygiene Plan at the department level and shall provide continuing support for chemical hygiene.

**Chemical Hygiene Officer - John Herrington, 0013 Evans Lab**

The Chemical Hygiene Officer is responsible for the development and implementation of chemical hygiene policies and practices in the laboratory. He/she shall:

1. See that appropriate audits are maintained.

2. Help the Laboratory Supervisors, administrators and employees develop precautions and adequate facilities.

3. Know the current legal requirements concerning regulated substances.

4. Develop, implement, and seek ways to improve the Chemical Hygiene Plan.

5. Communicate standards, changes in standard operating procedures (SOPs) and CHP status to the Department and Laboratory Supervisors affected.

**Laboratory Supervisor** (Principal Investigator) ‑- The Laboratory Supervisor is responsible for chemical hygiene in the laboratory. The Laboratory Supervisor shall ensure:

1. He/she has a working knowledge of this CHP and applicable laws including 29 CFR 1950.1450.

2. A hard copy of the most current CHP is available in the laboratory and students are aware of its location and contents.

3. Laboratory workers know and follow the chemical hygiene rules and relevant SOPs.

4. Protective equipment is available and in working order.

5. Appropriate training and facilities are provided and utilized.

6. Inspections of emergency equipment, chemical hygiene, and housekeeping are conducted and recorded.

7. SOP’s of all hazardous laboratory operations are prepared and reflect appropriate safety practices.

8. Any deficiencies that require Departmental or higher-level action are reported to the Department Chairman and/ or Departmental Administrator.

1. Copies of recent inspections are attached or included in the CHP

**Laboratory worker** -‑ Each laboratory worker is responsible for planning and conducting all operations in accordance with the chemical hygiene plan procedures, developing good personal chemical hygiene habits, reporting safety deficiencies to the Laboratory Supervisor, and taking advantage of appropriate training opportunities.

**Laboratory Inspection Teams** -- Each Laboratory Supervisor will appoint two or more individuals to conduct monthly laboratory self-inspections.

5.0 **GENERAL LABORATORY PROCEDURES**

5.1 BEHAVIOR IN THE LABORATORY

1. Employees should act in a professional manner at all times.

2. Horseplay and practical jokes are expressly forbidden.

3. Employees should not work alone on potentially dangerous activities.

4. Any visitor to the laboratory is to be escorted by an employee and is the responsibility of that employee. Refer to Section 15. Appropriate safety rules must be observed.

5. While running unattended operations, employees shall leave lights on, place appropriate information (experimenter's name and phone number, supervisor's name, chemical reagents and products and quantities) on or within the acrylic door signs, and provide for containment of hazardous substances in the event of a catastrophic (such as cooling water) failure.

6. Employees shall be aware of the location and proper operation of laboratory safety equipment.

5.2 AVOIDANCE OF ROUTINE EXPOSURES

1. Skin contact with chemicals should be avoided.

2. Do not smell or taste chemicals.

3. Use a vacuum or pipette bulb, do not pipette by mouth.

4. Vent any experiment that may discharge toxic or noxious chemicals into a local exhaust device, (i.e., a chemical fume hood).

5. Flammable, corrosive or toxic volatile materials must be trapped when they are evaporated, for example with rotary evaporators or similar devices.

5.3 PERSONAL HABITS IN THE LABORATORY

1. Eating, drinking, gum chewing and cosmetic application are not permitted in the laboratory.

2. Smoking is not allowed in any building or within 15 feet of an entrance.

3. Food may not be stored in a refrigerator that has been or is being used to store chemicals.

4. Ice produced by ice machines for laboratory use shall not be used for beverages, food or food storage.

1. No glassware or utensils that are used for laboratory operations shall be used for storage, handling, or consumption of food or beverages.

6. Hands should be washed before using the restrooms and before eating or smoking. Areas of exposed skin, i.e. forearms, should be washed frequently if there is potential of contact with chemicals.

7. Long hair and loose clothing should be confined.

8. Shoes and appropriate personal protective equipment shall be worn at all times in the laboratory.

1. Laboratory workers shall be alert to unsafe conditions and shall see that they are corrected when detected.

10. Any spills or accumulations of chemicals on work surfaces shall be removed as soon as possible using techniques that minimize residual surface contamination.

11. Safety glasses and/or face shields shall be worn at all times as required by the Departmental Eye Protection Policy (refer to Section 23.2).

5.4 HOUSEKEEPING

1. Lab areas are to be kept clean and uncluttered. This will help prevent spillage, breakage, personal injuries and unnecessary contact with chemicals.

2. Contaminated glassware should be cleaned daily.

3. Spills shall be cleaned up immediately from work areas and floors.

4. Doorways and walkways within the lab shall not be blocked or used for storage.

5. Access to exits, hallways, emergency equipment, and utility controls shall never be blocked.

6. Chemical containers shall be properly emptied and cleaned prior to disposal as described in the Departmental Safety Handbook. Glass bottles will be uncapped, washed out with an appropriate solvent, triple rinsed with water and placed in the glass container for disposal.

7. Equipment and instrumentation shall be cleaned to remove spillage and contamination before repair or calibration service is requested and service personnel will be informed of any hazardous contamination prior to servicing.

6.0 **CHEMICAL PROCUREMENT, DISTRIBUTION AND STORAGE**

6.1 PROCUREMENT

1. Before purchasing any new chemical the following information must be considered:

a. Proper storage and handling procedures,

b. Proper disposal procedures,

c. Presence of adequate facilities to handle and store the material safely, and

d. Adequate training for personnel handling the material.

2. All material safety data sheets (MSDS) that are received with shipments to the lab shall be maintained on file (preferably kept with this CHP in Section 29). An MSDS should be requested and kept on file if the hazardous chemical is used in large quantities in the lab or if the material is acutely hazardous.

3. No container should be accepted without an adequate identifying label. The label should include, at a minimum, the chemical name and an appropriate hazard warning and target organ effects.

6.2 HAZARDOUS CHEMICAL INVENTORY

Each laboratory will, at least annually, conduct and document a hazardous chemical inventory. The inventory shall be in compliance with the Hazard Communication Program. This inventory should be kept with this CHP (in Section 28). While no standardized format is required, the inventory should include, at minimum: the chemical name, container size, and the building name and room number. Unused or unwanted chemicals should be donated to the Chemical Recycling Program or shall be submitted for disposal in accordance with the *Department Safety Handbook*.

6.3 STORAGE

1. Stored and working amounts of hazardous chemicals shall be kept to a minimum.

2. All chemical containers must have a legible and firmly attached label with, at a minimum, the name of the compound and appropriate hazard information. If the container is too small, the name or structure of the compound is sufficient.

3. Chemicals shall be stored in containers with which they are chemically compatible.

1. Chemical reagents shall be kept in closed containers when not in use.

5. Flammable substances must be stored in a safety cabinet or refrigerator designed for flammable liquid storage as per Ohio Fire Code (Appendix III, Table 2).

6. Compressed gas cylinder must be properly secured at all times. Cylinder caps should be in place on cylinders when not in use. Use straps, chains, or stands to support the cylinders.

7. Incompatible chemicals must be segregated. Table 1 in Appendix III provides a partial list of incompatible chemicals. At a minimum, acids, bases, flammables, and oxidizers should be segregated within the laboratory. Water reactive materials must be separated from all other chemicals.

8. Food shall not be stored in refrigerators with chemicals.

9. Refrigerators shall be appropriately labeled with respect to materials stored inside. Labels are available from the Safety Office or from the Safety Web Page.

1. Highly toxic materials should be stored in a secure manner.
2. Glass chemical containers must not be stored on the floor.

7.0  **HAZARD IDENTIFICATION**

1. All chemical containers must have a legible, firmly attached label showing the contents of the container.

2. Labels on incoming containers of hazardous chemicals shall not be removed or defaced.

3. Chemical substances developed in the laboratory shall be assumed to be hazardous in the absence of other information.

4. Material safety data sheets (MSDS) for hazardous chemicals in a given laboratory shall be available to all employees in that laboratory by accessing a MSDS database that is maintained by the Ohio State University with a computer terminal. Hard copies may be requested from the Division of EHS or the Chemical Hygiene Officer.

5. If a chemical substance is produced in the laboratory for another use outside of the laboratory, the MSDS and labeling provisions of the OSHA Hazard Communication Standard apply. The Principal Investigator shall ensure these requirements are met.

8.0 **ENVIRONMENTAL MONITORING**

1. The Chemical Hygiene Officer or the Division of EHS shall be responsible for environmental monitoring.

1. Employee exposures to any substance regulated by an OSHA standard shall be measured when there is reason to believe that exposure levels routinely exceed the action levels specified in Appendix III, Table 16.
2. Employee's exposures to OSHA regulated substances shall not exceed the permissible exposure limit (PEL) specified in 29 CFR (Code of Federal Regulations) Part 1910, subpart Z. Refer to Table 16, Section 23.4.
3. Monitoring results shall be provided to the Department Chemical Hygiene Officer, the Principal Investigator and to the employee(s).

9.0 **MEDICAL PROGRAM**

9.1GENERAL PROVISIONS

1. An opportunity for medical surveillance, including medical consultation and follow‑up, shall be provided under the following circumstances:

a. Where exposure monitoring is over the action level for an OSHA regulated substance that has medical surveillance requirements.

b. Whenever a laboratory employee develops signs or symptoms that may be associated with a hazardous chemical to which the employee may have been exposed to in the laboratory.

c. Whenever a spill, leak, or explosion results in the likelihood of a hazardous exposure, as determined by the Chemical Hygiene Officer.

d. To all employees required to wear a respirator.

e. To all emergency response team members.

2. All examinations shall be provided by or under the supervision of a licensed physician, at no cost to the employee, without loss of pay, and at a reasonable time and place. A physician experienced in occupational medicine shall be used whenever possible.

3. First aid kits with contents approved by a physician will be supplied by the Department of Chemistry. First aid kits (see Section 11.7) will be maintained and checked periodically for expired or missing items. Medical assistance, if required, is available through the University Police (call 911). It is strongly recommended that laboratory personnel maintain proficiency in First Aid, including bloodborne pathogen protocols, through training courses.

4. Where medical consultations or examinations are provided, the examining physician shall be provided with the following information:

a. The identity of the hazardous chemical(s) to which the employees may have been exposed.

b. A description of the conditions under which the exposure occurred including quantitative exposure data, if available.

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

5. For examinations or consultations provided to employees, a written opinion from the examining physician shall be obtained by the laboratory supervisor and the Chemical Hygiene Officer. It shall include:

a. Recommendations for further medical follow‑up.

b. Results of the examination and associated tests.

c. Any medical condition revealed that places the employee at an increased risk of exposure to a hazardous substance found in the workplace.

1. A statement that the employee has been informed of the results of the examination or consultation.

9.2 ACCIDENTS

1. Laboratory accidents that involve a personal injury that appears to require medical assistance should be immediately reported to the University Police (call 911).

2. Personnel responding to any injury that appears to require emergency first aid shall notify the Laboratory Supervisor at the first, safe opportunity.

3. An incident report form must be filed with the Chemical Hygiene Officer for any laboratory accident involving personal injury as described in the Emergency Response Section of the Department Safety Handbook.

4. If a spill or incident represents a hazard to other building occupants, it should be reported immediately to them and to the Chemical Hygiene Officer, and to University safety officials, if appropriate.

5. Serious and reported accidents and near-accidents shall be investigated by the Safety Committee and/or the CHO. Results will be communicated to the Department and will be recorded.

10.0 **PERSONAL PROTECTIVE EQUIPMENT**

The Laboratory Supervisor will be responsible (with technical assistance from the Chemical Hygiene Officer) for selecting personal protective equipment, acquiring approved equipment, maintaining availability, and establishing equipment cleaning and disposal procedures as defined in appropriate SOPs and the Job Hazard Assessment (See Section 21 of this document and see Form 4 of Section 25.0). Laboratory workers should be advised on the proper selection, use and limitations of personal protective equipment before they are required to use the equipment. Personal protective equipment, excluding safety glasses and shoes, should be removed before leaving work areas.

10.1 EYE PROTECTION

1. Safety glasses and/or face shields must be worn as described by the Department Eye Protection Policy in Appendix II.B (Section 23.2).

2. Employees wearing contact lenses must be informed of the special hazards associated with their use, (i.e., absorption of chemicals from the air) and must inform their supervisors so that appropriate measures can be taken in an emergency.

3. Before each use, eye and face protection equipment is to be inspected for damage, (i.e. cracks, severe scratches, debris). If deficiencies are noted, the equipment should be cleaned, repaired or replaced before use.

10.2 GLOVES

1. Chemical resistant gloves shall be worn whenever the potential for hazardous skin contact exists. The material safety data sheet for the substance or glove selection charts should be referenced. (See Appendix II.A, Section 23.2) Standard operating procedures should specify glove requirements, if any.

3. Contaminated gloves shall be removed before touching surfaces outside the work area (i.e., doorknobs, faucet handles).

4. Before each use, gloves are to be inspected for damage and contamination, i.e., tears, punctures, discoloration. If deficiencies are noted, the gloves should be cleaned, repaired, or replaced before use.

5. Heat resistant gloves shall be used for handling hot objects. Asbestos containing gloves should not be used.

6. Abrasion resistant gloves (e.g. leather) should be worn for handling broken glass and other similar materials, but should not be used to handle chemicals.

10.3 SHOES

1. No sandals or open‑toed shoes shall be worn in the laboratory. Shoes worn should have non‑skid soles and should have reasonable heel heights.

2. Safety shoes, toe guards or the equivalent should be worn if there is potential for injury from heavy objects. Safety shoes must meet the requirements of ANSI Z41 (Current).

1. Before each use, shoes are to be inspected for damage, deterioration, contamination, (i.e., tears, punctures, discoloration). If deficiencies are noted, the shoes should be cleaned, repaired or replaced before use.

4. Any special shoe requirements or restrictions shall be specified in the standard operating procedures.

10.4 CLOTHING

1. Laboratory coats should be worn by laboratory employees whenever a reasonable risk of chemical exposure to skin or street clothing exists or when specified by SOPs. They should be kept in an appropriate clean storage area. Disposable laboratory coats are recommended when working with highly toxic materials such as select carcinogens, mutagens or teratogens.

2. Clothing should be cleaned regularly. Clothing contaminated with hazardous materials must be either decontaminated before reuse or disposed of. Laboratory coats may be laundered on site.

3. The commercial launderer of any contaminated work clothing shall be notified of potentially contaminating substances.

4. Before each use, clothing is to be inspected for damage, deterioration, contamination, (i.e. tears, punctures, or discoloration). If deficiencies are noted, the clothing should be cleaned, repaired or replaced before use.

5. Chemical protective clothing must be removed before leaving the work area.

10.5 HEARING PROTECTION

1. Hearing protection (noise attenuating ear muffs or plugs) are required whenever employees are exposed to 85 dBA or greater as an eight hour time weighted average.

2. Hearing protection is to be inspected before each use for tears and contamination. If deficiencies are noted, the hearing protector should be cleaned, repaired or replaced before use.

10.6 RESPIRATORS

All employees issued respirators for any reason must follow all the requirements set forth in the EHS Respiratory Protection Program.

11.0 **EMERGENCY EQUIPMENT**

11.1 GENERAL

Emergency equipment for the Department of Chemistry is located as indicated on the floor plans in Section 27.0. Each laboratory employee shall be familiar with the location, application and correct use, where applicable, of the following equipment.

1. Fire extinguishers,

2. Fire blankets,

3. Fire alarms,

4. Fire doors,

5. Smoke detectors,

6. Safety showers,

7. Eye wash units,

8. First aid kits,

9. Spill Kits

11.2 SAFETY SHOWERS AND EYE WASHES

1. Safety showers and eye washes should be easily accessible.

2. Inspections

* 1. Access should be checked weekly and must be documented monthly by laboratory personnel.

b. Safety showers will be tested and documented annually by Facilities Operations and Development personnel. Eye wash units should be checked for adequate flow once a month by laboratory personnel who will run them until water is clear.

11.3 FIRE EXTINGUISHERS

1. Fire extinguishers should be provided within 30 feet of a work area and located along normal paths of travel.

2. Access must be maintained and the location should be conspicuously marked in an appropriate manner.

3. Monthly Inspections shall include:

a. The extinguisher is in its designated location.

b. Access is maintained.

c. The pin should be in place and attached with unbroken wire.

d. The indicator, if present, should be in the full range.

e. No indication of physical damage.

f. The inspection should be documented.

4. Inspections, Maintenance will be conducted annually by Facilities Operations and Development. Maintenance of extinguishers involves a complete and thorough examination, including the mechanical parts, the amount and condition of the extinguishing agent, and the agent’s expelling device. The inspection shall be conducted by a qualified individual and documented.

5. Discharged fire extinguishers must be immediately reported to Facilities Operations and Development or the Chemical Hygiene Officer.

11.4 BLANKETS / FIRE BLANKETS

1. Fire blankets must be available and accessible.

2. Weekly Inspections

a. Blanket should be in its designated place.

b. Access should be maintained

c. The location should be conspicuously marked.

d. The blanket shall not be contaminated or damaged.

11.5 FIRE ALARMS

1. Fire alarms must be provided along normal paths of travel and along exit routes.

2. Inspections will be conducted periodically by Facilities Operations and Development

a. Fire alarms should be conspicuously marked.

b. Fire alarms in classroom buildings will be activated periodically by the Division of EHS to insure proper operation per manufacturer’s instructions and/or fire insurer’s instructions.

c. FIRE ALARMS ARE NOT TO BE TESTED BY LABORATORY PERSONNEL!

d. The inspections will be documented.

11.6 SMOKE OR HEAT DETECTORS

1. Should be installed and selected for the appropriate hazards per building codes, fire codes and fire insurer’s requirements.
2. Inspections will be performed periodically by Facilities Operations and Development The detection system should be tested to assure proper working order per manufacturer’s and/or fire insurer’s instructions.
3. SMOKE DETECTORS ARE NOT TO BE TESTED BY LABORATORY PERSONNEL!

11.7 FIRST AID KITS

1. First aid kits will be available and maintained for treatment of minor injuries or for short term emergency treatment until medical assistance arrives.

2. First aid kits will be kept in an accessible and marked location in the laboratory.

3. Monthly Inspections

The first aid kits should be kept adequately stocked and maintained.

4. For more information refer to the University's First Aid Kit Policy found in the appendices of the Safety Management Guidebook.

11.8 FIRE DOORS

1. Fire doors should be provided as required per building codes, fire codes and fire insurer’s requirements. Fire doors must not be blocked open, and must be able to close properly.

2. Inspections will be conducted periodically by Facilities Operations and Development

Fire doors with heat activated closures should be tested to assure proper working order.

3. FIRE DOORS ARE NOT TO BE TESTED BY LABORATORY PERSONNEL!

11.9 FIRE SUPPRESSION SYSTEMS

1. The fire suppression system must be selected based on the hazards.

2. Inspections‑‑Periodically by Office of Facilities Operations and Development.

a. All system components must be checked for physical condition.

b. The system should be activated and checked as appropriate for the type of system.

c. FIRE SUPPRESSION SYSTEMS ARE NOT TO BE TESTED BY LABORATORY PERSONNEL!

d. The inspections should be documented.

11.10 EMERGENCY LIGHTING

1. Emergency lighting must be adequate to provide lighting for egress during an emergency situation or power failure.

2. Inspections‑‑Annually by the Facilities Operations and Development

a. Emergency lighting must be activated to assure it is operational.

b. Inspections should be documented.

11.11 WASTE SPILL AND CONTAINMENT KITS

Each area in which hazardous chemicals are used will maintain an appropriate spill control kit as supplied by the Department of Chemistry with consultation of the Chemical Hygiene Officer. Employees should refer to the Department Safety Manual for instructions on the use of spill kits.

12.0 EMERGENCY PROCEDURES

The Department of Chemistry maintains a comprehensive safety program consistent with the guidelines outlined in the ACS publication, "Safety in Academic Chemistry Laboratories" and consistent with applicable OSHA standards and regulations. Also, refer to the department’s Emergency Operations & Evacuation Plan and to the "Emergency Response" section the Department of Chemistry's Safety Web Page (www.chemistry.ohio-state.edu/ehs). All faculty, staff, students, and departmental affiliates are expected to honor and abide by this departmental commitment to safety.

Despite our commitment to safety, however, we recognize that accidents happen due to the very nature of the work undertaken in this department. Therefore it is requisite that all personnel know what to do in the event of an emergency or accident.

No emergency plan can include all the contingencies for every emergency situation. The most important component of emergency planning is prevention. Prevention measures include:

1) Planning - Investigating the hazardous aspects of experimentation and thinking about "worst case scenarios" can greatly reduce risk.

2) Employee training and facility inspection programs.

3) Engineering design. Using devices such as fume hoods for chemicals or interlocks for lasers will also reduce risk.

4) Administrative Controls. Adopting and using Standard Operating Procedures, enforcing the Eye Protection Policy in your lab, and maintaining a chemical inventory are examples of using administrative controls to prevent injury.

5) Using appropriate personal protective equipment.

If a **MEDICAL EMERGENCY** occurs:

Immediately provide the minimum necessary first aid to prevent further injury to the victim.

If chemicals have splashed into the eyes, flush the eyes at an eyewash station for 15 minutes or until emergency medical personnel arrive and evaluate the accident.

If chemicals have splashed onto the body, drench the victim with water at a safety shower, while removing any contaminated clothing. Have a spare lab coat available to protect the modesty of the victim.

If the injury requires more than a band-aid (as a general rule) but is not life threatening, call 292-2121. If the injury is severe or life-threatening, call 911.

Meet the Emergency Personnel at the door and give them any relevant information.

UNDER NO CIRCUMSTANCES SHOULD YOU TRANSPORT AN INJURED PERSON TO THE HEALTH CENTER, NOR SHOULD YOU SUGGEST A VICTIM WALK TO THE HEALTH CENTER. If medical attention is needed, you are expected to call for help. This help is available at all hours.

Obtain an accident report form from the Instructional Lab Supervisor, stockroom personnel, the safety webpage, or from the Safety Coordinator. Complete the form while including as many of the details of the accident as possible. Sign the form and return it to the Lab Supervisor or the Safety Coordinator. ALL ACCIDENTS, NO MATTER HOW MINOR, MUST BE REPORTED. This is an extremely important document because it serves to protect everyone involved.

If a **FIRE** occurs:

CALL 911 AND REPORT THE LOCATION OF THE FIRE. Answer all of the questions that the dispatcher asks. Do not hang up until the dispatcher does first.

PULL THE HALL FIRE ALARM TO EVACUATE THE BUILDING. These hall fire alarms sound only within the building and may not alert the fire officials. YOU MUST CALL 911.

-Confine or control the fire if possible and safe.

-Turn off gas supplies and electrical power sources.

-Use an appropriate extinguisher:

-CO2 extinguisher for flammable liquids (class B) or electrical (class C) fires. -Dry Chemical extinguisher for paper or wood and all fires.

-Yellow "Class D" extinguishers or sand for metal (sodium, etc.) fires.

**Meet the Emergency Personnel at the door and give them any relevant information.**

Use common sense - a solvent fire in a beaker is easily extinguished by covering the beaker and depriving the fire of oxygen. Using a fire extinguisher on the same beaker may cause the solvent to spill, thus increasing the hazard!

If you are absolutely certain that have extinguished the fire, call 911 to report that the fire is out. If there is time, the fire truck response will be canceled, although fire safety officials will still come out to assess the damage and file a report.

You are expected to utilize good judgement - it may not be necessary to evacuate the building for a small fire in the lab. If, however, there is any chance that the fire may endanger others or may cause serious damage, do not hesitate to pull the fire alarm. Never feel embarrassed about being over-cautious.

**Immediately after a fire extinguisher has been used, call 292-6158 to request that it be recharged or call the Safety Coordinator.**

See the Safety Coordinator or the Safety Page to obtain a copy of the incident report form.

If a **CHEMICAL EMERGENCY** occurs:

1. Chemical emergencies such as large spills, spills involving highly hazardous or flammable materials, releases of toxic or corrosive gasses or substances should be treated as other types of emergencies. PULL THE FIRE ALARM AND EVACUATE THE BUILDING.
2. CALL 911. Notify the dispatcher of the type of emergency; they will notify appropriate emergency personnel.
3. If you do call 911, be sure to meet the emergency personnel at the door or the loading dock. You can then give them any relevant information and direct them to the exact location of the emergency.
4. If there are injured victims, provide the minimum necessary first aid ONLY IF YOU ARE SURE THAT THERE IS NO DANGER TO YOURSELF. If providing assistance will endanger your self, DO NOT attempt intervention; wait for emergency response personnel at the front of the building.
5. For small, low hazard spills:

-restrict access to the area and notify surrounding personnel

-use appropriate personal protective equipment and use spill clean up equipment suited to the spill. In Evans Lab, spill kits are available in the cabinets near the elevator.

-Spill-X-S is used for organic and flammable liquids  
-Spill-X-A is used for acids (except HF!)  
-Spill-X-C is used for caustics

-notify the Safety Office if you need equipment or have any questions

-package and dispose of the waste in an appropriate manner.

-complete an Incident Report

1. For larger spills that do not constitute an emergency:

-restrict access to the area and notify surrounding personnel.

-notify the Safety Coordinator at 9-679-1820.

-complete an Incident Report.

**Building Evacuation Procedures:**

Emergency response for all police, fire, and medical emergencies will be initiated by calling 911.

Also refer to the Emergency Evacuation and Operations Plan.

All alarms sounding in a building are to be reported via 911 as soon as possible. If discernable, advise the 911 operator if the alarm is the building evacuation alarm or the trouble alarm which is a single, continuous, ringing bell outside the building’s mechanical room

Evacuation is announced by the sounding of the emergency evacuation bells/horns. These bells/horns sound continuously for several minutes and can therefore be easily distinguished from the class change bells.

All university personnel are expected to promptly respond to the emergency evacuation alarm and to follow the emergency evacuation plan for the building in which they are located.

Unless unusual conditions dictate otherwise, the best evacuation route is the nearest stairway and out the nearest exit.  Refer to the "Emergency Floor Plans" located in this Chemical Hygiene Plan.

1. Building code requirements result in stairways being the safest locations in a building in the event of a fire. Stairways are routinely checked for people needing assistance by the firefighters.
2. Personnel should not use elevators as a means of evacuation. The high potential for electrical or mechanical malfunctions coupled with the increased risk of smoke inhalation has resulted in elevators being described as "death traps". Persons on elevators when the alarm bells sound are advised to exit at the first opportunity and evacuate via the nearest stairway.
3. Evacuees should not stop immediately after exiting the building, but proceed well away from the building so as to be clear of the fire and also not impede the movements of firefighters and fire fighting equipment.
4. Members of the Chemistry Department who have knowledge of the events that led to the emergency, can assemble at the parking lot next to the Cellar if it is safe to do so.

Classroom instructors are expected to interrupt class activity, and advise students to evacuate the building. Students are obligated to follow emergency procedures in accordance with the Code of Student Conduct. Provisions of the Ohio Revised Code as referenced in the University Operating Manual similarly obligate faculty.

Within the Department of Chemistry, Supervisors, Faculty, TA's, and Safety personnel are expected to make a quick visual inspection of the floor (including labs, offices, bathrooms, and stairwells) to make sure that everyone is leaving the building.  If performing this inspection poses unreasonable risk, then proceed to the nearest stairwell and exit the building.

Disabled students and personnel (e.g., persons with physical, visual, or hearing impairments, etc.) have the primary responsibility for requesting assistance. It is suggested that instructors determine, in advance, if any students require assistance during an emergency. If assistance is requested, the instructor should so advise the class without making any specific individual arrangements. Should the evacuation alarm sound, the instructor should request assistance to move students with physical disabilities to the nearest enclosed stairway or designated evacuation point. Other arrangements can include: assisting a blind or visually impaired person from the building, informing a deaf student that an alarm is sounding. Instructors must inform emergency officials of the location (s) of disabled students.

**Unless specifically requested and considered advisable by those providing the assistance, moving persons in wheelchairs down a stairway is not recommended.** One individual should remain with the disabled person, if this can be done without unreasonable personal risk. Others should evacuate the building and advise of the location of the persons remaining in the building so that the evacuation may be completed by the emergency personnel. Elevators should not be used to move persons with disabilities for the reasons outlined above

The building should not be reentered unless indicated safe by fire officials or University Safety Personnel at the scene.

13.0 **RECORD KEEPING**

1. Accident /Incident records shall be retained by the Department of Chemistry for five years with copies forwarded to the Division of EHS.

2. Medical records shall be retained by the University for the duration of employment plus thirty years.

3. Industrial hygiene monitoring records shall be maintained by the University for thirty years.

4. Monthly self-inspection forms (see Form 1 of Section 25.0) shall be maintained for 2 years.

14.0 **EMPLOYEE TRAINING**

14.1 TRAINING

1. All laboratory employees shall be trained on the hazards of the chemicals present in their work area.

2. The aim of the training program is to assure that all individuals at risk are adequately informed about the work in the laboratory, its risks, and what to do if an accident occurs.

3. This training shall be provided at the time of an employee’s initial assignment to a work area where hazardous chemicals are present. It shall also be provided prior to assignments involving new exposure situations. The training shall be coordinated through the Laboratory Supervisor, Chemical Hygiene Officer, Chemical Hygiene Committee, or designee, as appropriate.

4. The training should include:

a. Handling hazardous chemicals,

b. Exposure signs and symptoms,

c. Fire training‑‑prevention and response,

d. Emergency response and evacuation,

e. Interpretation of MSDS’s,

f. Engineering controls,

g. First aid,

h. Personal hygiene,

i. Protective clothing,

j. Chemical or infectious waste disposal,

k. Contents and availability of the CHP

l. Review of PELs

m. Laboratory hazards specific to work area, and if necessary,

n. Respirator protection and fit testing program.

5. Training will be documented with the following information (see Form 5-Section 25.0:

a. Trainer and/or media used,

b. Content of Training,

c. Attendees by signature,

d. Date, and

e. Location

14.2 REFERENCE MATERIALS

1. Reference materials on the hazards, safe handling, storage and disposal of hazardous chemicals can be found in the OSU Libraries, The Division of EHS, the *"Chemical Management Guidebook"* or in 480 New Chemistry.

2. The following reference texts are available through the University Libraries:

1. Prudent Practices for Handling Hazardous Chemicals in Laboratories, National Research Council, National Academy Press, Washington, DC, 1981. QD51 N32

2. Young, J.A., ed., Improving Safety in the Chemical Laboratory: A Practical Guide, John Wiley & Sons, New York, NY, 1987. QD51 I48 1987

3. Code of Federal Regulations, 29 CFR Part 1910 JK416.A3 A5 1966

3. Material safety data sheets (MSDS) shall be maintained by the Laboratory Supervisor as they are received. MSDS’s are also available on the Chemistry Safety Web Page.

14.3 TRAINING RESOURCES

1. The Division of EHS offers the following training programs:

Laboratory Standard Bloodborne Pathogens

Respirator Training and Fit Testing Solvent Safety

Fume Hoods Compressed Gases

Biosafety Cabinets Toxicology

Chemical Management (Waste) Personal Protective Equipment

Fire Extinguisher

1. The Department of Chemistry offers a yearly Safety Seminar Series and on-line training for all new employees.

15.0 **VISITOR AND CONTRACTOR TRAINING**

* 1. DEFINITIONS

1. Visitor - individual who is on site by invitation and who is not involved in the operations or processes of the laboratory and is not present in a contractual capacity.
2. Contractor - individual who is on site to complete a contracted responsibility and whose direct compensation is not being paid by The Ohio State University.

15.2 TRAINING

Visitor and contractor training will be the responsibility of the individual issuing the invitation, the agency awarding the contract or EHS, as appropriate.

16.0 **WASTE DISPOSAL PROCEDURES**

Waste Disposal procedures for chemical, infectious and other wastes are contained in The Ohio State University “*Chemical Management Guidebook*” and the Chemistry Department Safety Handbook.

17.0 **HOOD SAFETY AND VENTILATION**

17.1 GENERAL GUIDELINES

1. General laboratory ventilation shall provide air flow into the laboratory from non‑laboratory areas and out to the exterior of the building.

2. Laboratory doors should remain closed, except for egress and entrance.

17.2 HOOD USE

1. All reactions that produce unpleasant and/or potentially hazardous fumes, vapors and gases must be performed within a fume hood.

2. The hood sash should remain closed when it is in use. When adjustments are needed to laboratory equipment or operations within the hood while chemical emissions are being produced the hood sash should not be raised past the 100 linear feet per minute (lfm) indicator.

17.3 HOOD MAINTENANCE AND INSPECTIONS

1. Daily hood function inspections

Daily (or "before each use") inspections by operators should be conducted.

a. Visually inspect the hood area for storage of materials and other visible blockages.

b. If hood function indicating devices are not a part of your hood, place a 1 inch by 6 inch piece of soft tissue paper at the hood opening and observe it for appropriate directional flow into the hood.

c. If the hood is not operating properly, notify the Building Coordinator or the Safety Office and then your Supervisor

2. Periodic hood function inspections

The quality and quantity of ventilation shall be evaluated upon installation, annually, and whenever a change in local ventilation devices is made. These evaluations are the responsibility of EHS or the Chemical Hygiene Officer within the Department.

a. Capture or face velocity will be measured with a velometer or anemometer. Hoods for most common chemicals should have an average face velocity of 100 linear feet per minute at sash opening of 18 inches or higher. Face velocity readings should not vary by more than 20%. A minimum of six readings shall be used to determine average face velocity.

* 1. Local exhaust devices should be smoke tested to determine if the contaminants they are designed to remove are being adequately captured by the hood.

3. Annual maintenance

Overall maintenance of the local exhaust ventilation should be performed annually by Facilities Operations and Development Maintenance.

a. Exhaust fan maintenance, (i.e., lubrication, belt tension, fan blade deterioration and rpm), shall be in accordance with the manufacturer's recommendation or as adjusted for appropriate hood function.

b. Ductwork should be inspected for corrosion, buildup of condensate or particulate, and dampers checked and lubricated for appropriate operation.

* 1. Air cleaning equipment such as charcoal or HEPA filters should be monitored for contaminant buildup. If not supplied with differential pressure gauges or audible alarms, the filters should be leak tested.

17.4 VENTILATION FAILURE

1. Questionable ventilation or requests to evaluate ventilation throughput or efficiency should be made to the Chemical Hygiene Officer.

2. Ventilation problems or fume hood alarms that are sounding should be reported to the Building Coordinator or Chemical Hygiene Officer who shall submit repair requests to Facilities Operations and Development Maintenance.

1. In the event of a total or catastrophic ventilation failure:
   * 1. Take steps to cease operations (if doing so will not cause harm). This may include stabilizing the experiment, shutting off utilities, closing the sash, and closing the laboratory door.
     2. If appropriate, pull the fire alarm to evacuate the building. Otherwise, keep people from entering the lab.
     3. Notify your Laboratory Supervisor, the Chemical Hygiene Officer, the Building Coordinator, and the Hazardous Waste Specialist of the problem.

18.0 **WORK WITH PARTICULARLY HAZARDOUS MATERIALS**

1. The following safeguards must be used for all work with “Select Carcinogens” (Appendix III, Table 10), reproductive toxins (Appendix III, Table 11), and substances that have a high degree of acute toxicity (Appendix III, Table 14).

a. The establishment of a “designated area”, unless the Safety Committee and or the Chemical Hygiene Officer (CHO) decides after a case-by-case review that it is not necessary. The designated area may be an entire laboratory, an area of a laboratory or a device in the lab, such as a hood. This area must be clearly marked. (A suggested marking is illustrated in Appendix I, Figures 1-4.)

b. For those chemicals that require prior approval (see Section 20) signed forms (See Section 25.0, Form 3) are required before conducting the project.

c. Control equipment (glove box, hood, etc.) required.

d. Proper storage procedures utilized.

e. Personal protective equipment required.

f. Procedures for retention of records on amounts of these materials on hand and used, and the names of the workers involved.

g. Procedures for the prevention of spills and accidents, and emergency response.

h. Procedures for decontamination and /or the disposal of wastes.

i. Procedures for decontamination of the designated area.

2. SOPs must exist for all laboratory operations that involve substances that require designated areas for use. The SOPs must include provisions for appropriate signs and labels (SOP Section VI.G) and approvals for use (SOP Section X).

3. Guidelines for classification of toxic or highly toxic substances based on the LD50  in albino rats are listed in Appendix III, Table 13 and a partial list of acutely toxic compounds is given in Appendix III, Table 14.

19.0 **RADIONUCLIDES**

The Office of Radiation Safety (a Division of EHS) has strict policies and procedures for the handling, use and disposal of radioactive materials. See *"Radiation Safety Guidebook and Records Manual"*. These procedures shall be followed by anyone using radionuclides.

20.0 **OPERATIONS REQUIRING PRIOR APPROVAL**

Using and storing certain chemicals may require prior approval. Some of these compounds include, but are not limited to: toxic or corrosive gases such as: Fluorine, Chlorine, Phosgene, Arsine, Anhydrous Hydrofluoric Acid, Carbon Monoxide, Hydrogen Sulfide, unstable Boron Hydrides; highly reactive or explosive chemicals such as: Polynitrated Compounds, unstable Organic Peroxides, Heavy Metal Azides or Acetylides; or highly toxic materials such as: Cholinesterase Inhibitors, some Pesticides or Magic Methyl and related chemicals. Refer to Form 3 of Section 25.0.

21.0 **STANDARD OPERATING PROCEDURE AND JOB HAZARD ASSESSEMNT GUIDELINES**

In addition to the following generic laboratory procedures, each laboratory should develop standard operating procedures specific to its operation. SOPs should be included for all commonly repeated procedures used by more than one student and for procedures in which sufficient protection for an employee is not provided by the general practices described in the CHP. Safe work practices and a Job Hazard Assessment (outlining specific restrictions and the selection and use of personal protective equipment-see Form 4 of Section 25.0) should be part of the procedures.

21.1 LABORATORY AND GENERIC SOP INFORMATION

1. A specific SOP is required when the general requirements cited in the following sections of the CHP are insufficient to direct and protect a new laboratory worker in a commonly required and repeated laboratory procedure.

Section Content

5.0 General Laboratory Procedures

6.3 Chemical Storage

10.0 Personal Protection Equipment

16.0 Waste Disposal Procedures

17.0 Hood Safety and Ventilation

2. See the Safety Web Page for models for specific and generic SOPs. The SOP's must be modified or created for use within the specific laboratories. The Department Safety Committee may request Laboratory Supervisors to prepare a SOP when the need is evident.

3. Specific and generic SOPs that are relevant to the lab are to be included in Section 26.

4. SOPs will be based on the following outline.

**Generic or Specific Standard Operating Procedure Outline**

I. General Statement of Coverage

II. Hazard Assessment

III. Resources

A. Existing Standards B. Operating Manual Instructions

C. Literature References D. CHP Appendix III Chemical Tables

IV. Chemical Storage

A. Special Storage B. Securing Gas Cylinders

V. Personal Protection Equipment

A. Eye and Face Protection B. Eye Wash

C. Safety Showers D. Gloves

E. Protective Clothing F. Hearing Protection

G. Respirators

VI. Controls

A. Designated Areas B. Chemical Fume Hoods

C. Glove Boxes D. Safety Shielding

E. Special Ventilation F. Vacuum Protection

G. Signs and Labels H. Utilities

1. Doorways:

2. Containers:

I. Fire Protection J. Site Monitoring

VII. Specific Procedures

VIII. Emergency Procedures

A. Notification

1. Spill Response

IX. Decontamination and Waste Disposal

A. Decontamination Procedures

1. Personnel:

2. Area:

3. Equipment:

B. Waste Disposal

X. Approvals

XI. SOP Prepared by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_

Reviewed by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_

22.0 **REVIEW AND REVISION OF CHEMICAL HYGIENE PLAN**

The Chemistry Department's Chemical Hygiene Plan will be reviewed annually by the OSU Division of Environmental Health and Safety (EHS) and by the departmental Safety Committee. Requests for changes to the document may be made at any time during the year. Any request for changes that are more than editorial in nature will be reviewed by the Department Safety Committee (and OSU EHS, if appropriate). If the Department Safety Committee agrees that the requested change can be made, then an amendment to the CHP will be drafted and brought to the Faculty for a vote. If the Department Safety Committee cannot find a means of accommodating the request, the individual will be notified. If the individual wants to pursue the requested modification further, the issues will be documented and presented to the faculty for discussion.

23.1 APPENDIX I - Figure 1. Designated Area Marking for Carcinogens

This is a

Designated

Area

for

Chemical

Carcinogens



23.1 APPENDIX I - Figure 2. Designated Area Marking for Reproductive Toxins

##### This is a

Designated

##### Area

For

##### Reproductive

Toxins



23.1 APPENDIX I - Figure 3. Designated Area Marking for Highly Toxic Chemicals

This is a

Designated

Area

For

##### Highly Toxic

Chemicals



23.1 - Figure 4. Designated Area for Carcinogens, Reproductive Toxins, and Highly Toxic Chemicals

This is a

Designated

Area for



Chemical Carcinogens,

Highly Toxic Substances,

and

# Reproductive Toxins

23.2 APPENDIX II - PERSONAL PROTECTIVE EQUIPMENT - Part A. **Glove Selection**

Examples of Chemical Resistance of Common Glove Materials

**E**xcellent, **G**ood, **F**air, **P**oor, "**-**" (No) Resistance to chemical exposure for chemical listed.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Chemical | Notes | Natural  Rubber | Neoprene | Nitrile | PolyVinyl Alcohol |
| Acetaldehyde | a | P | P | P | P |
| Acetic Acid | b | F | E | F | P |
| Acetone | b | P | P | P | P |
| Acrylonitrile | b | P | P | P | P |
| Ammonium Hydroxide (sat.) | b | P | E | E | P |
| Aniline | b | P | P | P | E |
| Benzaldehyde | b | P | P | P | G |
| Benzene | a | P | P | P | E |
| Benzyl Chloride | a | P | P | P | F |
| Bromine |  | P | F | - | - |
| Butane |  | P | G | P | G |
| Butyraldehyde | b | P | P | P | P |
| Calcium Hypochlorite |  | G | G | G | P |
| Carbon Disulfide |  | P | P | P | G |
| Carbon Tetrachloride | a | P | P | P | E |
| Chlorine |  | P | F | - | P |
| Chloroacetone |  | F | E | - | P |
| Chloroform | a | P | P | P | E |
| Chromic Acid | b | P | P | F | P |
| Cyclohexane |  | P | P | E | P |
| Dibenzyl Ether |  | P | P | - | P |
| Dibutyl Phthalate | b | F | F | - | E |
| Diethanolamine | b | F | E | E | - |
| Diethyl Ether |  | P | P | P | E |
| Dimethyl Sulfoxide | b | P | E | P | P |
| Ethyl Acetate | b | P | P | P | G |
| Ethylene Dichloride | a | P | P | P | G |
| Ethylene Glycol | b | E | E | E | F |
| Ethylene Trichloride | a | P | P | P | F |
| Fluorine |  | P | P | - | P |
| Formaldehyde | b | P | F | E | P |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Chemical | Notes | Natural  Rubber | Neoprene | Nitrile | Vinyl |
| Formic Acid | b | F | E | F | P |
| Glycerol |  | E | E | E | F |
| Hexane |  | P | P | E | E |
| Hydrobromic Acid | b | P | G | F | P |
| Hydrochloric Acid (conc.) | b | G | G | G | P |
| Hydrofluoric Acid (30%) | b | F | F | P | P |
| Hydrogen Peroxide |  | E | F | E | P |
| Iodine |  | G | G | - | G |
| Methylamine | b | P | G | E | P |
| Methyl Cellusolve | b | P | P | F | P |
| Methyl Chloride | a | P | F | - | P |
| Methyl Ethyl Ketone | b | P | P | P | F |
| Methylene Chloride | a | P | P | P | E |
| Monoethanolamine | b | F | E | E | F |
| Morpholine | b | P | P | P | F |
| Naphthalene | a | P | P | F | P |
| Nitric Acid (conc.) | b | P | F | P | P |
| Perchloric Acid |  | E | E | E | P |
| Phenol |  | P | G | P | P |
| Phosphoric Acid |  | E | E | E | P |
| Potassium Hydroxide (sat.) |  | E | E | E | P |
| Propylene Dichloride | a | P | F | - | P |
| Sodium Hydroxide |  | E | E | E | P |
| Sodium Hypochlorite |  | E | E | E | P |
| Sulfuric Acid | b | P | F | P | P |
| Toluene | a | P | P | P | E |
| Trichloroethylene | a | P | P | P | E |
| Tricresyl Phosphate | b | P | G | G | E |
| Triethanolamine |  | G | E | E | E |
| Trinitrotoluene |  | P | F | F | P |

Notes:

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

b Butyl rubber recommended for handling DMSO.

For more detailed information concerning glove material selection consult with the Chemical Hygiene Officer.

23.2 APPENDIX II - PERSONAL PROTECTIVE EQUIPMENT - Part B. **Eye Protection Policy**

THE DEPARTMENT OF CHEMISTRY

EYE PROTECTION POLICY

The Department of Chemistry of The Ohio State University has established an eyewear/eye protection policy in accordance with the Ohio Revised Code that states:

\* Every student and teacher of a school, college or other educational institution shall wear industrial quality eye protective devices at all times while participating in or observing any of the following courses: (B) Chemical, physical, or combined chemical-physical laboratories involving caustic or explosive materials, hot liquids or solids, injurious radiations, or other hazards.

\* Industrial quality eye protective devices as used in this section, means devices meeting the standards of the American National Standard (ANSI) practice for occupational and educational eye and face protection, Z87.1-1968 [Z87.1-1989].

All persons must wear proper protective eye wear while in any undergraduate or graduate, teaching, or research laboratory or in any posted area requiring protective eye wear. The LSF eyewear policy supersedes Departmental Policy in the Laser Spectroscopy Facility. Proper protective eye wear for those persons in a posted area who are participating in activities which may involve an impact, heat, chemical, and/or dust hazard include:

\* ANSI certified goggles with shielded ventilation ports OR

\* Safety glasses that meet or exceed current ANSI Z87.1 standards containing permanently attached top AND side shields COUPLED with a full-face shield which also meets current ANSI Z87.1 standards.

All persons in a posted area whether directly involved in a potentially hazardous activity or not are required to wear certified goggles with shielded ventilation ports OR certified safety glasses with permanently attached top and side shields.

This policy applies to ALL persons: faculty, staff, students, and visitors. It is the responsibility of the faculty member or the area supervisor to enforce the Department protective eyewear policy. Failure to do so may subject an individual to personal liability.

**POLICY ENFORCEMENT**

Failure to comply with the Department protective eyewear policy will result in the following actions: First notification will consist of a verbal warning with accompanying notification of the Department Safety Coordinator. The second violation will consist of a written notice, with copies to the Department Safety Coordinator and Administrative Manager. Third and subsequent offenses will result in a 10% deduction from that month's paycheck. Further blatant disregard of the eyewear protection policy will result in disciplinary action.

Enforcement of the Department's eye protection policy will be coordinated through the Office of the Chemical Safety. Any questions regarding the implementation or enforcement of the policy are to be directed to that office.

Laser Spectroscopy Facility (LSF) Eye Protection Guidelines

1. The basic protective eyeglasses which users of the LSF have been issued shall be worn at ALL times when within any LSF laboratory. The ONLY places in the LSF where a person will not need protective eye wear are the Conference Room, the hallways, or the Lounge area immediately adjacent to the Conference Room.

2. Each set of protective eyewear contains an optional set of flip-up filters. These must be in place when working on, or in the vicinity of, a working laser emitting light for which the flip-up filters offer protection. It is important to recognize that due to the variety of wavelengths emitted by the lasers, no set of eye wear can offer the user complete protection unless it is opaque. It is the responsibility of each LSF user to be informed of the relevant laser wavelengths in use and the corresponding protection offered by the eyewear. If questions arise, the research advisor must be consulted.

3. ALL visitors to the LSF must wear the provided visitor goggles. These goggles may be found inside the west door or in the secretary's office.

4. When carrying out chemical reactions in the preparation room, chemical protective eye wear, as specified by the Chemistry Department for use elsewhere in the Department, shall be used INSTEAD of the laser protective eye wear.

5. All new users of the LSF must secure protective eyewear through the Safety Coordinator prior to working in the LSF.

6. Failure to comply with the guidelines will first consist of a verbal warning, followed by a written notice of a second offense. Records of these warnings will be kept by the Safety Coordinator. The automatic sanction for a third or further violations will be loss of 10% of a month's pay. Any 3-time (or greater) violator will be given a hearing by the LSF faculty to decide as to whether or not he/she will be allowed to continue work in the LSF. Violations will be noted by all LSF faculty members and the Senior Research Associate.

7. These policies will be rigorously enforced.

Ultraviolet Radiation

Persons using unprotected and/or uncovered sources of UV radiation for prolonged periods such as during gel viewing and manipulation are required to wear UV blocking eye wear OR a UV blocking face shield. The Department of Chemistry will pay for the initial purchase of a UV blocking face shield for research groups in the Department whose work requires one. Maintenance and replacement of the face shield is the responsibility of the research group.

Implementation of Eyewear Policy

The Department of Chemistry will purchase the FIRST pair of prescription or non-prescription ANSI Z87.1 Safety Glasses for members of the Chemistry Department who are faculty, staff, graduate students, post doctoral associates and visiting professors. Persons not falling into any of the above categories (i.e., undergraduates conducting extended research with a faculty member summer research program participants) may, on their own or in conjunction with the faculty with whom they are working, purchase ANSI Z87 Safety Glasses on their own or may petition the Safety Coordinator for special consideration so that the Department will pay for the purchase of such glasses. The Department of Chemistry holds its members responsible for obtaining a current eyeglass prescription (if necessary). The Department will consider purchasing subsequent prescription eye wear, should the member's prescription change after a minimum two-year period, or on the written recommendation of the attending physician.

The Department of Chemistry will initially purchase protective face shields for individuals who need them. These face shields will stay with the research group, laboratory, shop, or office. The maintenance and/or replacement of the face shields is the responsibility of the research group, laboratory, shop, or office.

Upon initial activation of the Eye wear Policy, members of the Chemistry Department will be required to sign a copy of the Policy indicating that they have read and understood it. New members of the Chemistry Department will also be required to sign a similar document at the time of their employment.

New members of the Chemistry Department will have 45 days during which they are to obtain their ANSI Z87.1 Safety Glasses. Until the glasses have been received, these new members must still comply with the Eye wear Policy by wearing appropriate eye protection.

Each research group, laboratory, shop, or office should have a Safety Officer in charge of coordinating the acquisition of Eye wear for members of his or her research group, laboratory, shop, or office as well as acting as a liaison between the research group, laboratory, shop, or office and the Office of the Safety Coordinator.

Contact Lenses

The Chemistry Department recommends that contact lenses NOT be worn in the laboratory for the following reasons: they can create a visual problem if suddenly displaced; contact lenses are difficult to remove should chemicals get into the eyes; and they tend to prevent the removal of contaminants by natural eye fluids. Soft contact lenses present special hazards. Not only will they discolor should they come into contact with many laboratory chemicals, but also can absorb chemicals and chemical vapors, causing extensive corneal damage before the wearer is aware of any problem.

23.4 APPENDIX III - Table 1. Chemical Incompatibilities

Chemical Is Incompatible With

Acetic acid Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates

Acetylene Chlorine, bromine, copper, fluorine, silver, mercury

Acetone Concentrated nitric and sulfuric acid mixtures

Alkali and alkaline earth Water, carbon tetrachloride or other chlorinated metals (e.g., powdered hydrocarbons, carbon dioxide, halogens, aluminum or magnesium, calcium, lithium, sodium, potassium)

Ammonia (anhydrous) Mercury (e.g., in manometers), chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid (anhydrous)

Ammonium nitrate Acids, powdered metals, flammable liquids, chlorates, nitrates, sulfur, finely divided organic or combustible materials

Aniline Nitric acid, hydrogen peroxide

Arsenical materials Any reducing agent

Azides Acids

Bromine See Chlorine

Calcium oxide Water

Carbon (activated) Calcium hypochlorite, all oxidizing agents

Carbon tetrachloride Sodium

Chlorates Ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials

Chromic acid and chromium Acetic acid, naphthalene, camphor, glycerol, alcohol, trioxide flammable liquids in general

Chlorine Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals turpentine

Chlorine dioxide Ammonia, methane, phosphine, hydrogen sulfide

Copper Acetylene, hydrogen peroxide

Cumene hydroperoxide Acids (organic or inorganic)

Cyanides Acids

Flammable liquids Ammonium nitrate, chromatic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens

Fluorine Everything

Hydrocarbons (e.g., butane, Fluorine, chlorine, bromine, chromic acid, sodium peroxide

propane, benzene)

Hydrocyanic acid Nitric acid, alkali

Hydrofluoric acid (anhydrous) Ammonia (aqueous or anhydrous)

Hydrogen peroxide Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, combustible materials

Hydrogen sulfide Fuming nitric acid, oxidizing gases

Hypochlorites Acids, activated carbon

Iodine Acetylene, ammonia (aqueous or anhydrous), hydrogen

Mercury Acetylene, fulminic acid, ammonia

Chemical Is Incompatible With

Nitrates Sulfuric acid

Nitric acid (concentrated) Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, copper, brass, any heavy metals

Nitrates Acids

Nitroparaffins Inorganic bases, amines

Oxalic acid Silver, mercury

Oxygen Oils, grease, hydrogen, flammable liquids, solids, or gases

Perchloric acid Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils

Peroxides, organic Acids (organic or mineral), avoid friction, store cold

Phosphorus (white) Air, oxygen, alkalis, reducing agents

Phosphorus pentoxide Water

Potassium Carbon tetrachloride, carbon dioxide, water

Potassium chlorate Sulfuric and other acids

Potassium perchlorate (see Sulfuric and other acids

also chlorates)

Potassium permanganate Glycerol, ethylene glycol, benzaldehyde, sulfuric acid

Selenides Reducing agents

Silver Acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid

Sodium Carbon tetrachloride, carbon dioxide, water

Sodium nitrate Ammonium nitrate and other ammonium salts

Sodium peroxide Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural

Sulfides Acids

Sulfuric acid Potassium chlorate, potassium perchlorate, potassium permanganate (similar compounds of light metals, such as sodium, lithium)

Tellurides Reducing agents

SOURCE: *Prudent Practices for Handling Hazardous Chemicals in Laboratories*, National Research Council, Washington, D.C., 1981.

###### 23.4 APPENDIX III - Table 2. Ohio Fire Code Information For Flammable Liquid Storage

Flammable and Combustible Liquids: Flammable and Combustible Liquid Container Size

Ohio Fire Code 2000 1301:7-7-03 (P) Section FM-316.0

Laboratories using Chemicals shall comply with NFPA 45 -2000

Fire Protection for Laboratories1 Using Chemicals

**NFPA 45-2000 Table7.2.3.2**

**MAXIMUM ALLOWABLE SIZE OF CONTAINERS**

**AND PORTABLE TANKS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Container type | Flammable liquids | | | Combustible liquids | |
|  | Class IA | Class IB | Class IC | Class II | Class III |
| Glass | 500 ml2 | 1 L2 | 4 L | 4 L | 20 L |
| Metal (other than DOT drums) or approved plastic | 4 L | 20 L | 20 L | 20 L | 20 L |
| Safety cans | 10 L | 20 L | 20 L | 20 L | 20 L |
| Metal drums (DOT spec.) | 4 L | 20 L | 20 L | 227 L | 227 L. |
| Polyethylene (DOT Spec.34) | 4 L | 20 L | 20 L | 227 L | 227 L |

**Notes:**

1. Laboratories used for graduate or post-graduate research and research centers.
2. Glass containers as large as 4 L shall be permitted to be used if needed and if the required purity would be adversely affected by storage in a metal or an approved plastic container, or if the liquid would cause excessive corrosion or degradation of a metal or an approved plastic container.

23.4 APPENDIX III - Table 3. Solvent Flammability Properties

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Chemical | Flash  Point  (°F) | Ignition  Temp  (°F) | Flammable  Limits  Lower Upper | | Specific  Gravity  Water=1 | Vapor  Density  Air=1 | Boiling  Point  (°F) | Water  Soluble | Notes | Hazard Rating  Health Flammability Reactivity | | |
| Acetaldehyde  CH3CHO  Ethanal | -36 | 347 | 4.0 | 60 | 0.8 | 1.5 | 70 | Yes | polymerizes | 2 | 4 | 2 |
| Acetone  CH3COCH3  2-Propanone | 0 | 869 | 2.6 | 12.8 | 0.8 | 2 | 134 | Yes |  | 1 | 3 | 0 |
| Acrolein  CH2CHCHO  Acrylic Aldehyde | -15 | 455 | 2.8 | 31 | 0.8 | 1.9 | 125 | Yes |  | 3 | 3 | 2 |
| Allylamine  CH2CHCH2NH2  2-Propenylamine | -20 | 705 | 2.2 | 22 | 0.8 | 2 | 128 | Yes |  | 3 | 3 | 1 |
| Amyl Acetate  CH3COOC5H11  1-Pentanol Acetate | 77 | 680 | 1.1 | 7.5 | 0.9 | 4.5 | 300 | Slight |  | 1 | 3 | 0 |
| Benzene  C6H6  Benzol | 12 | 1040 | 1.3 | 7.1 | 0.9 | 2.8 | 176 | No |  | 2 | 3 | 0 |
| Butadiene Monoxide  CH2CHCHOCH2  Vinylethylene Oxide | -58 |  |  |  | 0.9 | 2.4 | 151 |  |  | 2 | 3 | 2 |
| Butyl Alcohol  CH3 (CH2) 2CH2OH  Butanol | 84 | 689 | 1.4 | 11.2 | 0.8 | 2.6 | 243 | Yes |  | 1 | 3 | 0 |
| Butyl Chloride  C4H9Cl  1-Chlorobutane | 15 | 860 | 1.8 | 10.1 | 0.9 | 3.2 | 170 | No |  | 2 | 3 | 0 |
| Carbon Disulfide  CS2 | -22 | 194 | 1.3 | 50 | 1.3 | 2.6 | 115 | No |  | 2 | 3 | 0 |
| Collodion  Solution of Nitrated Cellulose in Ether Alcohol | 0 |  |  |  |  |  |  |  |  | 1 | 4 | 0 |
| Cyclohexane  C6H12 | -4 | 473 | 1.3 | 8 | 0.8 | 2.9 | 179 | No |  | 1 | 3 | 0 |
| Denatured Alcohol  Government Formula  CD-5  CD-5A  CD-10  SD-1  SD-2B  SD-3A  SD-13A  SD-17  SD-23A  SD-30  SD-39B  SD-39C  SD-40M | 60  60  60  49  57  56  59  19  60  35  59  60  59  59 | 750 |  |  | 0.8 | 1.6 | 175 | Yes |  | 0 | 3 | 0 |
| Dibutyl Ether  (C4H9) 2O  Butyl Ether | 77 | 383 | 1.5 | 7.6 | 0.8 | 4.5 | 286 | No |  | 2 | 3 | 0 |
| Dichloroethylene  ClCHCHCl | 43 |  | 9.7 | 12.8 | 1.3 | 3.4 | 141 | No |  | 2 | 3 | 2 |
| Diethylamine  (C2H5) 2NH | 0 | 594 | 1.8 | 10.1 | 0.7 | 2.5 | 134 | Yes |  | 2 | 3 | 0 |
| Dimethyl Butane  (CH3) 3CCH2CH3  Neohexane | -54 | 797 | 1.2 | 7.0 | 0.6 | 3.0 | 122 | No |  | 1 | 3 | 0 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Chemical | Flash  Point  (°F) | Ignition  Temp  (°F) | Flammable  Limits  Lower Upper | | Specific  Gravity  Water=1 | Vapor  Density  Air=1 | Boiling  Point  (°F) | Water  Soluble | Notes | Hazard Rating  Health Flammability Reactivity | | |
| Dimethyl Pentane  CH3CH(CH3)CH(CH3)CH2CH3 | 20 | 635 | 1.1 | 6.7 | 0.7 | 3.5 | 194 | No |  | 0 | 3 | 0 |
| ρ-Dioxane | 54 | 356 | 2.0 | 22 | 1.0 | 3.0 | 214 | Yes |  | 2 | 3 | 0 |
| Divinyl Ether  (CH2CH) 2O  Vinyl Ether | -22 | 680 | 1.7 | 27 | 0.8 | 2.4 | 102 | No |  | 2 | 3 | 2 |
| Ethyl Acetate  CH3COOC2H5  Ethyl Ethanoate | 24 | 800 | 2.2 | 11 | 0.9 | 3.0 | 171 | Slight |  | 1 | 3 | 0 |
| Ethyl Alcohol  C2H5OH  Ethanol  In Water 96%  95%  80%  70%  60%  50%  40%  30%  20%  10%  5% | 55  62  63  68  70  72  75  79  85  97  120  144 | 689 | 3.3 | 19 | 0.8 | 1.6 | 173 | Yes |  | 0 | 3 | 0 |
| Ethylamine  C2H5NH2  70% Aqueous Solution | 0 | 725 | 3.5 | 14 | 0.8 | 1.6 | 62 | Yes |  | 3 | 4 | 0 |
| Ethyl Chloride  C2H5Cl | -58 | 966 | 3.8 | 15.4 | 0.9 | 2.2 | 54 | No |  | 2 | 4 | 0 |
| Ethylene Oxide  CH2OCH2 | 0 | 804 | 3.6 | 100 | 0.9 | 1.5 | 51 | Yes |  | 2 | 4 | 3 |
| Ethyl Ether  C2H5OC2H5 | -49 | 320 | 1.9 | 36 | 0.7 | 2.6 | 95 | Slight |  | 2 | 4 | 0 |
| Gasoline | -36 | 853 | 1.4 | 7.6 | 0.8 | 3-4 | 100 | No |  | 1 | 3 | 0 |
| Hexadiene  CH3CHCHCH2CHCH2 | -6 |  | 2 | 6 | 0.7 | 2.8 | 151 | No |  | 0 | 3 | 0 |
| Hexane  CH3(CH2) 4CH3 | -7 | 437 | 1.1 | 7.5 | 0.7 | 3.0 | 156 | No |  | 1 | 3 | 0 |
| Isopropyl Alcohol (CH3) 2CHOH | 53 | 750 | 2 | 12 | 0.8 | 2.1 | 181 | Yes |  | 1 | 3 | 0 |
| Kerosene | 100 | 410 | 0.7 | 5 | <1 |  | 400 | No | Varies by state | 0 | 2 | 0 |
| Methyl Alcohol  CH3OH | 52 | 725 | 6.7 | 36 | 0.8 | 1.1 | 147 | Yes |  | 1 | 3 | 0 |
| Methyl Cyclohexane | 25 | 482 | 1.2 | 6.7 | 0.8 | 3.4 | 214 | No |  | 2 | 3 | 0 |
| Methyl Ethyl Ether  CH3OC2H5 | -35 | 374 | 2 | 10.1 | 0.7 | 2.1 | 51 | Yes |  | 2 | 4 | 0 |
| Methyl Ethyl Ketone  C2H5COCH3 | 21 | 960 | 1.8 | 10 | 0.8 | 2.5 | 176 | Yes |  | 1 | 3 | 0 |
| Naptha | 28 | 450 | 0.9 | 6 | <1 |  | 212 | No | Depends on manufac-turer | 1 | 3 | 0 |
| Nitroethane  C2H5NO2 | 82 | 778 | 3.4 |  | 1.1 | 2.6 | 237 | Slight |  | 1 | 3 | 3 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Chemical | Flash  Point  (°F) | Ignition  Temp  (°F) | Flammable  Limits  Lower Upper | | Specific  Gravity  Water=1 | Vapor  Density  Air=1 | Boiling  Point  (°F) | Water  Soluble | Notes | Hazard Rating  Health Flammability Reactivity | | |
| Paraldehyde  (CH3CHO) 3 | 96 | 460 | 1.3 |  | 1.0 | 4.5 | 255 | Slight |  | 2 | 3 | 1 |
| Pentane  CH3(CH2) 3CH3 | -40 | 500 | 1.5 | 7.8 | .06 | 2.5 | 97 | No |  | 1 | 4 | 0 |
| Petroleum Ether | 0 | 550 | 1.1 | 5.9 | 0.6 | 2.5 | 95 | No |  | 1 | 4 | 0 |
| Propanal  CH3CH2CHO | 15 |  | 2.9 | 17 | 0.8 | 2 | 120 | Slight |  | 2 | 3 | 1 |
| Propylene Oxide | -35 |  | 2.8 | 37 | 0.9 | 2 | 95 | Yes |  | 2 | 4 | 2 |
| Toluene  C6H5CH3 | 40 | 896 | 1.2 | 7.1 | 0.9 | 3.1 | 231 | No |  | 2 | 3 | 0 |
| Turpentine | 95 | 488 | 0.8 |  | <1 |  | 300 | No |  | 1 | 3 | 0 |
| Vinyl Ethyl Ether  CH2CHOC2H5 | -50 | 395 | 1.7 | 28 | 0.8 | 2.5 | 96 | No |  | 2 | 4 | 2 |
| Xylene  C6H4(CH3) 2 | 90 | 869 | 1 | 6 | 0.9 | 3.7 | 292 | No |  | 2 | 3 | 0 |

23.4 APPENDIX III - Table 4. Corrosive Chemicals

A Partial, Illustrative List of Corrosive Chemicals

Acids: Acetic Chromic

Chloroacetic Cresylic

Formic Hydrochloric

Hydrofluoric Hydoiodic

Perchloric Periodic Phosphoric Nitric

Sulfuric

Bases: Ammonium hydroxide Barium carbonate Barium hydroxide Calcium hydroxide

Calcium Oxide Potassium carbonate

Potassium hydroxide Sodium Carbonate

Sodium hydroxide Trisodium phosphate

Others: Bromine Glutaraldehyde

23.4 APPENDIX III - Table 5. Water Reactive Chemicals

Partial List of Water Reactive Chemicals

Alkali metals, such as Na, Li, K

Alkali metal hydrides, such as LiH, CaH2 , LiAlH4 , NaBH4 , alkali metal amides, such as NaNH2

Metal alkyls, such as lithium and aluminum alkyls

Grignard reagents, RMgX

Halides of nonmetals, such as BCl3 , BF3 , PCl3, PCl5 , SiCl4, S2, Cl2

Inorganic acid halides, such as POCl3, SOCl2, SO2, Cl2

Anhydrous metal halides, such as AlCl3, TiCl4, ZrCl4, SnCl4

Phosphorus pentoxide

Calcium carbide

Organic acid halides and anhydrides of low molecular weight, such as acetylchloride and acetic anhydride

23.4 APPENDIX III - Table 6. Pyrophoric Chemicals

Partial List of Pyrophoric Chemicals

Grignard reagents, RMgX

Metal alkyls and aryls, such as RLi, RNa, R3Al, R2Zn

Metal carbonyls, such as Ni(CO)4, Fe(CO)5, Co2 (CO)8

Alkali metals such as Na, K

Metal powders, such as Al, Co, Fe, Mg, Mn, Pd, Pt, Ti, Sn, Zn, Zr

Metal hydrides, such as NaH, LiAlH4

Nonmetal hydrides, such as B2H6 and other boranes, PH3 , AsH3

Nonmetal alkyls, such as R3B, R3P, R3As

Phosphorus (white)

23.4 APPENDIX III - Table 7. Strong Oxidizers

A Partial List of Strongly Oxidizing Chemicals

Ammonium perchlorate

Ammonium permanganate

Barium peroxide

Bromine

Calcium chlorate

Calcium hypochlorite

Chlorine trifluoride

Chromium anhydride

Chromic acid

Dibenzoyl peroxide

Fluorine

Hydrogen peroxide

Magnesium peroxide

Nitrogen trioxide

Perchloric acid

Potassium bromate

Potassium chlorate

Potassium peroxide

Propyl nitrate

Sodium chlorate

Sodium chlorite

Sodium perchlorate

Sodium peroxide

Source: CRC Handbook of Laboratory Safety, 3rd edition.

23.4 APPENDIX III - Table 8. Peroxide Forming Chemicals

Common Peroxide Forming Chemicals

List A: Severe Peroxide Hazard on Storage with Exposure to Air

**Discard within 3 months**

Diisopropyl ether (isopropyl ether) Potassium amide

Divinylacetylene (DVA) Sodium amide (sodamide)

Vinylidene Chloride Potassium metal

List B: Peroxide Hazard on Concentration

**Do not distill or evaporate without first testing for the presence of peroxides.**

**Discard or test for peroxides after 6 months**

Acetaldehyde diethyl acetal (acetal) Ethylene glycol dimethyl ether (glyme)

Cumene (isopropyl benzene) Ethylene glycol ether acetates

Cyclohexene Ethylene glycol monoethers (cellosolves)

Cyclopentene Furan

Decalin (decahydronaphthalene) Methylacetylene

Diacetylene (butadiene) Methylcyclopentane

Diethyl ether (ether) Tetrahydrofuran (THF)

Diethylene glycol dimethyl ether (diglyme) Tetralin (tetrahydronapthalene)

Dioxane Vinyl ethers

List C: Hazard of Rapid Polymerization Initiated by Internally Formed Peroxides

**Normal Liquids**

**Discard or test for peroxides after 6 months**

Chloroprene (2-chloro-1, 3-butadiene) Vinyl acetate

Styrene Vinyl pyridine

**Normal Gases**

**Discard after 12 months**

Butadiene Vinyl acetylene (MVA)

Tetrafluroethylene (TFE) Vinyl chloride

23.4 APPENDIX III - Table 9. Common Gas Properties

Data For Common Gases

Substances with Threshold Limit Values of 50 PPM or less should only be used in a properly operating chemical fume hood.

|  |  |  |  |
| --- | --- | --- | --- |
| Gas (state in cylinder) | Threshold Limit Values, ppm1  C=Ceiling limit | Flammability Limits in Air % by Vol2 | Major Hazards |
| Acetylene (Dissolved) | Not established (nontoxic, produces anesthetic effects) | 2.5‑81.0 | Flammable; asphyxiant |
| Ammonia (Liquid) | 25 | 15‑28 | Toxic |
| Argon | Not established (nontoxic) | None | Asphyxiant |
| Boron trifluoride | 1 C | None | Toxic; causes burns |
| 1,3‑Butadiene (Liquid) | 2 | 2‑11.5 | Flammable; skin irritant; suspect carcinogen |
| Butane (Liquid) | 800 (nontoxic, produces anesthetic effects) | 1.9‑8.5 | Flammable, narcosis |
| Carbon dioxide (Liquid) | 5000  C=30,000 | None | Asphyxiant |
| Carbon monoxide | 25 | 12.5‑74.0 | Toxic; chemical asphyxiant |
| Chlorine (Liquid) | 0.5  C=1.0 | None | Irritant; causes burns; corrosive |
| Ethane (Liquid) | Not established (nontoxic, produces anesthetic effects) | 3.0‑12.5 | Flammable; asphyxiant |
| Ethylene | Not established (nontoxic, produces anesthetic effects) | 3.1‑32.0 | Flammable; asphyxiant |
| Ethylene oxide (Liquid pure) | 1 ppm | 3.0‑100.0 | Flammable; toxic can cause burns when trapped by clothing or shoes; affects multiple organs, suspect carcinogen |
| Helium | Not established (nontoxic) | None | Asphyxiant |
| Hydrogen | Not established | 4.0‑75.0 | Flammable; asphyxiant |
| Hydrogen bromide (Liquid) | C=3.0 | None | Toxic; causes burns; corrosive |
| Hydrogen chloride (Liquid) | C=5.0 | None | Toxic; causes burns; corrosive |

|  |  |  |  |
| --- | --- | --- | --- |
| Gas (state in cylinder) | Threshold Limit Values, ppm1  C=Ceiling limit | Flammability Limits in Air % by Vol2 | Major Hazards |
| Hydrogen fluoride (Liquid) | C=3.0 | None | Toxic; causes severe slow healing burns; corrosive |
| Hydrogen sulfide (Liquid) | 10  C=15 | 4.3‑45.0 | Toxic; flammable; irritant |
| Methane | Not established | 5.3‑14.0 | Flammable; asphyxiant |
| Methyl bromide (Liquid) | 1 | 13.5‑14.5 | Toxic; causes burns |
| Methyl chloride (Liquid) | 50  C=100 | 10.7‑17.4 | Toxic; flammable |
| Methyl mercaptan (Liquid) | 0.5 | Unknown | Irritant; flammable |
| Nitrogen (nontoxic) | Not established | None | Asphyxiant |
| Nitrogen dioxide (Liquid) | 3  C=5.0 | None | Toxic; corrosive |
| Oxygen | Nontoxic | None | Highly reactive, oxidizer |
| Phosgene (Liquid) | 0.1 | None | Toxic |
| Propane (Liquid) | Not established (nontoxic, produces anesthetic effects) | 2.2‑9.5 | Flammable; asphyxiant |
| Sulfur dioxide (Liquid) | 2  C=5.0 | None | Toxic; causes burns |
| Vinyl chloride | 1 | 4.0‑22.0 | Flammable; causes burns, human carcinogen |

1 Threshold Limit Values (2000) ACGIH, Cincinnati, Ohio

2 Zabetakis, M. G. Flammability "Characteristics of Combustible Gases and Vapors" Bulletin 627, U.S. Bureau of Mines, U.S. Gov't Printing Office, WASH. D.C.

23.4 APPENDIX III - Table 10. Carcinogens Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Chemical** | **OSHA** | **IARC** | **NTP** | ACGIH |
| AF-2[2-(2-furyl)-3-(5-nitro-2-furyl)acrylamide] |  | 2B |  |  |
| acetaldehyde (ethyl aldehyde) |  | 2B | R | A3 |
| acetamide |  | 2B |  |  |
| acetic acid, cobalt(2+) salt |  | 2B |  |  |
| 2-acetylaminofluorene | yes |  | R |  |
| acrylamide |  | 2A | R | A3 |
| acrylonitrile | Yes | 2B | R | A3 |
| adriamycin |  | 2A | R |  |
| adriamycin hydrochloride |  |  | R |  |
| aflatoxin B1 |  | 1 |  |  |
| aflatoxin M1 |  | 2B |  |  |
| aflatoxins |  | 1 | K |  |
| alcoholic beverages |  | 1 | K |  |
| aldrin (HHDN) |  |  |  | A3 |
| allyl chloride |  |  |  | A3 |
| aluminium production |  | 1 |  |  |
| 1-amino-2-methylanthraquinone |  |  | R |  |
| 2-amino-5-(5-nitro-2-furyl)-1,3,4-thiadiazole |  | 2B |  |  |
| amino-alpha-c (2-amino-9h-pyrido[2,3-b]indole) |  | 2B |  |  |
| 2-aminoanthraquinone |  |  | R |  |
| para-aminoazobenzene |  | 2B |  |  |
| ortho-aminoazotoluene |  | 2B | R |  |
| 4-aminodiphenyl | yes | 1 | K | A1 |
| amitrole |  | 2B | R | A3 |
| ammonium dichromate (VI) |  | 1 |  |  |
| ammonium perfluorooctanoate |  |  |  | A3 |
| anaesthetics, volatile |  | 2A |  |  |
| analgesic mixtures containing phenacetin |  | 1 | K |  |
| androgenic (anabolic) steroids |  | 2A |  |  |
| aniline (aminobenzne) |  |  |  | A3 |
| ortho-anisidine |  | 2B | R | A3 |
| o-anisidine hydrochloride |  | 2B | R |  |
| antimony trioxide production |  | 2B |  | A2 |
| aramite |  | 2B |  |  |
| arsenenous acid, calcium salt (2:1), and potassium salt |  |  | K |  |
| arsenic acid, calcium salt, and calcium salt (2:3) |  | 1 | K |  |
| arsenic acid, disodium salt, heptahydrate |  |  | K |  |
| arsenic acid, lead (2+) salt (1:1) |  |  | K |  |
| arsenic acid, monopotassium salt, and sodium salt |  |  | K |  |

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| **OSHA-** Occupational Safety and Health Administration, U.S. Department of Labor  OSHA regulated chemicals marked with “yes” | **NTP-** National Toxicology Program, U.S. Department of Health and Human Services Group K: known to be human carcinogensGroup R: reasonably anticipated to be human carcinogens |
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| --- | --- | --- | --- | --- |
| **Chemical** | **OSHA** | **IARC** | **NTP** | ACGIH |
| arsenic pentoxide |  |  | K |  |
| arsenic trioxide |  | 1 | K |  |
| arsenic, elemental and inorganic compounds as As | yes | 1 | K | A1 |
| arsenious acid, monosodium salt |  | 1 | K |  |
| arsenious acid, calcium salt, and calcium salt (1:1) |  |  | K |  |
| art glass, glass containers and pressed ware (manufacture of) |  | 2A |  |  |
| asbestos | yes | 1 | K | A1 |
| asbestos, actinolite | yes | 1 |  | A1 |
| asbestos, amosite, anthophyllite, chrysotile, crocidolite | yes | 1 | K | A1 |
| asbestos, tremolite | yes | 1 |  | A1 |
| atrazine |  | 2B |  |  |
| auramine |  | 2B |  |  |
| auramine, manufacture of |  | 1 |  |  |
| azacitidine |  | 2A | R |  |
| azaserine |  | 2B |  |  |
| azathioprine |  | 1 | K |  |
| azbllen asbestos |  |  | K |  |
| barium chromate (VI) |  | 1 | K |  |
| benz[a]anthracene |  | 2A | R | A2 |
| benzal chloride |  | 2A |  |  |
| benzene | yes | 1 | K | A1 |
| benzidine | yes | 1 | K | A1 |
| benzidine-based dyes |  | 2A | K |  |
| benzo[a]pyrene |  | 2A | R | A2 |
| benzo[b]fluoranthene |  | 2B | R | A2 |
| benzo[j]fluoranthene, and [k] |  | 2B | R |  |
| benzofuran |  | 2B |  |  |
| benzotrichloride |  | 2A | R | A2 |
| benzoyl chloride |  | 2A |  |  |
| benzyl chloride |  | 2A |  | A3 |
| benzyl violet 4B |  | 2B |  |  |
| beryllium compounds |  | 1 | R | A1 |
| beryllium aluminum alloy |  | 1 | R |  |
| beryllium aluminum silicate |  | 1 | R |  |
| beryllium and beryllium compounds |  | 1 | R | A1 |
| beryllium chloride |  | 1 | R |  |
| beryllium compounds, n.o.s. |  | 1 | R |  |
| beryllium phosphate |  | 1 | R |  |
| beryllium hydroxide |  | 1 | R |  |
| beryllium oxide |  | 1 | R |  |
| beryllium oxide carbonate |  | 1 | R |  |
| beryllium sulfate |  | 1 | R |  |
| beryllium sulfate tetrahydrate |  | 1 | R |  |
| beryllium zinc silicate |  | 1 | R |  |
| betel quid with tobacco |  | 1 |  |  |

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| **IARC-** International Agency for Research on Cancer Group 1: carcinogenic to humans Group 2A: probably carcinogenic to humans  Group 2B:possibly carcinogenic to humans | **ACGIH-** American Conference of Governmental Industrial Hygienists Group A1: confirmed human carcinogen Group A2: suspected human carcinogen  Group A3: confirmed animal carcinogen with unknown relevance to humans |

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| --- | --- | --- | --- | --- |
| **Chemical** | **OSHA** | **IARC** | **NTP** | ACGIH |
| n,n-bis(2-chloroethyl)-2-naphthylamine (chlornaphazine) |  | 1 |  |  |
| bis(chloromethyl)ether & technical grade | yes | 1 | K | A1 |
| bischloroethyl nitrosourea (BCNU) |  | 2A | R |  |
| bitumens, extracts of steam-refined and air-refined |  | 2B,3 |  |  |
| bleomycin, chlorohydrate, and sulfate |  | 2B |  |  |
| bleomycins |  | 2B |  |  |
| boot and shoe manufacture and repair |  | 1 |  |  |
| bracken fern |  | 2B |  |  |
| bromacil |  |  |  | A3 |
| bromodichloromethane |  | 2B | R |  |
| bromoform |  |  |  | A3 |
| 1,3-butadiene | Yes | 2A | K | A2 |
| 1,4-butanediol dimethanesulfonate (busulphan;myleran) |  | 1 | K |  |
| butylated hydroxyanisole (BHA) |  | 2B | R |  |
| beta-butyrolactone |  | 2B |  |  |
| Cl acid red 114 |  | 2B |  |  |
| Cl basic red 9 |  | 2B | R |  |
| Cl direct blue 15 |  | 2B |  |  |
| cadmium, elemental, and compounds, as Cd | Yes | 1 | K | A2 |
| cadmium carbonate |  |  | K |  |
| cadmium chloride |  | 1 | K |  |
| cadmium fluoborate |  |  | K |  |
| cadmium fume (as Cd) |  | 1 | K |  |
| cadmium nitrate |  |  | K |  |
| cadmium oxide |  |  | K |  |
| cadmium sulfate |  | 1 | K |  |
| cadmium sulfide |  | 1 | K |  |
| caffeic acid |  | 2B |  |  |
| calcium chromate (VI) |  | 1 | K | A2 |
| captafol |  | 2A |  |  |
| captan |  |  |  | A3 |
| carbon black |  | 2B |  |  |
| carbon tetrachloride |  | 2B | R | A2 |
| carpentry and joinery |  | 2B |  |  |
| carrageenan, degraded |  | 2B |  |  |
| catechol |  | 2B |  | A3 |
| ceramic fibers |  | 2B | R |  |
| chlorambucil |  | 1 | K |  |
| chloramphenicol |  | 2A |  |  |
| alpha-chlordane, and beta, and gamma |  | 2B |  |  |
| chlordane |  | 2B |  | A3 |
| chlordane, technical |  | 2B |  |  |
| chlordecone (kepone) |  | 2B | R |  |
| chlorendic acid |  | 2B | R |  |
| chlorinated paraffins (C12 60% and C23, 43% chlorine) |  | 2B | R |  |

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| **Chemical** | **OSHA** | **IARC** | **NTP** | ACGIH |
| alpha-chlorinate toluenes (benzal chloride, benzyl chloride, benzotrichloride) and bonzoyl chloride (combined exposures) |  | 2A |  |  |
| 2-(4-chloro-2-methyl phenoxy) propionic acid (mecoprop) |  | 2B |  |  |
| 1-chloro-2-methylpropene |  | 2B | R |  |
| 3-chloro-2-methylpropene |  |  | R |  |
| 4-chloro-o-toluidine hydrochloride |  | 2A | R |  |
| 4-chloro-ortho-phenylenediamine |  | 2B | R |  |
| para-chloro-ortho-toluidine, and its strong acid salts |  | 2A |  |  |
| para-chloroaniline |  | 2B |  |  |
| chlorobenzene |  |  |  | A3 |
| chlorodiphenyl (54% chlorine) |  |  |  | A3 |
| 1-(2-chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (methyl-CCNU;semustine) |  | 1 | K |  |
| 1-(2-chloroethyl)-3-cyclohexyl-1-nitrosourea (CCNU) |  | 2A | R |  |
| chloroform |  | 2B | R | A3 |
| chloromethyl methyl ether (CMME) | yes | 1 | K | A1 |
| chlorophenols |  | 2B |  |  |
| polychlorophenols and their sodium salts (mixed exposures) |  | 2B |  |  |
| chlorophenoxy herbicides |  | 2B |  |  |
| 2-(o-chlorophenyl)-2-(p-chlorophenyl)-1,1,1-trichloroethane |  | 2B |  |  |
| 2-(o-chlorophenyl)-2-(p-chlorophenyl)-1, 1-dichloroethane |  | 2B |  |  |
| chloroprene |  | 2B | R |  |
| chlorothalonil |  | 2B |  |  |
| chlorozotocin |  | 2A | R |  |
| chromate(1-), hydroxyoctaoxodizincatedi-, potassium |  | 1 |  | A1 |
| chromic acid, lead(2+) Salt (1:1) |  | 1 | K | A2 |
| chromic acid, disodium salt |  | 1 | K |  |
| chromite (mineral) |  |  | K |  |
| chromite ore processing (chromate) as Cr |  |  |  | A1 |
| chromium (VI) chloride |  | 1 |  |  |
| chromium (VI) compounds |  | 1 | K |  |
| chromium (VI) dioxychloride |  | 1 |  |  |
| chromium and certain chromium compounds |  |  | K |  |
| chromium carbamate (6Cl) |  |  | K |  |
| chromium phosphate |  |  | K |  |
| chromium triacetate |  |  | K |  |
| chromium (VI) oxide (1:3) |  | 1 | K |  |
| chromium, metal & inorganic compounds, as Cr, insoluble Cr VI compunds, and water soluble Cr VI compounds |  |  |  | A1 |
| chrysene |  |  |  | A3 |
| cisplatin |  | 2A | R |  |
| citrus red number 2 |  | 2B |  |  |
| clonorchis sinensis (infection with) |  | 2A |  |  |
| coal gasification |  | 1 |  |  |
| coal tar, and coal tar distillate |  | 1 | K |  |
| coal tar pitch volatiles, as benzene solubles |  | 1 |  | A1 |
| cobalt (II) carbonate hydroxide (2:3) monohydroxide |  | 2B |  |  |

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| **Chemical** | **OSHA** | **IARC** | **NTP** | ACGIH |
| cobalt alloy, Co, Cr |  | 2B | K |  |
| cobalt and cobalt compunds |  | 2B |  | A3 |
| cobalt carbonate (1:1) |  | 2B |  |  |
| cobalt carbonate, cobalt dihydroxide (2:3) |  | 2B |  |  |
| cobalt (Co4(Co)12) |  | 2B |  |  |
| cobalt dinitrate hexahydrate |  | 2B |  |  |
| cobalt hydroxide |  | 2B |  |  |
| cobalt hydroxide oxide |  | 2B |  |  |
| cobalt molydate (VI) |  | 2B |  |  |
| cobalt naphthanate |  | 2B |  |  |
| cobalt oxide, (II) oxide, and (III) oxide |  | 2B |  |  |
| cobalt triacetate |  | 2B |  |  |
| cobalt (II) sulfide |  | 2B |  |  |
| cobalt (II) acetate tetrahydrate |  | 2B |  |  |
| cobalt (II) chloride, and chloride hexahydrate |  | 2B |  |  |
| cobalt (II) hydroxide |  | 2B |  |  |
| cobalt (II) nitrate (1:2) |  | 2B |  |  |
| cobalt (II) sulfate (1:1) |  | 2B |  |  |
| cobalt, (mu-(carbonato(2-)-O:O’))dihydroxydi |  | 2B |  |  |
| cobalt, di-mu-carbonylhexacarbonyldi-, (Co-Co) |  | 2B |  |  |
| cobalt-aluminium-chromium spinel |  | 2B |  |  |
| cobalt-chromium-molybdenum-alloy |  | 2B |  |  |
| cobalt-chromium-nickel-tungsten alloy |  | 2B |  |  |
| coffee (urinary bladder) |  | 2B |  |  |
| coke oven emissions | yes |  | K |  |
| coke production | yes | 1 | K |  |
| conjugated estrogens (sodium [estrone & equilin] sulfate) |  |  | K |  |
| creosote, and creosote wood |  | 2A | K |  |
| para-cresidine |  | 2B | R |  |
| crotonaldehyde (2-butenal) |  |  |  | A3 |
| cupferron |  |  | R |  |
| cycasin |  | 2B |  |  |
| cyclophosphamide |  | 1 | K |  |
| cyclophosphamide hydrate |  | 1 |  |  |
| cycosporin A |  | 1 | K |  |
| DDD (dichlorodiphenyldichloroethane) |  | 2B |  |  |
| DDE (dichlorodiphenyldichloroethylene) |  | 2B |  |  |
| DDT |  | 2B | R | A3 |
| dacarbazine |  | 2B | R |  |
| dantron (chrysazin; 1,8-dihydroxyanthraquinone, danthron) |  | 2B | R |  |
| daunomycin |  | 2B |  |  |
| decabromobiphenyl (under polybrominated biphenyls) |  |  | R |  |
| di(2-ethylhexyl)phthalate |  | 2B | R | A3 |
| N,N’-diacetylbenzidine |  | 2B |  |  |
| 2,4-diaminoanisole, and its salts |  | 2B |  |  |

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| --- | --- | --- | --- | --- |
| **Chemical** | **OSHA** | **IARC** | **NTP** | ACGIH |
| 2,4-diaminoanisole sulfate |  |  | R |  |
| 4,4’-diaminodiphenyl ether |  | 2B | R |  |
| 2,4-diaminotoluene |  | 2B | R |  |
| diazomethane |  |  |  | A2 |
| dibenz[a,h]acridine, and [a,j] |  | 2B | R |  |
| dibenz[a,h]anthracene |  | 2A | R |  |
| dibenzo[a,e]pyrene, and [a,h], and [a,I], and [a,l] |  | 2B | R |  |
| 7h-dibenzo[c,g]carbazole |  | 2B | R |  |
| 1,2-dibromo-3-chloropropane (DBCP) | yes | 2B | R |  |
| 1,4-dichloro-2-butene |  |  |  | A2 |
| 3,3’-dichloro-4,4’-diaminodiphenyl ether |  | 2B |  |  |
| dichloroacetylene |  |  |  | A3 |
| para-dichlorobenzene |  | 2B | R | A3 |
| 3,3’-dichlorobenzidine | yes | 2B | R | A3 |
| 3,3’-dichlorobenzidine hydrochloride |  |  | R |  |
| 1,2-dichloroethane |  | 2B | R |  |
| dichloromethane | yes | 2B | R | A3 |
| 2-(2,4-dichlorophenoxy)propionic acid |  | 2B |  |  |
| 1,3-dichloropropene (technical grade) (DCP) |  | 2B | R | A3 |
| dichlorvos |  | 2B |  |  |
| diepoxybutane, meso-1,2:3,4 |  | 2B | R |  |
| 1-1,2:3,4-diepoxybutane |  | 2B |  |  |
| diesel engine exhaust, and marine fuel, and distillate (light) |  | 2B | R |  |
| diethyl sulfate |  | 2A | R |  |
| di(2-ethylhexyl)phthalate (DEHP) |  |  |  | A3 |
| 1,2-diethylhydrazine |  | 2B |  |  |
| diethylstilbesterol (DES) |  | 1 | K |  |
| diglycidyl resorcinol ether |  | 2B | R |  |
| dihydrosafrole |  | 2B |  |  |
| dihydroxymethylfuratrizine |  | 2B |  |  |
| diisopropyl sulfate |  | 2B |  |  |
| 3,3’-dimethoxybenzidine (ortho-dianisidine) |  | 2B | R |  |
| 3,3’-dimethoxybenzidine dihydrochloride |  |  | R |  |
| dimethyl sulfate |  | 2A | R | A3 |
| trans-2-[(dimethylamino)methylimino]-5-[2-(5-nitro-2-furyl)vinyl]-1,3,4-oxadiazole |  | 2B |  |  |
| para-dimethylaminoazobenzene | yes | 2B | R |  |
| 2,6-dimethylaniline (2,6-xylidine) |  | 2B |  |  |
| 3,3’-dimethylbenzidine (o-tolidine) |  | 2B | R | A3 |
| dimethylcarbamoyl chloride |  | 2A | R | A2 |
| 1,1-dimethylhydrazine |  | 2B | R | A3 |
| 1,2-dimethylhydrazine |  | 2A |  |  |
| dimethylvinyl chloride |  |  | R |  |
| 3,7-dinitrofluorantene |  | 2B |  |  |
| 3,9-dinitrofluoranthene |  | 2B |  |  |
| 1,6-dinitropyrene, and 1,8 dinitropyrene |  | 2B | R |  |
| dinitrotoluene, 2,4 and 2,6 dinitrotoluene |  | 2B |  | A3 |

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| --- | --- | --- | --- | --- |
| **Chemical** | **OSHA** | **IARC** | **NTP** | ACGIH |
|  |  |  |  |  |
| 1,3-dichloropropene (technical grade) (DCP) |  | 2B | R | A3 |
| dichlorvos |  | 2B |  |  |
| diepoxybutane, meso-1,2:3,4 |  | 2B | R |  |
| 1-1,2:3,4-diepoxybutane |  | 2B |  |  |
| diesel engine exhaust, and marine fuel, and distillate (light) |  | 2B | R |  |
| diethyl sulfate |  | 2A | R |  |
| di(2-ethylhexyl)phthalate (DEHP) |  |  |  | A3 |
| 1,2-diethylhydrazine |  | 2B |  |  |
| diethylstilbesterol (DES) |  | 1 | K |  |
| diglycidyl resorcinol ether |  | 2B | R |  |
| dihydrosafrole |  | 2B |  |  |
| dihydroxymethylfuratrizine |  | 2B |  |  |
| diisopropyl sulfate |  | 2B |  |  |
| 3,3’-dimethoxybenzidine (ortho-dianisidine) |  | 2B | R |  |
| 3,3’-dimethoxybenzidine dihydrochloride |  |  | R |  |
| dimethyl sulfate |  | 2A | R | A3 |
| trans-2-[(dimethylamino)methylimino]-5-[2-(5-nitro-2-furyl)vinyl]-1,3,4-oxadiazole |  | 2B |  |  |
| para-dimethylaminoazobenzene | yes | 2B | R |  |
| 2,6-dimethylaniline (2,6-xylidine) |  | 2B |  |  |
| 3,3’-dimethylbenzidine (o-tolidine) |  | 2B | R | A3 |
| dimethylcarbamoyl chloride |  | 2A | R | A2 |
| 1,1-dimethylhydrazine |  | 2B | R | A3 |
| 1,2-dimethylhydrazine |  | 2A |  |  |
| dimethylvinyl chloride |  |  | R |  |
| 3,7-dinitrofluorantene |  | 2B |  |  |
| 3,9-dinitrofluoranthene |  | 2B |  |  |
| 1,6-dinitropyrene, and 1,8 dinitropyrene |  | 2B | R |  |
| dinitrotoluene, 2,4 and 2,6 dinitrotoluene |  | 2B |  | A3 |
| 1,4-dioxane |  | 2B | R | A3 |
| direct black 38 |  |  | K |  |
| direct blue 6 |  |  | K |  |
| disperse blue 1 |  | 2B | R |  |
| dry cleaning, (occupational exposures in) |  | 2B |  |  |
| engine exhaust, gasoline |  | 2B |  |  |
| epichlorohydrin |  | 2A | R | A3 |
| 1,2-epoxybutane |  | 2B |  |  |
| epstein-barr virus |  | 1 |  |  |
| erionite |  | 1 | K |  |
| estrogens (not conjugated), estradiol-17 beta, and estrone, and ethinylestradiol, and mestranol |  |  | R |  |
| ethyl acrylate |  | 2B | R |  |
| ethyl bromide |  |  |  | A3 |
| chloroethane (ethyl chloride) |  |  |  | A3 |

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| **Chemical** | **OSHA** | **IARC** | **NTP** | **ACGIH** |
| ethyl methanesulfonate |  | 2B | R |  |
| n-ethyl-N-nitrosourea |  | 2A | R |  |
| ethylene dibromide |  | 2A | R | A3 |
| ethylene oxide | Yes | 1 | K | A2 |
| ethylene thiourea |  | 2B | R |  |
| ethyleneimine (aziridine) | yes | 2B |  | A3 |
| foreign bodies implanted in tissue |  | 2B |  |  |
| formaldehyde gas | yes | 2A | R | A2 |
| 2-(2-formylhydrazino)-4-(5-nitro-2-furyl)thiazole |  | 2B |  |  |
| fowler’s solution |  | 1 |  |  |
| fuel oil, residual (heavy) |  | 2B |  |  |
| furan |  | 2B | R |  |
| furfural |  |  |  | A3 |
| furniture and cabinet making |  | 1 |  |  |
| fusarium moniliforme (toxins derived from) |  | 2B |  |  |
| gasoline, including unleaded |  | 2B |  | A3 |
| glass wool fibers |  | 2B | R | A3 |
| glu-p-1 (2-amino-6-methyldipyrido[1,2-a:3’,2’-d]imidazole |  | 2B |  |  |
| glu-p-2 (2-aminodipyrido[1,2-a:3’2’-d]imidazole |  | 2B |  |  |
| glycidaldehyde |  | 2B |  |  |
| glycidol |  |  | R | A3 |
| griseofulvin |  | 2B |  |  |
| hc blue #1 |  | 2B |  |  |
| hematite mining, underground with exposure to radon |  | 1 |  |  |
| hairdresser or barber, occupational exposure |  | 2A |  |  |
| helicobacter pylori, infection with |  | 1 |  |  |
| hepatitis b and c virus, (chronic infection with) |  | 1 |  |  |
| heptachlor, and heptachlor epoxide |  | 2B |  | A3 |
| hexachlorobenzene |  | 2B | R | A3 |
| hexachlorobutadiene (HCBD) |  |  |  | A3 |
| hexachlorocyclohexanes (all isomers) alpha, beta, gamma |  | 2B | R |  |
| hexachloroethane (perchloroethane) |  | 2B | R | A3 |
| hexamethylphosphoramide (HMPA) |  | 2B | R | A3 |
| hot mate |  | 2A |  |  |
| human t-cell lymphotropic virus type 1 |  | 1 |  |  |
| human immunodeficiency virus type 1 (infection with) |  | 1 |  |  |
| human immunodeficiency virus type 2 (infection with) |  | 2B |  |  |
| human papillomavirus type 16 and 18 |  | 1 |  |  |
| human papillomavirus type 31 and 33 |  | 2A |  |  |
| human papillomavirus type other than 16,18, 31 and 33 |  | 2B |  |  |
| hydrazine, methyl hydrazine |  | 2B | R | A3 |
| hydrazine sulfate |  |  | R |  |
| hydrazobenzene |  |  | R |  |
| hydrogen peroxide |  |  |  | A3 |
| hydroquinone |  |  |  | A3 |
| IQ (2-amino-3-methylimidazo[4,5-f]quinoline) |  | 2A |  |  |
| indeno[1,2,3-cd]pyrene |  | 2B | R |  |

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| **Chemical** | **OSHA** | **IARC** | **NTP** | **ACGIH** |
| iron and steel founding |  | 1 |  |  |
| iron-dextran complex |  | 2B | R |  |
| isophorone |  |  |  | A3 |
| isoprene |  | 2B | R |  |
| isopropanol manufacture (strong acid process) |  | 1 |  |  |
| kaposi’s sarcoma herpes virus/human herpes virus 8 |  | 2A |  |  |
| lasiocarpine |  | 2B |  |  |
| lead acetate, lead acetate (II) and trihydrate |  |  | R |  |
| lead and lead compounds, inorganic |  | 2B |  | A3 |
| lead chromate |  |  | K | A2 |
| lead chromate (VI) oxide |  | 1 | K |  |
| lead phosphate |  | 2B | R |  |
| lindane |  |  | R | A3 |
| MOPP & combined chemotherapy including alkylating agent |  | 1 |  |  |
| magenta, containing Cl basic red 9 |  | 2B |  |  |
| magenta, manufacture of |  | 1 |  |  |
| mea-alpha-c (2-amino-3-methyl-9H-pyrido[2,3-b]indole) |  | 2B |  |  |
| medroxyprogesterone acetate |  | 2B |  |  |
| MelQ (2-amino-3,4-dimethylimidazo[4,5f]quinoline |  | 2B |  |  |
| MelQx (2-amino-3,8-dimethylimidazo[4,5-f]quinoxaline |  | 2B |  |  |
| melphalan |  | 1 | K |  |
| merphalan |  | 2B |  |  |
| 5-methoxypsoralen |  | 2A |  |  |
| 8-methoxypsoralen (methoxsalen) plus uv radiation & uv (a) |  | 1 | K |  |
| methyl mercury compounds |  | 2B |  |  |
| methyl methanesulfonate |  | 2A | R |  |
| 2-methyl-1-nitroanthraquinone (uncertain purity) |  | 2B |  |  |
| n-methyl-N’-nitro-N-nitrosoguanidine (MNNG) |  | 2A | R |  |
| n-methyl-N-nitrosourea (N-nitroso-N-methylurea) |  | 2A | R |  |
| n-methyl-N-nitrosourethane |  | 2B |  |  |
| methyl-tert butyl ether |  |  |  | A3 |
| 2-methylaziridine (propyleneimine) |  | 2B | R | A3 |
| methylazoxymethanol, and its acetate |  | 2B |  |  |
| 5-methylchrysene |  | 2B | R |  |
| 4,4’-methylene bis(2-chloroaniline) (MBOCA) |  | 2A | R | A2 |
| 4,4’-methylene bis(2-methylaniline) |  | 2B |  |  |
| 4,4’-methylene bis(n,n-dimethyl)benzenamine |  |  | R |  |
| 4,4’-methylenedianiline | yes | 2B | R | A3 |
| 4,4’-methylenedianiline dihydrochloride |  |  | R |  |
| methylthiouracil |  | 2B |  |  |
| metronidazole |  | 2B | R |  |
| michler’s ketone |  |  | R |  |
| mineral oil, petroleum residual oils, acid treated, condensates |  | 1 |  |  |
| mineral oil, petroleum distillates, acid treated heavy naphthenic |  | 1 |  |  |

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| **Chemical** | **OSHA** | **IARC** | **NTP** | ACGIH |
| mineral oil, petroleum distillates, acid treated heavy paraffinic |  | 1 |  |  |
| mineral oil, petroleum distillates, acid treated light naphthenic |  | 1 |  |  |
| mineral oil, petroleum distillates, acid treated light paraffinic |  | 1 |  |  |
| mineral oil, petroleum distillates, heavy & light naphthenic |  | 1 |  |  |
| mineral oil, petroleum distillates, heavy & light paraphinic |  | 1 |  |  |
| mineral oil, petroleum distillates, hydrotreated heavy paraffinic |  | 1 |  |  |
| mineral oil, petroleum distillates, hydrotreated light paraffinic |  | 1 |  |  |
| mineral oil, petroleum distillates, solvent-dewaxed heavy or light naphthenic (mild or no solvent-refining or hydrotreatment) |  | 1 |  |  |
| mineral oil, petroleum distillates, solvent-dewaxed heavy paraffinic (mild or no solvent-refining or hydrotreatment) |  | 1 |  |  |
| mineral oil, petroleum distillates, solvent-refined (mild) heavy or light paraffinic |  | 1 |  |  |
| mineral oil, petroleum distillates, solvent-refined (mild) light naphthenic |  | 1 |  |  |
| mineral oil, petroleum extracts, heavy or light naphthenic distillate solvent |  | 1 |  |  |
| mineral oil, petroleum extracts, light or heavy paraffinic distillate solvent |  | 1 |  |  |
| mineral oil, petroleum extracts, residual oil solvent |  | 1 |  |  |
| mineral oil, petroleum naphthenic oils, catalytic dewaxed heavy or light (mild or no solvent-refining or hydrotreatment) |  | 1 |  |  |
| mineral oil, petroleum paraffin oils, catalytic dewaxed heavy (mild or no solvent-refining hydrotreatment) |  | 1 |  |  |
| mineral oil, petroleum distillates, hydrotreated (mild) heavy or light naphthenic |  | 1 |  |  |
| mineral oil, petroleum distillates, solvent-dewaxed light paraffinic (mild or no solvent-refining or hydrotreatment) |  | 1 |  |  |
| mineral oil, petroleum distillates, solvent-refined (mild) heavy naphthenic |  | 1 |  |  |
| mineral oils, untreated and mildly treated |  | 1 | K |  |
| mirex |  | 2B | R |  |
| mitomycin c |  | 2B |  |  |
| molybdate orange |  | 1 |  |  |
| molybdenum as Mo (soluble compounds) |  |  |  | A3 |
| monocrotaline |  | 2B |  |  |
| 5-(morpholinomethyl)-3-[(5-nitrofurfurylidene)amino]-2-oxazolidinone |  | 2B |  |  |
| mustard gas |  | 1 | K |  |
| nafenopin |  | 2B |  |  |
| 2-naphthylamine (alpha & beta) (aminonaphthalene) | yes | 1 | K | A1 |
| nickel alloy, Ni 47-59, Co 17-20, Cr 13-17, Mo 4.5-5.7, Al 3.7-4.7, Ti 3-4, Fe 0-1, C 0-0.1 (AISI 687) |  | 2B |  |  |
| nickel biscyclopentadiene |  |  | R |  |
| nickel carbonyl (as Ni) |  |  | R |  |
| nickel compounds |  | 1 | R |  |
| nickel hydroxide, nickel (II) hydroxide, nickel (III) hydroxide |  |  | R |  |

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| **Chemical** | **OSHA** | **IARC** | **NTP** | **ACGIH** |
| nickel sulfide (3:2) |  |  | R | A1 |
| nickel (II) acetate (1:2) |  |  | R |  |
| nickel (II) carbonate (1:1) |  |  | R |  |
| nickel (II) oxide (1:1) |  |  | R |  |
| nickel, insoluble compounds, as Ni |  |  |  | A1 |
| nickel, compound with pi-cyclopentadienyl (1:2) |  |  | R |  |
| nickel, metallic and alloys |  | 2B | R |  |
| niridazole |  | 2B |  |  |
| nitrilotriacetic acid and its salts |  | 2B | R |  |
| nitrilotriacetic acid disodium salt monohydrate |  | 2B |  |  |
| nitrilotriacetic acid monosodium salt |  | 2B |  |  |
| nitrilotriacetic acid sodium salt |  | 2B |  |  |
| nitrilotriacetic acid trisodium salt monohydrate |  | 2B |  |  |
| nitrilotriacetic acid disodium salt and trisodium salt |  | 2B |  |  |
| N-[4-(5-nitro-2-furyl)-2-thiazolyl]acetamide |  | 2B |  |  |
| 5-nitroacenaphthene |  | 2B |  |  |
| 2-nitroanisole |  | 2B | R |  |
| nitrobenzene |  | 2B |  | A3 |
| 4-nitrobiphenyl | yes |  |  | A2 |
| p-nitrochlorobenzene |  |  |  | A3 |
| 6-nitrochrysene |  | 2B | R |  |
| nitrofen, (technical-grade) |  | 2B | R |  |
| 2-nitrofluorene |  | 2B |  |  |
| 1-[(5-nitrofurfurylidene)amino]-2-imidazolidinone |  | 2B |  |  |
| nitrogen mustard, and hydrochloride |  | 2A | R |  |
| nitrogen mustard N-oxide, and N-oxide hydrochloride |  | 2B |  |  |
| Nitromethane |  |  |  | A3 |
| 2-nitropropane |  | 2B | R | A3 |
| 1-nitropyrene, and 4-nitropyrene |  | 2B | R |  |
| N-nitroso-N-ethylurea |  |  | R |  |
| n-nitrosobutylbutanolamine |  |  | R |  |
| n-nitrosobutylcarboxypropylamine |  |  | R |  |
| N-nitrosodi-n-butylamine |  | 2B | R |  |
| N-nitrosodi-n-propylamine |  | 2B | R |  |
| N-nitrosodiethanolamine |  | 2B | R |  |
| n-nitrosodiethylamine |  | 2A | R |  |
| n-nitrosodimethylamine | yes | 2A | R | A3 |
| 4-(N-nitrosomethylamino)-1-(3-pyridyl)-1-butanone (NNK) |  | 2B | R |  |
| 3-(N-nitrosomethylamino)propionitrile |  | 2B |  |  |
| N-nitrosomethylethylamine |  | 2B |  |  |
| N-nitrosomethylvinylamine |  | 2B | R |  |
| N-nitrosomorpholine |  | 2B | R |  |
| N’-nitrosonornicotine |  | 2B | R |  |
| N-nitrosopiperidine |  | 2B | R |  |
| N-nitrosopyrrolidine |  | 2B | R |  |
| N-nitrososarcosine |  | 2B | R |  |

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| **Chemical** | **OSHA** | **IARC** | **NTP** | ACGIH |
| norethisterone |  |  | R |  |
| ochratoxin A |  | 2B | R |  |
| oestrogen-proestrogen therapy, postmenopausal |  | 2B |  |  |
| oestrogens, steroidal and nonsteroidal |  | 1 |  |  |
| oil orange SS |  | 2B |  |  |
| opisthorchis viverrini (infection with) |  | 1 |  |  |
| oral contraceptives, sequential and combined |  | 1 |  |  |
| oxazepam |  | 2B |  |  |
| 4,4’-oxydianiline |  |  | R |  |
| oxymetholone |  |  | R |  |
| painter (occupational exposure as a) |  | 1 |  |  |
| palygorskite (attapulgite) (long fibers, >5 micrometers |  | 2B |  |  |
| panfuran S (containing dihydroxymethylfuratrizine) |  | 2B |  |  |
| pentachlorobiphenyl |  |  | R |  |
| pentachlorophenol |  |  |  | A3 |
| petroleum refining (occupational exposures in) |  | 2A |  |  |
| petroleum residues, thermal cracked |  | 2A |  |  |
| phenacetin |  | 2A | R |  |
| phenazopyridine hydrochloride |  | 2B | R |  |
| phenobarbital |  | 2B |  |  |
| phenolphthalein |  |  | R |  |
| phenoxybenzamine hydrochloride |  | 2B | R |  |
| phenyl glycidyl ether |  | 2B |  | A3 |
| o-phenylenediamine |  |  |  | A3 |
| phenylhydrazine |  |  |  | A3 |
| phenytoin |  | 2B | R |  |
| PhlP (2-amino-1-methyl-6-phenyl-imidazo[4,5-b]pyridine |  | 2B |  |  |
| pickled vegetables (traditional in Asia) |  | 2B |  |  |
| piperazine estrone sulfate (conjugated estrogen) |  |  | K |  |
| polybrominated biphenyl (FF-1), and (PBBs), firemaster BP-6, octabromobiphenyl |  | 2B | R |  |
| polychlorinated biphenyl (aroclor 1254) |  | 2A | R | A3 |
| polychlorinated biphenyl (aroclor 1260), and kanechlor |  |  | R |  |
| polychlorinated biphenyl [PCBs] |  | 2A | R |  |
| polychlorophenols and their sodium salts (mixed exposures) |  | 2B |  |  |
| polycyclic aromatic hydrocarbons (PAHs) |  |  | R |  |
| ponceau 3r |  | 2B |  |  |
| ponceau mx |  | 2B |  |  |
| potassium bromate |  | 2B |  |  |
| potassium chromate (VI), and dichromate (VI) |  | 1 | K |  |
| printing processes (occupational exposures in) |  | 2B |  |  |
| procarbazine hydrochloride |  | 2A | R |  |
| progesterone |  |  | R |  |
| progestins |  | 2B |  |  |
| progestrogen-only contraceptives |  | 2B |  |  |
| 1,3-propane sultone |  | 2B | R | A3 |

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| beta-propiolactone | yes | 2B | R | A3 |
| propoxur (baygon) |  |  |  | A3 |
| propylene oxide |  | 2B | R | A3 |
| propylthioracil |  | 2B | R |  |
| radon and its decay products |  | 1 | K |  |
| reserpine |  |  | R |  |
| rock wool fibers |  | 2B |  | A3 |
| rubber industry |  | 1 |  |  |
| saccharin, and saccharin sodium salt |  | 2B | R |  |
| saccharin calcium |  |  | R |  |
| safrole |  | 2B | R |  |
| salted fish (Chinese style) |  | 1 |  |  |
| schistosoma haematobium (infection with) |  | 1 |  |  |
| schistosoma japonicum (infection with) |  | 2B |  |  |
| selenium sulfide |  |  | R |  |
| senarmontite |  | 2B |  |  |
| shale-oils |  | 1 |  |  |
| silica, crystalline (respirable) |  | 1 | K |  |
| silica, crystalline cristobalite, tridymite & quartz |  | 2A | K | A2 |
| silica, crystalline tripoli |  | 2A |  |  |
| silicic acid, beryllium salt |  | 1 |  |  |
| slag wool fibers |  | 2B |  | A3 |
| sodium dichromate (VI) |  | 1 | K |  |
| sodium ortho-phenylphenate |  | 2B |  |  |
| solar radiation |  | 1 |  |  |
| soots |  | 1 | K |  |
| sterigmatocystin |  | 2B |  |  |
| streptozotocin |  | 2B | R |  |
| strontium chromate (VI) |  | 1 | K | A2 |
| styrene |  | 2B |  |  |
| styrene-7,8-oxide |  | 2A |  |  |
| sulfallate |  | 2B | R |  |
| sulfur trioxide |  | 1 |  |  |
| sulfuric acid, strong inorganic mists, occupational exposure to |  | 1 |  | A2 |
| sunlamps and sunbeds |  | 2A |  |  |
| synthetic vitreous fibers |  |  |  | A2 |
| Talc (containing asbestos or asbestiform fibers) |  | 1 |  | A1 |
| tamoxifen |  | 1 | K |  |
| Tars |  | 1 | K |  |
| 2,3,7,8-tetrachlorodibenzo-para-dioxin (TCDD) (dioxin) |  | 1 | K |  |
| 1,1,2,2-tetrachloroethane |  |  |  | A3 |
| tetrachloroethylene (perchloroethylene) |  | 2A | R | A3 |
| tetrafluoroethylene |  | 2B | R | A3 |
| tetranitromethane |  | 2B | R | A3 |
| textile manufacturing industry (work in) |  | 2B |  |  |
| thioacetamide |  | 2B | R |  |

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| **Chemical** | **OSHA** | **IARC** | **NTP** | **ACGIH** |
| 4,4’-thiodianiline |  | 2B |  |  |
| thiotepa |  | 2A | K |  |
| thiourea |  | 2B | R |  |
| thorium dioxide |  |  | K |  |
| tobacco smoke, tobacco products, smokeless |  | 1 | K |  |
| 2,6-toluene diisocyanate, and 2,4- |  | 2B |  |  |
| toluene diisocyanate (mixed isomers) |  | 2B | R |  |
| o-toluenesulfonamide |  | 2B |  |  |
| p-toluidine |  |  | R | A3 |
| o-toluidine hydrochloride |  |  | R |  |
| ortho-toluidine |  | 2B | R | A3 |
| toxaphene (polychlorinated camphenes) |  | 2B | R | A3 |
| Treosulphan |  | 1 |  |  |
| trichlormethine (trimustine hydrochloride) |  | 2B |  |  |
| trichloroacetic acid |  |  |  | A3 |
| 1,1,2-trichloroethane |  |  |  | A3 |
| trichloroethylene (ethylene trichloride) |  | 2A | R |  |
| 2,4,6-trichlorophenol |  |  | R |  |
| 1,2,3-trichloropropane |  | 2A | R | A3 |
| tris(2,3-dibromopropyl)phosphate |  | 2A | R |  |
| trp-P-1(3-amino-1,4-dimethyl-5H-pyrido[4,3-b]indole) |  | 2B |  |  |
| trp-P-2(3-amino-1-methyl-5H-pyrido[4,3-b]indole |  | 2B |  |  |
| trypan blue |  | 2B |  |  |
| ultraviolet radiation A, and B, and C |  | 2A |  |  |
| uracil mustard |  | 2B |  |  |
| uranium (as U) |  |  |  | A1 |
| urethane |  | 2B | R |  |
| vm & p naphtha |  |  |  | A3 |
| valentinite |  | 2B |  |  |
| vinyl acetate |  | 2B |  | A3 |
| vinyl bromide |  | 2A |  | A2 |
| vinyl chloride | yes | 1 | K | A1 |
| 4-vinyl cyclohexene |  | 2B |  | A3 |
| vinyl fluoride |  | 2A |  | A2 |
| 4-vinyl-1-cyclohexene diepoxide |  | 2B | R | A3 |
| welding fumes |  | 2B |  |  |
| wood dust (certain hard woods as beech & oak) |  | 1 |  | A1 |
| xylidine |  |  |  | A3 |
| zinc chromate (VI) |  | 1 | K | A1 |
| zinc chromate (VI) hydroxide |  | 1 |  |  |
| zinc chromates as Cr (zinc potassium chromate) |  |  |  | A1 |
| zinc chromates as Cr (zinc yellow) |  |  |  | A1 |

|  |  |
| --- | --- |
| **OSHA-** Occupational Safety and Health Administration, U.S. Department of Labor  OSHA regulated chemicals marked with “yes” | **NTP-** National Toxicology Program, U.S. Department of Health and Human Services Group K: known to be human carcinogensGroup R: reasonably anticipated to be human carcinogens |
| **IARC-** International Agency for Research on Cancer Group 1: carcinogenic to humans Group 2A: probably carcinogenic to humans  Group 2B:possibly carcinogenic to humans | **ACGIH-** American Conference of Governmental Industrial Hygienists Group A1: confirmed human carcinogen Group A2: suspected human carcinogen  Group A3: confirmed animal carcinogen with unknown relevance to humans |

23.4 APPENDIX III - Table 11. Reproductive Toxins

Partial List of Reproductive Toxins

(From: “Reproductive Hazards of the Workplace” by Linda M. Frazier, MD, MPH & Marvin L. Hage, MD)

|  |  |
| --- | --- |
| CHEMICAL / ROUTE OF ENTRY | COMMENTS / POTENTIAL PROBLEMS |
| acrylamide [resp/skin] | animal-decrease copulatory behavior & fertility, possible fetotoxin |
| acrylates [resp/skin] | animal-possible fetotoxin, decrease in fetal size |
| aflatoxin B1 [oral/resp] | human-mutagen, decrease male fertility, animal-teratogen, fetotoxin, decrease sperm counts, increase sperm abnormalities |
| aldicarb [resp/skin/oral] | human-at near toxic levels may cause stillbirth |
| aluminum [resp] | animal-neurotoxin mid to late term |
| ammonia [resp] | human-spermicide |
| anesthetic gases (enflurane, halothane, nitrous oxide) [resp] | human-decrease in female fertility when exposed to nitrous oxide > 5 hours a week, mixed gases may increase chance of spontaneous abortion, decrease birth weight, animal-teratogen, embryotoxin, nitrous oxide- reduced sperm counts, mixed gases-possible reduced fertility, |
| aniline & derivatives [resp/skin] | human-possible menstrual & ovarian disorders, reduction of , maternal and fetal blood oxygen |
| antimony [resp] | animal-increase spontaneous abortion rate |
| antineoplastic agent [resp/oral/skin] | human-testicular & ovarian dysfunction, permanent sterility, increased rate of spontaneous abortion, ectopic pregnancy, decrease birth weight, animal-teratogen, embryolethal |
| arsine [resp] | animal-teratogen |
| arsenic [resp/skin/oral] | human-possible chromosomal and testicular toxin, increased rate of spontaneous abortion, teratogen, mutagen, fetotoxin |
| barium [resp/oral] | animal-soluble compound (carbonate, chloride) acute testicular toxicity |
| benomyl [resp/oral] | human-possible teratogen, animal-possible teratogen, testicular toxin, increase rate of post implantation mortality, |
| benzene [resp/skin] | animal-fetal death, delayed ossification |
| beryllium [resp] | possible human mutagen (sperm), fetal stunting, pre-implantation mortality |
| boric acid [skin/resp] | animal-high dose tests- borax is testicular toxin, female impaired fertility |
| 1,3-butadiene [resp] | human-increased rate of abnormal sperm, animal-reduced fetal weight |
| cadmium [resp/oral] | human mutagen, decrease in motility counts, testicular necrosis, may prevent egg implantation, increase stillbirth rate, animal-teratogen, fetotoxic |
| captan [oral/resp] | human-mutagen, possible teratogen, animal-possible teratogen, testicular toxin, increase post implant mortality |
| carbaryl [oral/resp/skin] | human-weak mutagen, animal-increased rate of sperm abnormality, decreased sperm counts & function, teratogen only at toxic levels |
| carbon disulfide [resp/skin] | human-reduced male libido, alterations of menstrual cycle, increased rate of spontaneous abortion and neurobehavioral abnormalities after birth |
| carbon monoxide [resp] | human-fetal asphyxiation, increased rate of neurological abnormalities, malformations, animal-reduced fetal weight, |
| chlordecone [skin/resp/oral/ocular] | human-decreased motility, animal-reduced male fertility, reduced litter size, increase in mouse resorptions, subtle neurobehavioral changes |
| chlorine dioxide, chlorite, chlorate [resp/skin/oral] | animal-reduced weight between birth and weaning |
| chloroform [resp/skin] | animal-increased rate of fetal loss, reduced fertility |
| chloroprene [resp] | human-possible increase in spontaneous abortion rate , animal-reduced male fertility |
| chlorpryrifos [oral/skin] | animal-near lethal doses decrease sperm motility, possible neurotoxin |
| chromium [resp] | human genotoxin, decreased motility counts |
| cobalt [resp] | animal-seminiferous tubule degeneration |
| copper [resp] | human-direct contact is toxic to sperm, low motility counts |

23.4 APPENDIX III - Table 11. Reproductive Toxins (Continued)

Partial List of Reproductive Toxins

(From: “Reproductive Hazards of the Workplace” by Linda M. Frazier, MD, MPH & Marvin L. Hage, MD)

|  |  |
| --- | --- |
| CHEMICAL / ROUTE OF ENTRY | COMMENTS / POTENTIAL PROBLEMS |
| cyfluthrin [oral/resp/skin] | animal-large exposures through pregnancy caused neurological dysfunction |
| cypermethrin [oral/resp] | animal-large exposures through pregnancy caused neurological dysfunction |
| 2,4-D [skin] | human-(reversible) abnormal sperm, animal-possible teratogen at toxic levels |
| DDT [resp/ocular/skin/oral] | human-possible male infertility, |
| DEET (N,N-diethyl-m-toluamide) [skin/oral] | human-at (maternal) high dose exposures there is an increase in acute neurotoxic symptoms in children |
| diazinon [oral/skin] | animal-teratogen, reduced genital weight, decreased motility, increase in sperm mortality |
| dibromochloropropane [oral/skin/resp] | human-testicular damage, animal-mutagen, genotoxin |
| dicamba [skin/resp] | animal-(single study) induced unscheduled DNA synthesis |
| 1,3-dichloropropene and 1,2-dichloropropane [resp/skin] | animal-mutagen, causes testicular degeneration, reduced sperm counts, abnormal sperm |
| dimethylformamide [resp/skin] | human-possible testicular cancer, inconsistent data indicates teratogen |
| epichlorhydrin [resp/skin] | animal-male reproductive toxin, sterility, |
| ethidium bromide [skin/resp] | animal-mutagen, embryotoxin |
| ethyl alcohol [resp/oral/skin] | human-high doses suggest an increased rate of miscarriages & stillbirths, fetal alcohol syndrome, occupational exposure problems rarely encountered |
| ethylene bisdithiocarbamate [resp] | animal-possible teratogen near lethal dose |
| ethylene oxide [resp] | human-teratogen, increased rate of spontaneous abortions, animal-teratogen, testicular toxin, increased rate of sterility, decreased fertility |
| formaldehyde [resp] | human-one study suggests a slight % increase in spontaneous abortion and subtle neurobehavioral abnormalities, animal-decreased sperm motility, reduced fetal & maternal weight |
| glutaraldehyde [resp/oral/skin] | animal-cytotoxin (bacteria) |
| glycidyl ethers [skin/resp] | animal-testicular atrophy |
| glyphosate [oral/skin] | animal-sperm count reduction at high concentrations |
| hair dyes [skin] | human-may cause neuroblastoma, animal-bacterial mutagen (coal tar) |
| hexachlorobenzene [oral/resp] | human-long half life, excessive exposures can result from breast milk, animal-menstrual irregularities, neonatal lethality at high doses |
| hexane (n-) [resp] | animal-testicular toxin, reduced fetal weight |
| hydrazine & derivatives [resp] | animal-abnormal sperm, reduced fetal weight, increased rate of resorptions, |
| hydrogen cyanide [resp/skin] | animal-impaired spermatogenesis & fertility, reduced brain function |
| hydrogen sulfide [resp] | human-fetal asphyxiation, increased rate of menstrual irregularities, |
| hydroquinone [resp/skin] | animal-reduced testicular weight, increased rate of resorptions, recent studies suggest that hydroquinone is not a reproductive toxin |
| indium [resp] | animal-teratogen, testicular and sperm abnormalities |
| iron [resp] | human-decline in semen parameters, |
| isocyanates [resp] | human-increased risk of spontaneous abortion and stillbirths, animal-male decrease in successful matings, female persistent diestrus, increased rate of resorptions, |
| lead [resp/oral/skin] | human-decrease in motility counts, increased rate of preterm deliveries, stillbirths, neurological abnormalities |
| lindane [resp/skin] | animal-testicular degeneration, altered fetal steroid metabolism |
| malathion [oral/skin] | human-(applicators) increase in chromosomal abnormalities, animal-testicular atrophy |

23.4 APPENDIX III - Table 11. Reproductive Toxins (Continued)

Partial List of Reproductive Toxins

(From: “Reproductive Hazards of the Workplace” by Linda M. Frazier, MD, MPH & Marvin L. Hage, MD)

|  |  |
| --- | --- |
| CHEMICAL / ROUTE OF ENTRY | COMMENTS / POTENTIAL PROBLEMS |
| manganese [resp] | human-possible decline in sperm parameters (excessive exposure & manganese deficient), animal-adverse neurodevelopmental effects from breast milk, retarded offspring growth |
| mercury [resp/oral/skin] | human-mutagen, teratogen, neurotoxin, increased rate of spontaneous abortion, embryolethal, menstrual irregularities |
| methyl alcohol [resp/oral/skin] | animal-decrease testicle size, reduced sperm counts, high dose (inhale >5,000 ppm) teratogen, |
| methyl bromide [resp] | animal-(high dose studies near toxic levels) mutagen, genotoxin |
| methyl chloride [resp] | animal-reduced male fertility, testicular degeneration, heart valve defects |
| methyl ethyl ketone [resp] | animal-at high doses (3,000 ppm-7 hour days) minor birth defects |
| methylene chloride [resp/skin] | animal-fetotoxic, neurologic deficits because it is metabolized into CO |
| methylpyrrolidone (N)[resp/skin] | animal-fetotoxin |
| molybdenum [resp/oral] | human-mutagen, animal-embryolethal |
| nickel [resp/oral] | human-mutagen, decline in semen parameters, animal-embryolethal, increased rate of fetal growth retardation and skeletal anomalies |
| nitriles [resp/skin] | animal-teratogen, reduced sperm counts, increased rate of resorptions, |
| nitrates, nitrites & organic nitro compounds [resp/skin/oral] | human-reduced oxygen uptake causing oxygen debt, animal-testicular toxin, abortifacient |
| paraquat [resp/oral/skin] | animal-mutagen, embryotoxin |
| pentamidine [resp/skin/oral] | animal-increased rate of resorptions |
| perchloroethylene [resp] | human-possible increased rate of spontaneous abortion (only a few studies were completed) |
| permethrin [oral/resp] | animal-large exposures through pregnancy caused neurological dysfunction |
| phenol [skin/resp/oral] | animal-minimal embryotoxin |
| phenoxyacid herbicides [oral] | animal-fetotoxin at high doses |
| phthalates [oral/resp/skin] | animal-possible teratogen, testicular toxin, increased rate of resorptions & stillbirths |
| polybrominated biphenyls [oral/skin/resp] | animal-possible prolonged menstrual cycles, blocked implantation, increased rate of resorptions, increased fetal liver weight |
| polychloronated biphenyls [skin/oral] | human-hyperpigmentaion, possible reduction of birth weights do to shortened gestation, neurological delay, animal-testicular toxin, reduced female conception rates, fetotoxin at high dose, decrease birth weight, |
| polycyclic aromatic hydrocarbons [resp/oral] | animal-gonadotoxin, increased rate of stillbirths & resorptions, |
| providone-iodine [skin/oral] | human-possible fetal goiter due to elevated iodine levels |
| selenium [resp/oral] | animal-teratogen, embryolethal |
| sodium azide [oral/resp] | animal-embryotoxin, increased rate of resorptions |
| styrene [resp/skin] | human-associated with sperm abnormalities, menstrual disorders, animal-possible genotoxin |
| tellurium [resp] | human-does not cross the placenta, animal-mutagen |
| thallium [resp/oral/skin] | human-induces abortion, absorbed by testicles, animal-lethal mutagen, teratogen |
| tin [resp/skin] | animal-possible increase in subtle neurological & skeletal deformities |
| titanium dioxide [resp] | animal-embryolethal, reduction in litter sizes |
| toluene [resp/skin] | human-increased rate of spontaneous abortion at 50-150 ppm TWA, intentional inhalation-microcephali, growth retardation, learning delayed |
| 1,1,1-trichloroethane [resp/skin] | human-acute exposure at high concentrations cause fetal death (drug abuse) |
| trichloroethylene [resp/skin] | human-decreased libido, increase in menstrual disorders at levels that effect CNS |
| tungsten [resp] | animal-possible embryolethal (single study) |

23.4 APPENDIX III - Table 11. Reproductive Toxins (Continued)

Partial List of Reproductive Toxins

(From: “Reproductive Hazards of the Workplace” by Linda M. Frazier, MD, MPH & Marvin L. Hage, MD)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CHEMICAL / ROUTE OF | | | | COMMENTS / POTENTIAL PROBLEMS |
| ENTRY | | | |  |
| uranium | [resp/oral] | | | animal-nephrotoxin, genotoxin (from radiation) |
| vanadium pentoxide | | | [resp] | animal-mutagen (at high doses), decrease in fertility rates |
| vinyl chloride | | [resp] | | human-increased rate of impotence, decreased libido, decreased |
|  | |  | | testosterone, change in menstrual cycles, pregnancy complications |
| xylene | | [resp/skin] | | animal-increased rate of abnormal sperm, may also be genotoxic and |
|  | |  | | mutagenic (rats only) |
| zinc chloride & oxide [resp] | | | | human-deficiency is teratogenic and can cause behavioral abnormalities, |
|  | | | | zinc salts are spermicidal |

|  |
| --- |
|  |

23.4 APPENDIX III - Table 12. Toxic Metals and Metal Compounds

Partial List of Toxic Metals and Metal Compounds

Antimony, antimony compounds

Arsenic, arsenic compounds, arsine

Barium, soluble compounds, sulfate

Beryllium, compounds

Boron, borates, boron halides

Cadmium, salts

Chromium, compounds

Germanium tetrahydride

Indium, compounds

Iron salts, soluble

Lead, salts, organo compounds

Manganese compounds

Mercury metal, compounds, organo compounds

Molybdenum compounds

Nickel compounds

Osmium compounds, tetroxide

Rhodium compounds

Selenium compounds

Silver compounds, soluble

Tellurium compounds

Thallium compounds, soluble

Tin compounds, inorganic and organic

Tungsten compounds, soluble

Uranium compounds

Yttrium metal and compounds

Zinc, chromates, oxide dust

Zirconium compounds

23.4 APPENDIX III - Table 13. Definitions of High Degree of Acute Toxicity

Compounds with a High Degree of Acute Toxicity

**Toxic Highly Toxic**

Oral LD50 50-500 mg/kg <50 mg/kg

(albino rats)

Skin Contact LD50 200-1000 mg/kg <200 mg/kg

(albino rabbits)

Inhalation LD50 200-2000 ppm/air <200 ppm/air

(albino rats)

23.4 APPENDIX III - Table 14. Chemicals with High Acute Toxicity

|  |  |  |
| --- | --- | --- |
| Acrolein | Ethylene Fluorohydrin | Osmium Tetroxide |
| Acrylyl Chloride | Fluorine | Oxygen Difluoride |
| 2-Aminopyridine | Hexamethylene Diisocyanate | Ozone |
| Arsenic Pentafluoride | Hexamethyl Phoshoramide | Pentaborane |
| Arsine | Iodine | Perchloromethyl Mercaptan |
| Benzyl Chloride | Iron Pentacarbonyl | Phosgene |
| Boron Trifluoride | Isopropyl Formate | Phosphine |
| Bromine | Methacryloyl Chloride | Phosphorous Oxychloride |
| Chlorine | Methacryloxyethyl Isocyanate | Phosphorous Pentafluoride |
| Chlorine Dioxide | Methyl Acrylonitrile | Phosphorous Trichloride |
| Chlorine Trifluoride | Methyl Chloroformate | Sarin |
| Chlorpicrin | Methyl Mercaptan | Selenium Hexafluoride |
| Cyanogen Chloride | Methylene Biphenyl Isocyanate | Silicon Tetrafluoride |
| Cyanuric Fluoride | Methyl Fluoroacetate | Stibine |
| Decaborane | Methyl Fluorosulfate | Sulfur Monochloride |
| Diazomethane | Methyl Hydrazine | Sulfur Pentafluoride |
| Diborane | Methyltrichlorosilane | Sulfur Tetrafluoride |
| Dichloro Acetylene | Methyl Vinyl Ketone | Sulfuryl chloride |
| Dimethyl Disulfide | Nickel Carbonyl | Tellurium Hexafluoride |
| Dimethyl Sulfate | Nitrogen Tetroxide | Thionyl Chloride |
| Dimethyl Sulfide | Nitrogen Trioxide |  |
| Ethylene Chlorohydrin | Organo Tin Compounds |  |

23.4 APPENDIX III - Table 15. Class 4 Chemical Hazards

Examples of Chemicals Listed as Hazards under NFPA 49

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Chemical Name | Health Rating | Flammability Rating | Reactivity Rating | Additional Hazards |
| 3 - Bromopropyne | 3 | 3 | 4 |  |
| Acetaldehyde | 3 | 4 | 2 |  |
| Acetone Cyanohydrin, stabilized | 4 | 2 | 2 |  |
| Acetylene | 0 | 4 | 3 |  |
| Acrolein, inhibited | 4 | 3 | 3 |  |
| Acrylonitrile, inhibited | 4 | 3 | 2 |  |
| Allyl alcohol | 4 | 3 | 1 |  |
| Allylamine | 4 | 3 | 1 |  |
| Aluminum alkyls | 3 | 4 | 3 | water reactive |
| Aluminum phosphide | 4 | 4 | 2 | water reactive |
| Ammonium perchlorate | 1 | 0 | 4 | oxidizing |
| Antimony pentafluoride | 4 | 0 | 1 |  |
| Arsenic pentafluoride | 4 | 0 | 1 |  |
| Arsine | 4 | 4 | 2 |  |
| Boron trifluoride | 4 | 0 | 1 |  |
| Bromine pentafluoride | 4 | 0 | 3 | water reactive, oxidizing |
| Bromine trifluoride | 4 | 0 | 3 | water reactive, oxidizing |
| Butadienes, inhibited | 2 | 4 | 2 |  |
| Butyllithium | 3 | 4 | 2 | water reactive |
| Carbon disulfide | 3 | 4 | 0 |  |
| Carbon monoxide | 3 | 4 | 0 |  |
| Chlorine | 4 | 0 | 0 | oxidizing |
| Chlorine trifluoride | 4 | 0 | 3 | water reactive, oxidizing |
| Chlorodinitrobenzenes | 3 | 1 | 4 |  |
| Chloropicrin | 4 | 0 | 3 |  |
| Chlorosulfonic acid | 4 | 0 | 2 | water reactive, oxidizing |
| Crotonaldehyde, stabilized | 4 | 3 | 2 |  |
| Cyanogen bromide | 4 | 0 | 1 |  |
| Cyanogen, liquified | 4 | 4 | 2 |  |
| Diborane | 4 | 4 | 3 | water reactive |
| Dichlorodimethyl ether | 4 | 3 | 1 |  |
| Dichlorosilane | 4 | 4 | 2 | water reactive |
| Diethyl ether | 1 | 4 | 1 |  |
| Diethyl telluride | 1 | 4 | 3 | water reactive |
| Diethylaluminum chloride | 3 | 4 | 3 | water reactive |
| Diethylzinc | 3 | 4 | 3 | water reactive |
| Diketene, inhibited | 4 | 2 | 2 |  |
| Dimethyl ether | 1 | 4 | 1 |  |
| Dimethyl sulfate | 4 | 2 | 0 |  |
| Dimethylamine, anhydrous | 3 | 4 | 0 |  |
| Dimethylamine, solution | 3 | 4 | 0 |  |
| Dimethylhydrazine, unsymetrical | 4 | 3 | 1 |  |
| Dinitrobenzenes | 3 | 1 | 4 |  |
| Ethyl methyl ether | 1 | 4 | 4 |  |
| Ethyl nitrite solutions | 3 | 4 | 4 |  |
| Ethylamine | 3 | 4 | 0 |  |
| Ethylchloroformate | 4 | 3 | 1 |  |
| Ethylene chlorohydrin | 4 | 2 | 0 |  |
| Ethylene oxide | 3 | 4 | 3 |  |
| Ethylene, compressed | 1 | 4 | 2 |  |
| Ethylenimine, inhibited | 4 | 3 | 3 |  |
| Chemical Name | Health Rating | Flammability Rating | Reactivity Rating | Additional Hazards |
| Fluorine, compressed | 4 | 0 | 4 | water reactive |
| Formaldehyde, flammable | 3 | 4 | 0 |  |
| Formaldehyde, solutions | 3 | 4 | 0 |  |
| Germane | 4 | 4 | 3 | water reactive |
| Hydrogen cyanide, anhydrous, stabilized | 4 | 4 | 2 |  |
| Hydrogen cyanide, anhydrous, stabilized, absorbed in a porous inert material | 4 | 4 | 2 |  |
| Hydrogen fluoride, anjydrous | 4 | 0 | 1 |  |
| Hydrogen sulfide, liquified | 4 | 4 | 0 |  |
| Hydrogen, refrigerated liquid | 3 | 4 | 0 |  |
| Isoprene, inhibited | 1 | 4 | 2 |  |
| Isopropylamine | 3 | 4 | 0 |  |
| Methyl formate | 2 | 4 | 0 |  |
| Methyl isocyanate | 4 | 3 | 2 | water reactive |
| Methyl mercaptan | 4 | 4 | 0 |  |
| Methyl vinyl ketone | 4 | 3 | 2 |  |
| Methylamine, anhydrous | 3 | 4 | 0 |  |
| Methylamine, aqueous solution | 3 | 4 | 0 |  |
| Methylhydrazine | 4 | 3 | 2 |  |
| Natural gas, liquified | 3 | 4 | 0 |  |
| Nickel carbonyl | 4 | 3 | 3 |  |
| Nickel catalyst | 2 | 4 | 1 |  |
| Nitric acid (> 40%) | 4 | 0 | 0 | oxidizing |
| Nitric acid, fuming | 4 | 0 | 1 | oxidizing |
| Nitromethane | 1 | 3 | 4 |  |
| Pentaborane | 4 | 4 | 2 |  |
| Peracetic acid (<40%) | 3 | 2 | 4 | oxidizing |
| Phenol, molten | 4 | 2 | 0 |  |
| Phenol, solid | 4 | 2 | 0 |  |
| Phenol, solutions | 4 | 2 | 0 |  |
| Phosgene | 4 | 0 | 1 |  |
| Phosphorus oxychloride | 4 | 0 | 2 | water reactive |
| Phosphorus trichloride | 4 | 0 | 1 | water reactive |
| Phosphorus, white, molten | 4 | 4 | 2 |  |
| Phsophine | 4 | 4 | 2 |  |
| Picric acid, wet, with not less than 10% water | 3 | 4 | 4 |  |
| Propargyl alcohol | 4 | 3 | 3 |  |
| Propylene oxide | 3 | 4 | 2 |  |
| Silane | 1 | 4 | 3 |  |
| Stibine | 4 | 4 | 2 |  |
| Tetrafluoroethylene, inhibited | 2 | 4 | 3 |  |
| Thionyl chloride | 4 | 0 | 2 | water reactive |
| Trichlorosilane | 3 | 4 | 2 | water reactive |
| Triethylaluminum | 3 | 4 | 3 | water reactive |
| Triisobutylaluminum | 3 | 4 | 3 | water reactive |
| Trimethoxysilane | 3 | 4 | 2 |  |
| Trimethylamine | 3 | 4 | 0 |  |
| Vinyl acetylene | 2 | 4 | 3 |  |
| Vinyl chloride, inhibited | 2 | 4 | 2 |  |
| Vinyl ether | 2 | 4 | 2 |  |
| Vinylidene chloride, inhibited | 4 | 4 | 2 |  |

23.4 APPENDIX III - Table 16. Limits for Air Contaminants

29CFR PART 1910 ‑ OCCUPATIONAL SAFETY AND HEALTH STANDARDS

###### Subpart Z ‑ Toxic and Hazardous Substances

TABLE Z‑1 Limits for Air Contaminants.

NOTE: Because of the length of the table, explanatory Footnotes applicable to all substances are given below as well as at the end of the table. Footnotes specific only to a limited number of substances are also shown within the table.

Footnote (1) The PELs are 8‑hour TWAs unless otherwise noted; a (C) designation denotes a ceiling limit. They are to be determined from breathing‑zone air samples.

Footnote (a) Parts of vapor or gas per million parts of contaminated air by volume at 25 degrees C and 760 torr.

Footnote (b) Milligrams of substance per cubic meter of air. When entry is in this column only, the value is exact; when listed with a ppm entry, it is approximate.

Footnote (c) 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.

Footnote (d) The final benzene standard in 1910.1028 applies to all occupational exposures to benzene except in some circumstances the 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. See 1910.1028 for specific circumstances.

Footnote (e) 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 garnetting. See also 1910.1043 for cotton dust limits applicable to other sectors.

Footnote (f) All inert or nuisance dusts, whether mineral, inorganic, or organic, not listed specifically by substance name are covered by the Particulates Not Otherwise Regulated (PNOR) limit which is the same as the inert or nuisance dust limit of Table Z‑3.

Footnote (2) See Table Z‑2.

Footnote (3) See Table Z‑3

Footnote (4) Varies with compound.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| **Substance** | **CAS No. (c)** | **ppm (a)(1)** | **mg/m3 (b)(1)** | **Skin designation** |
|  |  |  |  |  |
| Acetaldehyde | 75‑07‑0 | 200 | 360 |  |
|  |  |  |  |  |
| Acetic acid | 64‑19‑7 | 10 | 25 |  |
|  |  |  |  |  |
| Acetic anhydride | 108‑24‑7 | 5 | 20 |  |
|  |  |  |  |  |
| Acetone | 67‑64‑1 | 1000 | 2400 |  |
|  |  |  |  |  |
| Acetonitrile | 75‑05‑8 | 40 | 70 |  |
|  |  |  |  |  |
| 2‑Acetylaminofluorene; see 1910.1014 | 53‑96‑3 |  |  |  |
|  |  |  |  |  |
| Acetylene dichloride; see 1,2‑Dichloroethylene |  |  |  |  |
|  |  |  |  |  |
| Acetylene tetrabromide | 79‑27‑6 | 1 | 14 |  |
|  |  |  |  |  |
| Acrolein | 107‑02‑8 | 0.1 | 0.25 |  |
|  |  |  |  |  |
| Acrylamide | 79‑06‑1 |  | 0.3 | X |
|  |  |  |  |  |
| Acrylonitrile; see 1910.1045 | 107‑13‑1 |  |  |  |
|  |  |  |  |  |
| Aldrin | 309‑00‑2 |  | 0.25 | X |
|  |  |  |  |  |
| Allyl alcohol | 107‑18‑6 | 2 | 5 | X |
|  |  |  |  |  |
| Allyl chloride | 107‑05‑1 | 1 | 3 |  |
|  |  |  |  |  |
| Allyl glycidyl ether (AGE) | 106‑92‑3 | (C)10 | (C)45 |  |
|  |  |  |  |  |
| **Substance** | **CAS No.**  **(c)** | **Ppm**  **(a)(1)** | **mg/m3**  **(b)(1)** | **Skin designation** |
| Allyl propyl disulfide | 2179‑59‑1 | 2 | 12 |  |
|  |  |  |  |  |
| alpha‑Alumina | 1344‑28‑1 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Aluminum Metal (as Al) | 7429‑90‑5 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| 4‑Aminodiphenyl; see 1910.1011 | 92‑67‑1 |  |  |  |
|  |  |  |  |  |
| 2‑Aminoethanol; see Ethanolamine |  |  |  |  |
|  |  |  |  |  |
| 2‑Aminopyridine | 504‑29‑0 | 0.5 | 2 |  |
|  |  |  |  |  |
| Ammonia | 7664‑41‑7 | 50 | 35 |  |
|  |  |  |  |  |
| Ammonium sulfamate | 7773‑06‑0 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| n‑Amyl acetate | 628‑63‑7 | 100 | 525 |  |
|  |  |  |  |  |
| sec‑Amyl acetate | 626‑38‑0 | 125 | 650 |  |
|  |  |  |  |  |
| Aniline and homologs | 62‑53‑3 | 5 | 19 | X |
|  |  |  |  |  |
| Anisidine (o‑,p‑isomers) | 29191‑52‑4 |  | 0.5 | X |
|  |  |  |  |  |
| Antimony and compounds (as Sb) | 7440‑36‑0 |  | 0.5 |  |
|  |  |  |  |  |
| ANTU (alpha Naphthylthiourea) | 86‑88‑4 |  | 0.3 |  |
|  |  |  |  |  |
| Arsenic, inorganic compounds (as As); see 1910.1018 | 7440‑38‑2 |  |  |  |
|  |  |  |  |  |
| Arsenic, organic compounds (as As) | 7440‑38‑2 |  | 0.5 |  |
| Arsine | 7784‑42‑1 | 0.05 | 0.2 |  |
|  |  |  |  |  |
| Asbestos; see 1910.1001 |  |  | (4) |  |
|  |  |  |  |  |
| Azinphos‑methyl | 86‑50‑0 |  | 0.2 | X |
|  |  |  |  |  |
| Barium, soluble compounds (as Ba) | 7440‑39‑3 |  | 0.5 |  |
|  |  |  |  |  |
| Barium sulfate | 7727‑43‑7 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Benomyl | 17804-35-2 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Benzene; See 1910.1028  See Table Z‑2 for the limits applicable in the operations or sectors excluded in 1910.1028(d) | 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 |  |
|  |  |  |  |  |
| Benzyl chloride | 100‑44‑7 | 1 | 5 |  |
|  |  |  |  |  |
| Beryllium and beryllium compounds (as Be) | 7440‑41‑7 |  | (2) |  |
|  |  |  |  |  |
| Biphenyl; see Diphenyl |  |  |  |  |
|  |  |  |  |  |
| Bismuth telluride, Undoped | 1304‑82‑1 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Boron oxide | 1303‑86‑2 |  |  |  |
| Total dust |  |  | 15 |  |
|  |  |  |  |  |
| Boron trifluoride | 7637‑07‑2 | (C)1 | (C)3 |  |
|  |  |  |  |  |
| Bromine | 7726‑95‑6 | 0.1 | 0.7 |  |
|  |  |  |  |  |
| Bromoform | 75‑25‑2 | 0.5 | 5 | X |
|  |  |  |  |  |
| **Substance** | **CAS No.**  **(c)** | **Ppm**  **(a)(1)** | **mg/m3**  **(b)(1)** | **Skin designation** |
| Butadiene (1,3‑Butadiene) | 106‑99‑0 | 1000 | 2200 |  |
|  |  |  |  |  |
| Butanethiol; see Butyl mercaptan |  |  |  |  |
|  |  |  |  |  |
| 2‑Butanone (Methyl ethyl ketone) | 78‑93‑3 | 200 | 590 |  |
|  |  |  |  |  |
| 2‑Butoxyethanol | 111‑76‑2 | 50 | 240 | X |
|  |  |  |  |  |
| n‑Butyl‑acetate | 123‑86‑4 | 150 | 710 |  |
|  |  |  |  |  |
| sec‑Butyl acetate | 105‑46‑4 | 200 | 950 |  |
|  |  |  |  |  |
| tert‑Butyl‑acetate | 540‑88‑5 | 200 | 950 |  |
|  |  |  |  |  |
| n‑Butyl alcohol | 71‑36‑3 | 100 | 300 |  |
|  |  |  |  |  |
| sec‑Butyl alcohol | 78‑92‑2 | 150 | 450 |  |
|  |  |  |  |  |
| tert‑Butyl alcohol | 75‑65‑0 | 100 | 300 |  |
|  |  |  |  |  |
| Butylamine | 109‑73‑9 | (C)5 | (C)15 | X |
|  |  |  |  |  |
| tert‑Butyl chromate (as CrO(3)) | 1189‑85‑1 |  | (C)0.1 | X |
|  |  |  |  |  |
| n‑Butyl glycidyl ether (BGE) | 2426‑08‑6 | 50 | 270 |  |
|  |  |  |  |  |
| Butyl mercaptan | 109‑79‑5 | 10 | 35 |  |
| p‑tert‑Butyltoluene | 98‑51‑1 | 10 | 60 |  |
|  |  |  |  |  |
| Cadmium (as Cd); see 1910.1027 | 7440‑43‑9 |  |  |  |
|  |  |  |  |  |
| Calcium Carbonate | 1317‑65‑3 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Calcium hydroxide | 1305‑62‑0 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Calcium oxide | 1305‑78‑8 |  | 5 |  |
|  |  |  |  |  |
| Calcium silicate |  |  |  | 1344‑95‑2 |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Calcium sulfate | 7778‑18‑9 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Camphor, synthetic | 76‑22‑2 |  | 2 |  |
|  |  |  |  |  |
| Carbaryl (Sevin) | 63‑25‑2 |  | 5 |  |
|  |  |  |  |  |
| Carbon black | 1333‑86‑4 |  | 3.5 |  |
|  |  |  |  |  |
| Carbon dioxide | 124‑38‑9 | 5000 | 9000 |  |
|  |  |  |  |  |
| Carbon disulfide | 75‑15‑0 |  | (2) |  |
|  |  |  |  |  |
| Carbon monoxide | 630‑08‑0 | 50 | 55 |  |
|  |  |  |  |  |
| Carbon tetrachloride | 56‑23‑5 |  | (2) |  |
|  |  |  |  |  |
| Cellulose | 9004‑34‑6 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Chlordane | 57‑74‑9 |  | 0.5 | X |
|  |  |  |  |  |
| Chlorinated camphene | 8001‑35‑2 |  | 0.5 | X |
|  |  |  |  |  |
| Chlorinated diphenyl oxide | 55720‑99‑5 |  | 0.5 |  |
|  |  |  |  |  |
| Chlorine | 7782‑50‑5 | (C)1 | (C)3 |  |
|  |  |  |  |  |
| Chlorine dioxide | 10049‑04‑4 | 0.1 | 0.3 |  |
|  |  |  |  |  |
| Chlorine trifluoride | 7790‑91‑2 | (C)0.1 | (C)0.4 |  |
|  |  |  |  |  |
| Chloroacetaldehyde | 107‑20‑0 | (C)1 | (C)3 |  |
|  |  |  |  |  |
| a‑Chloroacetophenone (Phenacyl chloride) | 532‑27‑4 | 0.05 | 0.3 |  |
|  |  |  |  |  |
| Chlorobenzene | 108‑90‑7 | 75 | 350 |  |
|  |  |  |  |  |
| o‑Chlorobenzylidene malononitrile | 2698‑41‑1 | 0.05 | 0.4 |  |
|  |  |  |  |  |
| Chlorobromomethane | 74‑97‑5 | 200 | 1050 |  |
|  |  |  |  |  |
| **Substance** | **CAS No.**  **(c)** | **Ppm**  **(a)(1)** | **mg/m3**  **(b)(1)** | **Skin designation** |
| 2‑Chloro‑1,3‑butadiene; See beta‑Chloroprene |  |  |  |  |
|  |  |  |  |  |
| Chlorodiphenyl (42% Chlorine)(PCB) | 53469‑21‑9 |  | 1 | X |
|  |  |  |  |  |
| Chlorodiphenyl (54% Chlorine)(PCB) | 11097‑69‑1 |  | 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 |  |
|  |  |  |  |  |
| 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 |  |
|  |  |  |  |  |
| Chloropicrin | 76‑06‑2 | 0.1 | 0.7 |  |
|  |  |  |  |  |
| beta‑Chloroprene | 126‑99‑8 | 25 | 90 | X |
|  |  |  |  |  |
| 2‑Chloro‑6 (trichloromethyl) pyridine | 1929‑82‑4 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Chromic acid and chromates (as CrO(3)) | (4) |  | (2) |  |
|  |  |  |  |  |
| Chromium (II) compounds (as Cr) | 7440‑47‑3 |  | 0.5 |  |
|  |  |  |  |  |
| Chromium (III) compounds (as Cr) | 7440‑47‑3 |  | 0.5 |  |
|  |  |  |  |  |
| Chromium metal and insol. salts (as Cr) | 7440‑47‑3 |  | 1 |  |
|  |  |  |  |  |
| Chrysene; see Coal tar pitch volatiles |  |  |  |  |
|  |  |  |  |  |
| Clopidol | 2971‑90‑6 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Coal dust (less than 5% SiO(2)), |  |  |  |  |
| respirable fraction |  |  | (3) |  |
|  |  |  |  |  |
| Coal dust (greater than or equal to 5% SiO(2)), |  |  |  |  |
| respirable fraction |  |  | (3) |  |
|  |  |  |  |  |
| Coal tar pitch volatiles (benzene soluble fraction), anthracene, BaP, phenanthrene, acridine, chrysene, pyrene | 65966‑93‑2 |  | 0.2 |  |
|  |  |  |  |  |
| Cobalt metal, dust, and fume (as Co) | 7440‑48‑4 |  | 0.1 |  |
|  |  |  |  |  |
| Coke oven emissions; see 1910.1029 |  |  |  |  |
|  |  |  |  |  |
| Copper | 7440‑50‑8 |  |  |  |
| Fume (as Cu) |  |  | 0.1 |  |
| Dusts and mists (as Cu) |  |  | 1 |  |
|  |  |  |  |  |
| Cotton dust (e), see 1910.1043 |  |  | 1 |  |
|  |  |  |  |  |
| Crag herbicide (Sesone) | 136‑78‑7 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Cresol, all isomers | 1319‑77‑3 | 5 | 22 | X |
|  |  |  |  |  |
| Crotonaldehyde | 123‑73‑9 | 2 | 6 |  |
|  | 4170‑30‑3 |  |  |  |
| Cumene | 98‑82‑8 | 50 | 245 | X |
|  |  |  |  |  |
| Cyanides (as CN) | (4) |  | 5 |  |
|  |  |  |  |  |
| Cyclohexane | 110‑82‑7 | 300 | 1050 |  |
|  |  |  |  |  |
| Cyclohexanol | 108‑93‑0 | 50 | 200 |  |
|  |  |  |  |  |
| Cyclohexanone | 108‑94‑1 | 50 | 200 |  |
|  |  |  |  |  |
| Cyclohexene | 110‑83‑8 | 300 | 1015 |  |
|  |  |  |  |  |
| Cyclopentadiene | 542‑92‑7 | 75 | 200 |  |
|  |  |  |  |  |
| 2,4‑D (Dichlorophenoxyacetic acid) | 94‑75‑7 |  | 10 |  |
|  |  |  |  |  |
| Decaborane | 17702‑41‑9 | 0.05 | 0.3 | X |
|  |  |  |  |  |
| **Substance** | **CAS No.**  **(c)** | **Ppm**  **(a)(1)** | **mg/m3**  **(b)(1)** | **Skin designation** |
| Demeton (Systox) | 8065‑48‑3 |  | 0.1 | X |
|  |  |  |  |  |
| Diacetone alcohol (4‑Hydroxy‑4‑methyl‑2‑pentanone) | 123‑42‑2 | 50 | 240 |  |
|  |  |  |  |  |
| 1,2‑Diaminoethane; see Ethylenediamine |  |  |  |  |
|  |  |  |  |  |
| Diazomethane | 334‑88‑3 | 0.2 | 0.4 |  |
|  |  |  |  |  |
| Diborane | 19287‑45‑7 | 0.1 | 0.1 |  |
|  |  |  |  |  |
| 1,2‑Dibromo‑3‑chloropropane (CBCP); see 1910.1044 | 96‑12‑8 |  |  |  |
| 1,2‑Dibromoethane; see Ethylene dibromide |  |  |  |  |
|  |  |  |  |  |
| Dibutyl phosphate | 107‑66‑4 | 1 | 5 |  |
|  |  |  |  |  |
| Dibutyl phthalate | 84‑74‑2 |  | 5 |  |
|  |  |  |  |  |
| o‑Dichlorobenzene | 95‑50‑1 | (C)50 | (C)300 |  |
|  |  |  |  |  |
| p‑Dichlorobenzene | 106‑46‑7 | 75 | 450 |  |
|  |  |  |  |  |
| 3,3'‑Dichlorobenzidine; see 1910.1007 | 91‑94‑1 |  |  |  |
|  |  |  |  |  |
| Dichlorodifluoromethane | 75‑71‑8 | 1000 | 4950 |  |
|  |  |  |  |  |
| 1,3‑Dichloro‑5, 5‑dimethyl hydantoin | 118‑52‑5 |  | 0.2 |  |
|  |  |  |  |  |
| Dichlorodiphenyltrichloroethane (DDT) | 50‑29‑3 |  | 1 | X |
|  |  |  |  |  |
| 1,1‑Dichloroethane | 75‑34‑3 | 100 | 400 |  |
|  |  |  |  |  |
| 1,2‑Dichloroethane; see Ethylene dichloride |  |  |  |  |
|  |  |  |  |  |
| 1,2‑Dichloroethylene | 540‑59‑0 | 200 | 790 |  |
|  |  |  |  |  |
| Dichloroethyl ether | 111‑44‑4 | (C)15 | (C)90 | X |
|  |  |  |  |  |
| Dichloromethane; see Methylene chloride |  |  |  |  |
|  |  |  |  |  |
| Dichloromonofluoromethane | 75‑43‑4 | 1000 | 4200 |  |
|  |  |  |  |  |
| 1,1‑Dichloro‑1-nitroethane | 594‑72‑9 | (C)10 | (C)60 |  |
|  |  |  |  |  |
| 1,2‑Dichloropropane; see Propylene dichloride |  |  |  |  |
|  |  |  |  |  |
| Dichlorotetrafluoroethane | 76‑14‑2 | 1000 | 7000 |  |
|  |  |  |  |  |
| Dichlorvos (DDVP) | 62‑73‑7 |  | 1 | X |
|  |  |  |  |  |
| Dicyclopentadienyl iron | 102‑54‑5 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Dieldrin | 60‑57‑1 |  | 0.25 | X |
|  |  |  |  |  |
| Diethylamine | 109‑89‑7 | 25 | 75 |  |
|  |  |  |  |  |
| 2‑Diethylaminoethanol | 100‑37‑8 | 10 | 50 | X |
|  |  |  |  |  |
| Diethyl ether; see Ethyl ether |  |  |  |  |
|  |  |  |  |  |
| Difluorodibromomethane | 75‑61‑6 | 100 | 860 |  |
|  |  |  |  |  |
| Diglycidyl ether (DGE) | 2238‑07‑5 | (C)0.5 | (C)2.8 |  |
|  |  |  |  |  |
| Dihydroxybenzene; see Hydroquinone |  |  |  |  |
|  |  |  |  |  |
| Diisobutyl ketone | 108‑83‑8 | 50 | 290 |  |
|  |  |  |  |  |
| Diisopropylamine | 108‑18‑9 | 5 | 20 | X |
|  |  |  |  |  |
| 4‑Dimethylaminoazobenzene; see 1910.1015 | 60‑11‑7 |  |  |  |
|  |  |  |  |  |
| Dimethoxymethane; see Methylal |  |  |  |  |
|  |  |  |  |  |
| Dimethyl acetamide | 127‑19‑5 | 10 | 35 | X |
|  |  |  |  |  |
| Dimethylamine | 124‑40‑3 | 10 | 18 |  |
|  |  |  |  |  |
| Dimethylaminobenzene; see Xylidine |  |  |  |  |
|  |  |  |  |  |
| Dimethylaniline (N,N‑Dimethylaniline) | 121‑69‑7 | 5 | 25 | X |
|  |  |  |  |  |
| Dimethylbenzene; see Xylene |  |  |  |  |
|  |  |  |  |  |
| Dimethyl‑1,2‑dibromo‑2,2‑dichloroethylphosphate | 300‑76‑5 |  | 3 |  |
|  |  |  |  |  |
| Dimethylformamide | 68‑12‑2 | 10 | 30 | X |
|  |  |  |  |  |
| 2,6‑Dimethyl‑4‑heptanone; see Diisobutyl ketone |  |  |  |  |
|  |  |  |  |  |
| 1,1‑Dimethylhydrazine | 57‑14‑7 | 0.5 | 1 | X |
|  |  |  |  |  |
| Dimethylphthalate | 131‑11‑3 |  | 5 |  |
|  |  |  |  |  |
| **Substance** | **CAS No.**  **(c)** | **Ppm**  **(a)(1)** | **mg/m3**  **(b)(1)** | **Skin designation** |
| Dimethyl sulfate | 77‑78‑1 | 1 | 5 | X |
|  |  |  |  |  |
| Dinitrobenzene (all isomers) |  |  | 1 | X |
| (ortho) | 528‑29‑0 |  |  |  |
| (meta) | 99‑65‑0 |  |  |  |
|  |  |  |  |  |
| Dinitro‑o‑cresol | 534‑52‑1 |  | 0.2 | X |
|  |  |  |  |  |
| Dinitrotoluene | 25321‑14‑6 |  | 1.5 | X |
|  |  |  |  |  |
| Dioxane (Diethylene dioxide) | 123‑91‑1 | 100 | 360 | X |
|  |  |  |  |  |
| Diphenyl (Biphenyl) | 92‑52‑4 | 0.2 | 1 |  |
|  |  |  |  |  |
| Diphenylmethane diisocyanate; |  |  |  |  |
| see Methylene bisphenyl isocyanate |  |  |  |  |
|  |  |  |  |  |
| Dipropylene glycol methyl ether | 34590‑94‑8 | 100 | 600 | X |
|  |  |  |  |  |
| Di‑sec octyl phthalate (Di‑(2‑ethylhexyl) phthalate) | 117‑81‑7 |  | 5 |  |
|  |  |  |  |  |
| Emery | 12415‑34‑8 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Endosulfan | 115‑29‑7 |  | 0.1 | X |
|  |  |  |  |  |
| Endrin | 72‑20‑8 |  | 0.1 | X |
|  |  |  |  |  |
| Epichlorohydrin | 106‑89‑8 | 5 | 19 | X |
|  |  |  |  |  |
| EPN | 2104‑64‑5 |  | 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 |  |
|  |  |  |  |  |
| 2‑Ethoxyethanol (Cellosolve) | 110‑80‑5 | 200 | 740 | X |
|  |  |  |  |  |
| 2‑Ethoxyethyl acetate (Cellosolve acetate) | 111‑15‑9 | 100 | 540 | X |
|  |  |  |  |  |
| Ethyl acetate | 141‑78‑6 | 400 | 1400 |  |
|  |  |  |  |  |
| Ethyl acrylate | 140‑88‑5 | 25 | 100 | X |
|  |  |  |  |  |
| Ethyl alcohol (Ethanol) | 64‑17‑5 | 1000 | 1900 |  |
|  |  |  |  |  |
| Ethylamine | 75‑04‑7 | 10 | 18 |  |
|  |  |  |  |  |
| Ethyl amyl ketone (5‑Methyl‑3‑heptanone) | 541‑85‑5 | 25 | 130 |  |
|  |  |  |  |  |
| Ethyl benzene | 100‑41‑4 | 100 | 435 |  |
|  |  |  |  |  |
| Ethyl bromide | 74‑96‑4 | 200 | 890 |  |
|  |  |  |  |  |
| Ethyl butyl ketone (3‑Heptanone) | 106‑35‑4 | 50 | 230 |  |
|  |  |  |  |  |
| Ethyl chloride | 75‑00‑3 | 1000 | 2600 |  |
|  |  |  |  |  |
| Ethyl ether | 60‑29‑7 | 400 | 1200 |  |
|  |  |  |  |  |
| Ethyl formate | 109‑94‑4 | 100 | 300 |  |
|  |  |  |  |  |
| Ethyl mercaptan | 75‑08‑1 | (C)10 | (C)25 |  |
|  |  |  |  |  |
| Ethyl silicate | 78‑10‑4 | 100 | 850 |  |
|  |  |  |  |  |
| Ethylene chlorohydrin | 107‑07‑3 | 5 | 16 | X |
|  |  |  |  |  |
| Ethylenediamine | 107‑15‑3 | 10 | 25 |  |
|  |  |  |  |  |
| Ethylene dibromide | 106‑93‑4 |  | (2) |  |
|  |  |  |  |  |
| Ethylene dichloride (1,2‑Dichloroethane) | 107‑06‑2 |  | (2) |  |
|  |  |  |  |  |
| Ethylene glycol dinitrate | 628‑96‑6 | (C)0.2 | (C)1 | X |
| Ethylene glycol methyl acetate; see Methyl cellosolve acetate |  |  |  |  |
| Ethyleneimine;  See 1910.1012 |  |  |  |  |
|  |  |  |  |  |
| Ethylene oxide; see 1910.1047 | 75‑21‑8 |  |  |  |
|  |  |  |  |  |
| Ethylidene chloride; see 1,1‑Dichlorethane |  |  |  |  |
|  |  |  |  |  |
| N‑Ethylmorpholine | 100‑74‑3 | 20 | 94 | X |
|  |  |  |  |  |
| **Substance** | **CAS No.**  **(c)** | **Ppm**  **(a)(1)** | **mg/m3**  **(b)(1)** | **Skin designation** |
| Ferbam | 14484‑64‑1 |  |  |  |
| Total dust |  |  | 15 |  |
|  |  |  |  |  |
| Ferrovanadium dust | 12604‑58‑9 |  | 1 |  |
|  |  |  |  |  |
| Fluorides (as F) | (4) |  | 2.5 |  |
|  |  |  |  |  |
| Fluorine | 7782‑41‑4 | 0.1 | 0.2 |  |
|  |  |  |  |  |
| Fluorotrichloromethane (Trichloro‑fluoromethane) | 75‑69‑4 | 1000 | 5600 |  |
|  |  |  |  |  |
| Formaldehyde; see 1910.1048 | 50‑00‑0 |  |  |  |
|  |  |  |  |  |
| Formic acid | 64‑18‑6 | 5 | 9 |  |
|  |  |  |  |  |
| Furfural | 98‑01‑1 | 5 | 20 | X |
|  |  |  |  |  |
| Furfuryl alcohol | 98‑00‑0 | 50 | 200 |  |
|  |  |  |  |  |
| Grain dust (oat, wheat, barley) |  |  | 10 |  |
|  |  |  |  |  |
| Glycerin (mist) | 56‑81‑5 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Glycidol | 556‑52‑5 | 50 | 150 |  |
| Glycol monoethyl ether; see 2‑Ethoxyethanol |  |  |  |  |
|  |  |  |  |  |
| Graphite, natural respirable dust | 7782‑42-5 |  | (3) |  |
|  |  |  |  |  |
| Graphite, synthetic |  |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable Fraction |  |  | 5 |  |
|  |  |  |  |  |
| Guthion; see Azinphos methyl |  |  |  |  |
|  |  |  |  |  |
| Gypsum | 13397‑24‑5 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Hafnium | 7440‑58‑6 |  | 0.5 |  |
|  |  |  |  |  |
| Heptachlor | 76‑44‑8 |  | 0.5 | X |
|  |  |  |  |  |
| Heptane (n‑Heptane) | 142‑82‑5 | 500 | 2000 |  |
|  |  |  |  |  |
| Hexachloroethane | 67‑72‑1 | 1 | 10 | X |
|  |  |  |  |  |
| Hexachloronaphthalene | 1335‑87‑1 |  | 0.2 | X |
|  |  |  |  |  |
| n‑Hexane | 110‑54‑3 | 500 |  | 1800 |
|  |  |  |  |  |
| 2‑Hexanone (Methyl n‑butyl ketone) | 591‑78‑6 | 100 | 410 |  |
|  |  |  |  |  |
| Hexone (Methyl isobutyl ketone) | 108‑10‑1 | 100 | 410 |  |
|  |  |  |  |  |
| sec‑Hexyl acetate | 108‑84‑9 | 50 | 300 |  |
|  |  |  |  |  |
| Hydrazine | 302‑01‑2 | 1 | 1.3 | X |
|  |  |  |  |  |
| Hydrogen bromide | 10035‑10‑6 | 3 | 10 |  |
|  |  |  |  |  |
| Hydrogen chloride | 7647‑01‑0 | (C)5 | (C)7 |  |
|  |  |  |  |  |
| Hydrogen cyanide | 74‑90‑8 | 10 | 11 | X |
|  |  |  |  |  |
| Hydrogen fluoride (as F) | 7664‑39‑3 |  | (2) |  |
|  |  |  |  |  |
| Hydrogen peroxide | 7722‑84‑1 | 1 | 1.4 |  |
|  |  |  |  |  |
| Hydrogen selenide (as Se) | 7783‑07‑5 | 0.05 | 0.2 |  |
|  |  |  |  |  |
| Hydrogen sulfide | 7783‑06‑4 |  | (2) |  |
|  |  |  |  |  |
| Hydroquinone | 123‑31‑9 |  | 2 |  |
|  |  |  |  |  |
| Iodine | 7553‑56‑2 | (C)0.1 | (C)1 |  |
|  |  |  |  |  |
| Iron oxide fume | 1309‑37‑1 |  | 10 |  |
|  |  |  |  |  |
| Isomyl acetate | 123‑92-2 | 100 | 525 |  |
|  |  |  |  |  |
| Isomyl alcohol (primary and secondary) | 123‑51‑3 | 100 | 360 |  |
|  |  |  |  |  |
| Isobutyl acetate | 110‑19‑0 | 150 | 700 |  |
|  |  |  |  |  |
| Isobutyl alcohol | 78‑83‑1 | 100 | 300 |  |
|  |  |  |  |  |
| Isophorone | 78‑59‑1 | 25 | 140 |  |
|  |  |  |  |  |
| Isopropyl acetate | 108‑21‑4 | 250 | 950 |  |
|  |  |  |  |  |
| **Substance** | **CAS No.**  **(c)** | **Ppm**  **(a)(1)** | **mg/m3**  **(b)(1)** | **Skin designation** |
| Isopropyl alcohol | 67‑63‑0 | 400 | 980 |  |
|  |  |  |  |  |
| Isopropylamine | 75‑31‑0 | 5 | 12 |  |
|  |  |  |  |  |
| Isopropyl ether | 108‑20‑3 | 500 | 2100 |  |
|  |  |  |  |  |
| Isopropyl glycidyl ether (IGE) | 4016‑14‑2 | 50 | 240 |  |
|  |  |  |  |  |
| Kaolin | 1332‑58‑7 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Ketene | 463‑51‑4 | 0.5 | 0.9 |  |
|  |  |  |  |  |
| Lead inorganic (as Pb); see 1910.1025 | 7439‑92‑1 |  |  |  |
|  |  |  |  |  |
| Limestone | 1317‑65‑3 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
| Lindane | 58‑89‑9 |  | 0.5 | X |
|  |  |  |  |  |
| Lithium hydride | 7580‑67‑8 |  | 0.025 |  |
|  |  |  |  |  |
| L.P.G. (Liquified petroleum gas) | 68476‑85‑7 | 1000 | 1800 |  |
| Magnesite | 546‑93‑0 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Magnesium oxide fume | 1309‑48‑4 |  |  |  |
| Total Particulate |  |  | 15 |  |
|  |  |  |  |  |
| Malathion | 121‑75‑5 |  | 15 | X |
| Total dust |  |  |  |  |
|  |  |  |  |  |
| Maleic anhydride | 108‑31‑6 | 0.25 | 1 |  |
|  |  |  |  |  |
| Manganese compounds (as Mn) | 7439‑96‑5 |  | (C)5 |  |
|  |  |  |  |  |
| Manganese fume (as Mn) | 7439‑96‑5 |  | (C)5 |  |
|  |  |  |  |  |
| Marble | 1317‑65‑3 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Mercury (aryl and inorganic)(as Hg) | 7439‑97‑6 |  | (2) |  |
|  |  |  |  |  |
| Mercury (organo) alkyl compounds (as Hg) | 7439‑97‑6 |  | (2) |  |
|  |  |  |  |  |
| Mercury (vapor) (as Hg) | 7439‑97‑6 |  | (2) |  |
|  |  |  |  |  |
| Mesityl oxide | 141‑79‑7 | 25 | 100 |  |
|  |  |  |  |  |
| Methanethiol; see Methyl mercaptan |  |  |  |  |
|  |  |  |  |  |
| Methoxychlor | 72‑43‑5 |  |  |  |
| Total dust |  |  | 15 |  |
|  |  |  |  |  |
| 2‑Methoxyethanol; (Methyl cellosolve) | 109‑86‑4 | 25 | 80 | X |
|  |  |  |  |  |
| 2‑ Methoxyethyl acetate (Methyl cellosolve acetate) | 110‑49‑6 | 25 | 120 | X |
|  |  |  |  |  |
| Methyl acetate | 79‑20‑9 | 200 | 610 |  |
|  |  |  |  |  |
| Methyl acetylene (Propyne) | 74‑99‑7 | 1000 | 1650 |  |
|  |  |  |  |  |
| Methyl acetylene propadiene mixture (MAPP) |  | 1000 | 1800 |  |
|  |  |  |  |  |
| Methyl acrylate | 96‑33‑3 | 10 | 35 | X |
|  |  |  |  |  |
| Methylal (Dimethoxy‑methane) | 109‑87‑5 | 1000 | 3100 |  |
|  |  |  |  |  |
| Methyl alcohol | 67‑56‑1 | 200 | 260 |  |
|  |  |  |  |  |
| Methylamine | 74‑89‑5 | 10 | 12 |  |
|  |  |  |  |  |
| Methyl amyl alcohol; see Methyl Isobutyl carbinol |  |  |  |  |
| Methyl n‑amyl ketone | 110‑43‑0 | 100 | 465 |  |
|  |  |  |  |  |
| Methyl bromide | 74‑83‑9 | (C)20 | (C)80 | X |
|  |  |  |  |  |
| Methyl butyl ketone; see 2‑Hexanone |  |  |  |  |
|  |  |  |  |  |
| Methyl cellosolve; see 2‑Methoxyethanol |  |  |  |  |
|  |  |  |  |  |
| Methyl cellosolve acetate; see 2‑Methoxyethyl acetate |  |  |  |  |
| **Substance** | **CAS No.**  **(c)** | **Ppm**  **(a)(1)** | **mg/m3**  **(b)(1)** | **Skin designation** |
| Methyl chloride | 74‑87‑3 |  | (2) |  |
|  |  |  |  |  |
| Methyl chloroform (1,1,1‑Trichloro‑ethane) | 71‑55‑6 | 350 | 1900 |  |
|  |  |  |  |  |
| Methylcyclohexane | 108‑87‑2 | 500 | 2000 |  |
|  |  |  |  |  |
| Methylcyclohexanol | 25639‑42‑3 | 100 | 470 |  |
|  |  |  |  |  |
| o‑Methylcyclohexanone | 583‑60‑8 | 100 | 460 | X |
|  |  |  |  |  |
| Methylene chloride | 75‑09‑2 |  | (2) |  |
|  |  |  |  |  |
| Methyl ethyl ketone (MEK); see 2‑Butanone |  |  |  |  |
|  |  |  |  |  |
| Methyl formate | 107‑31‑3 | 100 | 250 |  |
|  |  |  |  |  |
| Methyl hydrazine (Monomethyl hydrazine) | 60‑34‑4 | (C)0.2 | (C)0.35 | X |
| Methyl iodide | 74‑88‑4 | 5 | 28 | X |
|  |  |  |  |  |
| Methyl isoamyl ketone | 110‑12‑3 | 100 | 475 |  |
|  |  |  |  |  |
| Methyl isobutyl carbinol | 108‑11‑2 | 25 | 100 | X |
|  |  |  |  |  |
| Methyl isobutyl ketone; see Hexone |  |  |  |  |
|  |  |  |  |  |
| Methyl isocyanate | 624‑83‑9 | 0.02 | 0.05 | X |
|  |  |  |  |  |
| Methyl mercaptan | 74‑93‑1 | (C)10 | (C)20 |  |
|  |  |  |  |  |
| Methyl methacrylate | 80‑62‑6 | 100 | 410 |  |
|  |  |  |  |  |
| Methyl propyl ketone; see 2‑Pentanone |  |  |  |  |
|  |  |  |  |  |
| alpha‑Methyl styrene | 98‑83‑9 | (C)100 | (C)480 |  |
|  |  |  |  |  |
| Methylene bisphenyl isocyanate (MDI) | 101‑68‑8 | (C)0.02 | (C)0.2 |  |
| Mica; see Silicates |  |  |  |  |
|  |  |  |  |  |
| Molybdenum (as Mo) | 7439‑98‑7 |  |  |  |
| Soluble compounds |  |  | 5 |  |
| Insoluble Compounds |  |  |  |  |
| Total dust |  |  | 15 |  |
|  |  |  |  |  |
| Monomethyl aniline | 100‑61‑8 | 2 | 9 | X |
|  |  |  |  |  |
| Monomethyl hydrazine; see Methyl hydrazine |  |  |  |  |
|  |  |  |  |  |
| Morpholine | 110‑91‑8 | 20 | 70 | X |
|  |  |  |  |  |
| Naphtha (Coal tar) | 8030‑30‑6 | 100 | 400 |  |
| Naphthalene | 91‑20‑3 | 10 | 50 |  |
|  |  |  |  |  |
| alpha‑Naphthylamine; see 1910.1004 | 134‑32‑7 |  |  |  |
|  |  |  |  |  |
| beta‑Naphthylamine; see 1910.1009 | 91‑59‑8 |  |  |  |
|  |  |  |  |  |
| Nickel carbonyl (as Ni) | 13463‑39‑3 | 0.001 | 0.007 |  |
|  |  |  |  |  |
| Nickel, metal and insoluble compounds (as Ni) | 7440‑02‑0 |  | 1 |  |
|  |  |  |  |  |
| Nickel, soluble compounds (as Ni) | 7440‑02‑0 |  | 1 |  |
|  |  |  |  |  |
| Nicotine | 54‑11‑5 |  | 0.5 | X |
|  |  |  |  |  |
| Nitric acid | 7697‑37‑2 | 2 | 5 |  |
|  |  |  |  |  |
| Nitric oxide | 10102‑43‑9 | 25 | 30 |  |
|  |  |  |  |  |
| p‑Nitroaniline | 100‑01‑6 | 1 | 6 | X |
|  |  |  |  |  |
| Nitrobenzene | 98‑95‑3 | 1 | 5 | X |
|  |  |  |  |  |
| p‑Nitrochlorobenzene | 100‑00‑5 |  | 1 | X |
|  |  |  |  |  |
| 4‑Nitrodiphenyl; see 1910.1003 | 92‑93‑3 |  |  |  |
|  |  |  |  |  |
| Nitroethane | 79‑24‑3 | 100 | 310 |  |
|  |  |  |  |  |
| Nitrogen dioxide | 10102‑44‑0 | (C)5 | (C)9 |  |
|  |  |  |  |  |
| Nitrogen trifluoride | 7783‑54‑2 | 10 | 29 |  |
|  |  |  |  |  |
| Nitroglycerin | 55‑63‑0 | (C)0.2 | (C)2 | X |
|  |  |  |  |  |
| Nitromethane | 75‑52‑5 | 100 | 250 |  |
|  |  |  |  |  |
| 1‑Nitropropane | 108‑03‑2 | 25 | 90 |  |
|  |  |  |  |  |
| 2‑Nitropropane | 79‑46‑9 | 25 | 90 |  |
|  |  |  |  |  |
| N‑Nitrosodimethylamine; see 1910.1016 |  |  |  |  |
|  |  |  |  |  |
| **Substance** | **CAS No.**  **(c)** | **Ppm**  **(a)(1)** | **mg/m3**  **(b)(1)** | **Skin designation** |
| Nitrotoluene (all isomers) |  | 5 | 30 | X |
| o‑isomer | 88‑72‑2 |  |  |  |
| m‑isomer | 99‑08‑1 |  |  |  |
| p‑isomer |  |  |  |  |
|  |  |  |  |  |
| Nitrotrichloromethane; see Chloropicrin |  |  |  |  |
|  |  |  |  |  |
| Octachloronaphthalene | 2234‑13‑1 |  | 0.1 | X |
|  |  |  |  |  |
| Octane | 111‑65‑9 | 500 | 2350 |  |
|  |  |  |  |  |
| Oil mist, mineral | 8012‑95‑1 |  | 5 |  |
|  |  |  |  |  |
| Osmium tetroxide (as Os) | 20816‑12‑0 |  | 0.002 |  |
|  |  |  |  |  |
| Oxalic acid | 144‑62‑7 |  | 1 |  |
|  |  |  |  |  |
| Oxygen difluoride | 7783‑41‑7 | 0.05 | 0.1 |  |
|  |  |  |  |  |
| Ozone | 10028‑15‑6 | 0.1 | 0.2 |  |
|  |  |  |  |  |
| Paraquat, respirable dust | 4685‑14‑7 |  | 0.5 | X |
|  | 1910‑42‑5 |  |  |  |
|  | 2074‑50‑2 |  |  |  |
|  |  |  |  |  |
| Parathion | 56‑38‑2 |  | 0.1 | X |
|  |  |  |  |  |
| Particulates not otherwise regulated (PNOR)(f) |  |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| PCB; see Chlorodiphenyl (42% and 54% chlorine) |  |  |  |  |
|  |  |  |  |  |
| Pentaborane | 19624‑22‑7 | 0.005 | 0.01 |  |
|  |  |  |  |  |
| Pentachloronaphthalene | 1321‑64‑8 |  | 0.5 | X |
|  |  |  |  |  |
| Pentachlorophenol | 87‑86‑5 |  | 0.5 | X |
|  |  |  |  |  |
| Pentaerythritol | 115‑77‑5 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Pentane | 109‑66‑0 | 1000 | 2950 |  |
|  |  |  |  |  |
| 2‑Pentanone (Methyl propyl ketone) | 107‑87‑9 | 200 | 700 |  |
|  |  |  |  |  |
| Perchloroethylene (Tetrachloroethylene) | 127‑18‑4 |  | (2) |  |
|  |  |  |  |  |
| Perchloromethyl mercaptan | 594‑42‑3 | 0.1 | 0.8 |  |
|  |  |  |  |  |
| Perchloryl fluoride | 7616‑94‑6 | 3 | 13.5 |  |
|  |  |  |  |  |
| Perlite | 93763‑70‑3 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Petroleum distillates (Naphtha)(Rubber Solvent) |  | 500 | 2000 |  |
|  |  |  |  |  |
| Phenol | 108‑95‑2 | 5 | 19 | X |
|  |  |  |  |  |
| p‑Phenylene diamine | 106‑50‑3 |  | 0.1 | X |
|  |  |  |  |  |
| Phenyl ether, vapor | 101‑84‑8 | 1 | 7 |  |
|  |  |  |  |  |
| Phenyl ether‑biphenyl mixture, vapor |  | 1 | 7 |  |
|  |  |  |  |  |
| Phenylethylene; see Styrene |  |  |  |  |
|  |  |  |  |  |
| Phenyl glycidyl ether (PGE) | 122‑60‑1 | 10 | 60 |  |
|  |  |  |  |  |
| Phenylhydrazine | 100‑63‑0 | 5 | 22 | X |
|  |  |  |  |  |
| Phosdrin (Mevinphos) | 7786‑34‑7 |  | 0.1 | X |
|  |  |  |  |  |
| Phosgene (Carbonyl chloride) | 75‑44‑5 | 0.1 | 0.4 |  |
|  |  |  |  |  |
| Phosphine | 7803‑51‑2 | 0.3 | 0.4 |  |
|  |  |  |  |  |
| Phosphoric acid | 7664‑38‑2 |  | 1 |  |
|  |  |  |  |  |
| Phosphorus (yellow) | 7723‑14‑0 |  | 0.1 |  |
|  |  |  |  |  |
| Phosphorus pentachloride | 10026‑13‑8 |  | 1 |  |
|  |  |  |  |  |
| Phosphorus pentasulfide | 1314‑80‑3 |  | 1 |  |
|  |  |  |  |  |
| Phosphorus trichloride | 7719‑12‑2 | 0.5 | 3 |  |
| **Substance** | **CAS No.**  **(c)** | **Ppm**  **(a)(1)** | **mg/m3**  **(b)(1)** | **Skin designation** |
| Phthalic anhydride | 85‑44‑9 | 2 | 12 |  |
|  |  |  |  |  |
| Picloram | 1918‑02‑1 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Picric acid | 88‑89‑1 |  | 0.1 | X |
|  |  |  |  |  |
| Pindone (2‑Pivalyl‑1,3‑indandione) | 83‑26‑1 |  | 0.1 |  |
| Plaster of paris | 26499‑65‑0 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Platinum (as Pt) Metal Soluble Salts | 7440‑06‑4 |  | 0.002 |  |
|  |  |  |  |  |
| Portland cement | 65997‑15‑1 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Propane | 74‑98‑6 | 1000 | 1800 |  |
|  |  |  |  |  |
| beta‑Propriolactone; see 1910.1013 | 57‑57‑8 |  |  |  |
|  |  |  |  |  |
| n‑Propyl acetate | 109‑60‑4 | 200 | 840 |  |
|  |  |  |  |  |
| n‑Propyl alcohol | 71‑23‑8 | 200 | 500 |  |
|  |  |  |  |  |
| n‑Propyl nitrate | 627‑13‑4 | 25 | 110 |  |
|  |  |  |  |  |
| Propylene dichloride | 78‑87‑5 | 75 | 350 |  |
|  |  |  |  |  |
| Propylene imine | 75‑55‑8 | 2 | 5 | X |
|  |  |  |  |  |
| Propylene oxide | 75‑56‑9 | 100 | 240 |  |
|  |  |  |  |  |
| Propyne; see Methyl acetylene |  |  |  |  |
|  |  |  |  |  |
| Pyrethrum | 8003‑34‑7 |  | 5 |  |
|  |  |  |  |  |
| Pyridine | 110‑86‑1 | 5 | 15 |  |
|  |  |  |  |  |
| Quinone | 106‑51‑4 | 0.1 | 0.4 |  |
|  |  |  |  |  |
| RDX: see Cyclonite |  |  |  |  |
|  |  |  |  |  |
| Rhodium (as Rh), metal fume | 7440‑16‑6 |  | 0.1 |  |
| and insoluble compounds |  |  |  |  |
|  |  |  |  |  |
| Rhodium (as Rh), soluble compounds | 7440‑16‑6 |  | 0.001 |  |
|  |  |  |  |  |
| Ronnel | 299‑84‑3 |  | 15 |  |
|  |  |  |  |  |
| Rotenone | 83‑79‑4 |  | 5 |  |
|  |  |  |  |  |
| Rouge |  |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Selenium compounds (as Se) | 7782‑49‑2 |  | 0.2 |  |
|  |  |  |  |  |
| Selenium hexafluoride (as Se) | 7783‑79‑1 | 0.05 | 0.4 |  |
|  |  |  |  |  |
| Silica, amorphous, precipitated and gel | 112926‑00‑8 |  | (3) |  |
|  |  |  |  |  |
| Silica, amorpous, diatomaceous earth, |  |  |  |  |
| containing less than 1% crystalline silica | 61790‑53‑2 |  | (3) |  |
|  |  |  |  |  |
| Silica, crystalline cristobalite, respirable dust | 14464‑46‑1 |  | (3) |  |
|  |  |  |  |  |
| Silica, crystalline quartz, respirable dust | 14808‑60‑7 |  | (3) |  |
|  |  |  |  |  |
| Silica, crystalline tripoli (as quartz), respirable dust | 1317‑95‑9 |  | (3) |  |
|  |  |  |  |  |
| Silica, crystalline tridymite, respirable dust | 15468‑32‑3 |  | (3) |  |
|  |  |  |  |  |
| Silica, fused, respirable dust | 60676‑86‑0 |  | (3) |  |
|  |  |  |  |  |
| Silicates (less than 1% crystalline silica) |  |  |  |  |
| Mica (respirable dust) | 12001‑26‑2 |  | (3) |  |
| Soapstone, total dust |  |  | (3) |  |
| Soapstone, respirable dust |  |  | (3) |  |
| Talc (containing asbestos): use asbestos limit: |  |  |  |  |
| see 29 CFR 1910.1001 |  |  | (3) |  |
|  |  |  |  |  |
|  |  |  |  |  |
| **Substance** | **CAS No.**  **(c)** | **Ppm**  **(a)(1)** | **mg/m3**  **(b)(1)** | **Skin designation** |
| Talc (containing no asbestos), respirable dust  Tremolite, asbestiform; see 1910.1001 | 14807‑96‑6 |  | (3) |  |
|  |  |  |  |  |
| Silicon | 7440‑21‑3 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Silicon carbide | 409‑21‑2 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Silver, metal and soluble compounds (as Ag) | 7440‑22‑4 |  | 0.01 |  |
|  |  |  |  |  |
| Soapstone; see Silicates |  |  |  |  |
|  |  |  |  |  |
| Sodium fluoroacetate | 62‑74‑8 |  | 0.05 | X |
|  |  |  |  |  |
| Sodium hydroxide | 1310‑73‑2 |  | 2 |  |
|  |  |  |  |  |
| Starch | 9005‑25‑8 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Stibine | 7803‑52‑3 | 0.1 | 0.5 |  |
|  |  |  |  |  |
| Stoddard solvent | 8052‑41‑3 | 500 | 2900 |  |
|  |  |  |  |  |
| Strychnine | 57‑24‑9 |  | 0.15 |  |
|  |  |  |  |  |
| Styrene | 100‑42‑5 |  | (2) |  |
|  |  |  |  |  |
| Sucrose | 57‑50‑1 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Sulfur dioxide | 7446‑09‑5 | 5 | 13 |  |
|  |  |  |  |  |
| Sulfur hexafluoride | 2551‑62‑4 | 1000 | 6000 |  |
|  |  |  |  |  |
| Sulfuric acid | 7664‑93‑9 |  | 1 |  |
|  |  |  |  |  |
| Sulfur monochloride | 10025‑67‑9 | 1 | 6 |  |
|  |  |  |  |  |
| Sulfur pentafluoride | 5714‑22‑7 | 0.025 | 0.25 |  |
|  |  |  |  |  |
| Sulfuryl fluoride | 2699‑79‑8 | 5 | 20 |  |
|  |  |  |  |  |
| Systox; see Demeton |  |  |  |  |
|  |  |  |  |  |
| 2,4,5‑T (2,4,5‑tri‑chlorophenoxyacetic acid) | 93‑76‑5 |  | 10 |  |
|  |  |  |  |  |
| Talc; see Silicates |  |  |  |  |
|  |  |  |  |  |
| Tantalum, metal and oxide dust | 7440‑25‑7 |  | 5 |  |
|  |  |  |  |  |
| TEDP (Sulfotep) | 3689‑24‑5 |  | 0.2 | X |
|  |  |  |  |  |
| Tellurium and compounds (as Te) | 13494‑80‑9 |  | 0.1 |  |
|  |  |  |  |  |
| Tellurium hexafluoride (as Te) | 7783‑80‑4 | 0.02 | 0.2 |  |
|  |  |  |  |  |
| Temephos | 3383‑96‑8 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| TEPP (Tetraethyl pyrophosphaate) | 107‑49‑3 |  | 0.05 | X |
|  |  |  |  |  |
| Terphenylis | 26140‑60‑3 | (C)1 | (C)9 |  |
|  |  |  |  |  |
| 1,1,1,2‑Tetrachloro‑2,2‑difluoroethane | 76‑11‑9 | 500 | 4170 |  |
|  |  |  |  |  |
| 1,1,2,2‑Tetrachloro‑1,2‑difluoroethane | 76‑12‑0 | 500 | 4170 |  |
|  |  |  |  |  |
| 1,1,2,2‑Tetrachloro‑ethane | 79‑34‑5 | 5 | 35 | X |
|  |  |  |  |  |
| Tetrachoroethylene; see Perchloroethylene |  |  |  |  |
|  |  |  |  |  |
| Tetrachloromethane; see Carbon tetrachloride |  |  |  |  |
|  |  |  |  |  |
| Tetrachloronaphthalene | 1335‑88‑2 |  | 2 | X |
|  |  |  |  |  |
| Tetraethyl lead (as Pb) | 78‑00‑2 |  | 0.075 | X |
|  |  |  |  |  |
| Tetrahydrofuran | 109‑99‑9 | 200 | 590 |  |
|  |  |  |  |  |
| Tetramethyl lead, (as Pb) | 75‑74‑1 |  | 0.075 | X |
|  |  |  |  |  |
| Tetramethyl succinonitrile | 3333‑52‑6 | 0.5 | 3 | X |
|  |  |  |  |  |
| **Substance** | **CAS No.**  **(c)** | **Ppm**  **(a)(1)** | **mg/m3**  **(b)(1)** | **Skin designation** |
| Tetranitromethane | 509‑14‑8 | 1 | 8 |  |
|  |  |  |  |  |
| Tetryl (2,4,6‑Trinitro‑phenylmethyl‑nitramine) | 479‑45‑8 |  | 1.5 | X |
|  |  |  |  |  |
| Thallium, soluble compounds (as Tl) | 7440‑28‑0 |  | 0.1 | X |
| 4,4'‑Thiobis (6‑tert, Butyl‑m‑cresol) | 96‑69‑5 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Thiram | 137‑26‑8 |  | 5 |  |
|  |  |  |  |  |
| Tin, inorganic compounds (except oxides) (as Sn) | 7440‑31‑5 |  | 2 |  |
|  |  |  |  |  |
| Tin, organic compounds (as Sn) | 7440‑31‑5 |  | 0.1 |  |
|  |  |  |  |  |
| Titanium dioxide | 13463‑67‑7 |  |  |  |
| Total dust |  |  | 15 |  |
|  |  |  |  |  |
| Toluene | 108‑88‑3 |  | (2) |  |
|  |  |  |  |  |
| Toluene‑2,4‑diisocyanate (TDI) | 584‑84‑9 | (C)0.02 | (C)0.14 |  |
|  |  |  |  |  |
| o‑Toluidine | 95‑53‑4 | 5 | 22 | X |
|  |  |  |  |  |
| Toxaphene; see Chlorinated camphene |  |  |  |  |
|  |  |  |  |  |
| Tremolite; see Silicates |  |  |  |  |
|  |  |  |  |  |
| Tributyl phosphate | 126‑73‑8 |  | 5 |  |
|  |  |  |  |  |
| 1,1,1‑Trichloroethane; see Methyl chloroform |  |  |  |  |
|  |  |  |  |  |
| 1,1,2‑Trichloroethane | 79‑00‑5 | 10 | 45 | X |
|  |  |  |  |  |
| Trichloroethylene | 79‑01‑6 |  | (2) |  |
|  |  |  |  |  |
| Trichloromethane; see Chloroform |  |  |  |  |
|  |  |  |  |  |
| Trichloronaphthalene | 1321‑65‑9 |  | 5 | X |
|  |  |  |  |  |
| 1,2,3‑Trichloropropane | 96‑18‑4 | 50 | 300 |  |
|  |  |  |  |  |
| 1,1,2‑Trichloro‑1,2,2‑trifluoroethane | 76‑13‑1 | 1000 | 7600 |  |
|  |  |  |  |  |
| Triethylamine | 121‑44‑8 | 25 | 100 |  |
|  |  |  |  |  |
| Trifluorobromomethane | 75‑63‑8 | 1000 | 6100 |  |
|  |  |  |  |  |
| 2,4,6‑Trinitrophenyl; see Picric acid |  |  |  |  |
|  |  |  |  |  |
| 2,4,6‑Trinitrophenyl‑methyl nitramine; see Tetryl |  |  |  |  |
|  |  |  |  |  |
| 2,4,6‑Trinitrotoluene (TNT) | 118‑96‑7 |  | 1.5 | X |
|  |  |  |  |  |
| Triorthocresyl phosphate | 78‑30‑8 |  | 0.1 |  |
|  |  |  |  |  |
| Triphenyl phosphate | 115‑86‑6 |  | 3 |  |
|  |  |  |  |  |
| Turpentine | 8006‑64‑2 | 100 | 560 |  |
|  |  |  |  |  |
| Uranium (as U) | 7440‑61‑1 |  |  |  |
| Soluble compounds |  |  | 0.05 |  |
| Insoluble compounds |  |  | 0.05 |  |
|  |  |  |  |  |
| Vanadium | 1314‑62‑1 |  |  |  |
| Respirable dust (as V(2)O(5)) |  |  | (C)0.5 |  |
| Fume (as V(2)O(5)) |  |  | (C)0.1 |  |
|  |  |  |  |  |
| Vegetable oil mist |  |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Vinyl benzene; see Styrene |  |  |  |  |
|  |  |  |  |  |
| Vinyl chloride; see 1910.1017 | 75‑01‑4 |  |  |  |
|  |  |  |  |  |
| Vinyl cyanide; see Acrylonitrile |  |  |  |  |
|  |  |  |  |  |
| Vinyl toluene | 25013‑15‑4 | 100 | 480 |  |
| Warfarin | 81‑81‑2 |  | 0.1 |  |
|  |  |  |  |  |
| Xylenes (o‑, m‑, p‑isomers) | 1330‑20‑7 | 100 | 435 |  |
|  |  |  |  |  |
| Xylidine | 1300‑73‑8 | 5 | 25 | X |
|  |  |  |  |  |
| Yttrium | 7440‑65‑5 |  | 1 |  |
|  |  |  |  |  |
| Zinc chloride fume | 7646‑85‑7 |  | 1 |  |
|  |  |  |  |  |
| **Substance** | **CAS No.**  **(c)** | **Ppm**  **(a)(1)** | **mg/m3**  **(b)(1)** | **Skin designation** |
| Zinc oxide fume | 1314‑13‑2 |  | 5 |  |
|  |  |  |  |  |
| Zinc oxide | 1314‑13‑2 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Zinc stearate | 557‑05‑1 |  |  |  |
| Total dust |  |  | 15 |  |
| Respirable fraction |  |  | 5 |  |
|  |  |  |  |  |
| Zirconium compounds (as Zr) | 7440‑67‑7 |  | 5 |  |

Table Z2 Limits for Air Contaminants.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Compound |  | 8 Hour  TWA | Ceiling  Conc. | Max. Peak Conc. | |
| Conc. | Duration |
| Benzene | Z37.40-1969 | 10 ppm | 25 ppm | 50 ppm | 10 min |
| Berylium and Berylium  Compounds | Z37.29-1970 | 2 g/m3 | 5 g/m3 | 25 g/m3 | 30 min. |
| Cadmium  Fume  Dust | Z37.5-1970 | 100 g/m3  200 g/m3 | 300 g/m3  600 g/m3 | \_\_\_\_\_\_ | \_\_\_\_\_\_\_ |
| Carbon Disulfide | Z37.3-1968 | 20 ppm | 30 ppm | 100 ppm | 30 min. |
| Carbon Tetrachloride | Z37.17-1967 | 10 ppm | 25 ppm | 200 ppm | 5 min. in 4 hr. per. |
| Chromic acid and  Chromates | Z37.7-1971 |  | 100 g/m3 |  |  |
| Ethylene Dibromide | Z37.31-1970 | 20 ppm | 30 ppm | 50 ppm | 5 min. |
| Ethylene Dichloride | Z37.21-1969 | 50 ppm | 100 ppm | 200 ppm | 5 min. in 3 hr. per. |
| Fluoride (as dust) | Z37.28-1969 | 2,500 g/m3 |  |  |  |
| Hydrogen Fluoride | Z37.28-1969 | 3 ppm |  |  |  |
| Hydrogen Sulfide | Z37.2-1966 |  | 20 ppm | 50 ppm | 10 min. if  no add. exposure |
| Mercury | Z37.8-1971 |  | 100 g/m3 |  |  |
| Methyl Chloride | Z37.18-1969 | 100 ppm | 200 ppm | 300 ppm | 5 min. in 3 hr. per. |
| Methylene Chloride | Z37.23-1969 | 500 ppm | 1,000 ppm | 2,000 ppm | 5 min. in 2 hr. per. |
| Alkyl Mercury | Z37.30-1969 | 10 g/m3 | 40 g/m3 |  |  |
| Styrene | Z37.15-1969 | 100 ppm | 200 ppm | 600 ppm | 5 min. in 3 hr. per. |
| Tetrachloroethylene | Z37.22-1967 | 100 ppm | 200 ppm | 300 ppm | 5 min. in 3 hr. per. |
| Toluene | Z37.12-1967 | 200 ppm | 300 ppm | 500 ppm | 10 min. |
| Trichloroethylene | Z37.19-1967 | 100 ppm | 200 ppm | 300 ppm | 5 min. in 2 hr. per |

Table Z3 Limits for Air Contaminants.

|  |  |  |
| --- | --- | --- |
| Coumpound | Millions of Particles  per cubic foot of air | mg/ m3 |
| Silica:  Crystaline  Quartz (Respirable)  Quartz (Total Dust)  Cristobalite  Tridymite  Amorphous ( incl. natural  diatamaceous earth)  Silicates ( Less than 1% Crystaline)  Mica  Soapstone  Talc (non-asbestos)  Portland Cement | 20  20  20  50 | 10 / (%SiO2 + 2)  30 / (%SiO2 + 2)  1/2 Value Calc. for Quartz  1/2 Value Calc. for Quartz  80 /(%SiO2) |
| Graphite (Natural) | 15 |  |
| Coal Dust -- Respirable  Less than 5% SiO2  Greater than 5% SiO2 |  | 2.4 / (%SiO2 + 2)  10 / (%SiO2 + 2) |
| Inert or Nuisance Dust  Respirable  Total Dust | 15  50 | 5  15 |

[54 FR 36767, Sept. 5, 1989; 54 FR 41244, Oct. 6, 1989; 55 FR 3724, Feb. 5, 1990; 55 FR 12819, Apr 6, 1990; 55 FR 19259, May 9, 1990; 55 FR 46950, Nov. 8, 1990; 57 FR 29204, July 1, 1992; 57 FR 42388, Sept. 14, 1992; 58 FR 35340, June 30, 1993]

24.0 DEPARTMENT POLICIES RELATING TO THE CHP

###### Policy 1

###### End of Term Sign-Out Policy ("Check-Out" Policy)

The intention of the Chemical Hygiene Plan is to reduce exposure to hazardous chemicals in the laboratory. Materials left by departing laboratory workers can provide an unexpected source of exposure if proper clean-up, disposal, storage and transfer of responsibility for hazardous materials is not accomplished.

Students, graduate students and post-doctoral fellows shall be responsible for cleaning their laboratory area and apparatus, for storing chemicals and materials appropriately, and for disposing of waste materials correctly before leaving the Department of Chemistry.

Laboratory Supervisors shall be responsible to certify prior to termination of a Laboratory employee that the following conditions have been met.

1. Laboratory area has been cleaned and glassware, apparatus and chemicals have stored properly.

2. All laboratory employee generated chemicals have been properly identified and labeled.

3. All wastes and hazardous materials have been either disposed of or responsibility for them has been transferred to a continuing laboratory employee.

4. All safety responsibilities have been reassigned to continuing laboratory employees and notification has been made to the Chemical Hygiene Officer.

Signatures of the Laboratory Supervisor and the Chemical Hygiene Officer will be required on the Exit Form available through the Personnel Office.

Adopted 4-12-95

24.0 DEPARTMENT POLICIES RELATING TO THE CHP

###### Policy 2

###### Safety Enforcement Policy

**Introduction**

The Department of Chemistry, specifically the Chairperson, faculty and staff, recognizes that we must comply with a variety of State and Federal mandates including those issued by the Environmental Protection Agency (EPA), the Occupational Health and Safety Administration (OSHA) and the State of Ohio (Administrative, Building and Fire Codes). Each employee of the Department, therefore, has an obligation to understand and comply with applicable environmental, health and safety regulations as well as those policies established by the University, the College of Mathematics and Physical Sciences, and the Department of Chemistry. This means that all faculty, emeritus faculty, staff, graduate students, visitors and guests must:

Observe health and safety related signs, warning signals and directions.

Review the Department's emergency procedures.

Have an awareness of potential work hazards.

Take appropriate health and safety training.

Follow all standard operating procedures and precautions.

Warn coworkers about defective equipment and notify appropriate personnel.

Use personal protective equipment and safety engineering equipment appropriate to their work.

Stop work that poses imminent danger to health and safety and notify appropriate personnel.

Participate in required inspection and monitoring activities.

Report unsafe conditions to a supervisor or the Department Safety Committee.

All supervisors, Principal Investigators and Managers are responsible for the safe operation of their laboratories or areas. They must:

Train employees to identify and mitigate potential hazards.

Maintain and update a chemical inventory as required.

Develop and implement procedures and practices as required by the Department Chemical Hygiene and Hazard Communication Plans.

Analyze work procedures for hazard identification and correction.

Promote regular self-assessment inspections to review and correct deficiencies.

Implement measures to eliminate or control workplace hazards.

Encourage prompt employee reporting of health and safety problems without fear of reprisal.

Stop any work that poses imminent danger.

The Chairperson with the Safety Committee must:

Within the resources available, ensure that all environmental, health and safety obligations are fulfilled.

Communicate the importance of establishing a high priority for health, safety and a concern for the environment.

Inspections

The Chairperson, the Administrative Manager, the Chemical Hygiene Officer (Safety Coordinator) and all members of the Safety Committee will have authority to:

Conduct random and/or periodic inspections anywhere within the Department to monitor compliance.

Issue verbal and written warnings based on above inspections. The written warnings will be addressed to the individual in violation of the policies, with copies to the individual's supervisor and the Safety Committee.

Stop or curtail any work or process that is immediately or imminently dangerous to life and health and padlock the laboratory until the danger can be resolved.

**The Enforcement Mechanism**

Violations of accepted policies may be discovered by casual observation, inspection by a member of the Department Safety Committee or Chemical Hygiene Officer (Safety Coordinator), inspection by State Fire Marshall or University Environmental Health and Safety Division, OSHA inspection or reported accident, or formal complaint. The attached table provides the type of incentives that can be applied for a given violation. Under normal circumstances, a first incident will result in actions taken at the first level (top of table). Increasing incentive levels may be reached by continuing noncompliance for a single violation. If the violation is egregious in nature, it is also possible to reach higher incentive levels for a single violation. The incentives listed for each level are options that may be applied individually or in combination to achieve compliance with safety requirements.

The Department of Chemistry will not assess fines as an incentive for compliance. Furthermore, if penalties or charges for remedial services are applied by agencies outside of the Department or University, individual liability for direct costs and fines should not exceed $1,000 for students and/or staff or $5,000 for faculty members of the Department at the highest level of severity. Progressively lower limits should be applied for incidents of lesser severity. These limits of liability should be viewed as guidelines and do not imply a level of financial responsibility.

Adopted 4-20-95

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 5  OSU Administration | 4  Chair's Advisory  Committee | 3  Chairperson | 2  Safety  Committee | 1  Laboratory  Supervisor  or CHO | Compliance  **Table of Incentives for Compliance with Fire, Safety and Chemical Hygiene Plan Requirements**  Incentive level |
| Request Dismissal Hearing through the Graduate School Initiate Judicial Proceedings | Removal of Department Subsidies for Tuition and Fees  Removal of GTA or GRA Status  Revoke Laboratory Privileges until  reinstated by Chairman  Postpone Graduation | Remove Lab Privileges until Safety  Course Successfully Repeated | Written Reprimand  Review Pertinent MSDS's and SOP's  Safety Refresher  Reduce Laboratory Privileges | Verbal Reprimand by Supervisor  Document Incident | Students |
| Continue Disciplinary Action which may lead to Dismissal Initiate Judicial Proceedings | Continue Disciplinary Actions through Office of Human resources which may  result in:  Unpaid Leave of Absence  Possible Reassignment  Reduction in Grade | Initiate Disciplinary Action through Office of Human Resources | Written Reprimand  Review Pertinent MSDS's and SOP's  Counseling Session for Employee and Supervisor  Safety Refresher | Verbal Reprimand by Supervisor  Document Incident | Staff |
| Initiate Proceedings under Faculty Rule  3335-5-04 which may lead to dismissal  Initiate Judicial Proceeding | Suspend ability to recruit students  Reduce Lab Space  Padlock lab until compliance met  Notify OSURF/ Granting Agencies of  Non-compliance | Initiate Disciplinary Action  Freeze Caley Accounts  Remove Dept. Subsidies for Support Services | Written Reprimand  Review Pertinent MSDS' and SOP's  Appear before Safety Committee | Document Incident | Faculty |

24.0 DEPARTMENT POLICIES RELATING TO THE CHP

Policy 3

**Disposal Policy for Materials of Uncertain Composition** ("Chemical Unknowns")

Disposal of hazardous waste is dangerous and expensive even when the contents of the waste are identified. Fortunately, most of the chemical waste produced by the Department is identifiable. However, when the contents of a reagent bottle, reaction flask or gas cylinder are not identified, the process of disposal is much more dangerous, expensive and difficult. Without mitigating information, all unknown materials have to be treated as if they were potentially lethal and hazardous. In all cases, chemical unknowns cannot be disposed of until a general profile of the unknown has been generated. Even then, the cost of disposal is a premium. Additionally, there is a constant threat of personal injury or death to the individuals required to handle these potentially dangerous materials. No price tag can be attached to an avoidable personal injury.

The obvious goal is to reduce the number of "unknowns" to as close to zero as possible by following the Chemical Hygiene Plan and the Hazard Communication Protocol. Labeling all chemical containing glassware; disposing of all old, outdated and questionable chemicals and samples; recycling unneeded chemical reagents; maintaining separate waste containers for different classes of chemical wastes; and keeping a running log of the amounts and quantities of all wastes placed into disposal containers will reduce the number of unknowns and should be considered standard laboratory practice. This policy details the procedures that should be followed when an "unknown" is discovered and a request for disposal is to be generated.

**Procedure**

It is the responsibility of the generator to identify each "unknown" as completely as possible before submitting an "unknown" to the Safety Office. The generator is defined as the Principal Investigator (PI) or Laboratory Supervisor initiating the disposal request.

The three steps to be followed by the generator are:

1. Complete an UNKNOWN PROFILE FORM, available from the Safety Office.

2. Attach the sheet to the material being submitted for disposal.

3. Call the Safety Office at 9-679-1820 or 9-679-1438.

**Instructions for Completing the UNKNOWN PROFILE FORM**

1. Container Identification Number

The Generator will supply a Container Identification Number which should include the Generator's surname, the year and a number unique to the container submitted. This number should be included on all information attached.

1. Generator Knowledge.

If the Lab Supervisor has adequate knowledge of the material, then "Generator Knowledge" can be a substitute for analytical tests and can greatly simplify the process of dealing with the "unknown". Provide a physical description to include the appearance, odor and quantity of the unknown; the source and/or history of the unknown; and, especially, a listing of potential elements for inorganic waste or compounds for organic waste, even if the percentages or absolute amounts are not known. The presence of specific hazard classes should be indicated with a "**Y**" when known. If the presence of a material is likely (but not certain), indicate with a "**?**". When compounds or classes of compounds are known to be absent, a "**N**" should be placed in the appropriate blank

1. Analytical Tests

In the absence of generator knowledge, the results of screening tests should be provided by the Laboratory Supervisor to provide an indication of the major components present. Suggested screening tests include a determination of the pH and a general qualitative analysis. If radioactive contamination is suspected, the Office of Radiation Safety must be contacted to schedule an accurate test for Alpha and Beta emissions. Specific additional tests that will assist the Safety Office in the disposing the materials are strongly recommended, but are at the discretion of the Laboratory Supervisor. Use of Departmental instrumentation to test unknowns in preparation for disposal will not be charged to the Laboratory Supervisor.

1. Signature

Each sample must be accompanied by a signature of the PI or Laboratory Supervisor or designated individual certifying the above information is the best "Good Faith Effort" to describe and identify the unknown.

**Notice**

Individuals who dispose of hazardous wastes in an inappropriate manner will face disciplinary action as outlined in the Departmental Enforcement Policy.

Adopted 10/2/96

**Unknown Profile Form**

**Department of Chemistry**

**I. Container Identification Number**  (Name/Year/#) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Laboratory Supervisor \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Contact Name (If different than Laboratory Supervisor) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Contact Telephone Number \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Building/ Room Number \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**II. Generator Knowledge**

Source of Material \_\_\_ Lab Clean Out \_\_\_ Reagent \_\_\_ Lab Waste \_\_\_ Unknown \_\_\_ Other \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Physical Description** \_\_\_ Solid \_\_\_ Liquid \_\_\_ Gas

Color \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Odor \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Quantity \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Potential Contents:**  (Y = Present, ? = Possible, N = Known Absent)

**General Classification**

\_\_\_ Organic Only \_\_\_ Inorganic Only \_\_\_ Mixture

**Potential Hazard Classes** (\* Critical Information for Disposal)

|  |  |  |  |
| --- | --- | --- | --- |
| \_\_\_ Strong Acids\* | \_\_\_ Strong Bases\* | \_\_\_ Mercury\* | \_\_\_ Flammable\* |
| \_\_\_ Radioactive\* | \_\_\_ Peroxides\* | \_\_\_ Cyanide | \_\_\_ Air Reactive |
| \_\_\_ Water Reactive | \_\_\_ Oxidizer | \_\_\_ Picrates | \_\_\_ Pyrophoric |
| \_\_\_ Heavy Metals | \_\_\_ Perchlorates | \_\_\_ Sulfide | \_\_\_ Biological |

**III. Analytical Tests Performed**

pH \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Qualitative Analysis (attach results)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Additional Tests Performed (attach results) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**IV. Laboratory Supervisor** (Print) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Signature** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_

1. DEPARTMENT FORMS RELATING TO THE CHP

Form 1-Monthly Laboratory Self-Inspection

**Monthly Laboratory Self-Inspection Checklist**

**for Laboratory Personnel** (updated June 8, 1998)

Laboratory Inspection Teams - Each Laboratory Supervisor will appoint two or more individuals to conduct laboratory self- inspections (Section 3 of the CHP, under “Laboratory Inspection Teams).

Inspector names\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Date\_\_\_\_\_\_\_\_\_\_\_

Building and Room Number\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Emergency Equipment:**

Safety Showers: Last Inspection Dates?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Accessible?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Eye Wash Units: Last Inspection Dates?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Accessible?\_\_\_\_\_\_\_\_\_\_ Adequate Flow?\_\_\_\_\_\_\_\_\_\_\_\_

How Many Fire Extinguishers:\_\_\_\_\_\_\_ Accessible?\_\_\_\_\_\_\_ Pin in Place?\_\_\_\_\_\_

Damage?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Full Gauge (if applicable)?\_\_\_\_\_\_\_\_\_\_\_

How many Fire Blankets:\_\_\_\_\_\_\_\_\_\_\_ Available and Accessible?\_\_\_\_\_\_\_\_

How many First Aid Kits:\_\_\_\_\_\_\_\_\_\_\_ Available and Accessible?\_\_\_\_\_\_\_\_ Adequately Stocked?\_\_\_\_\_\_

Fire Doors: Blocked or Blocked Open?\_\_\_\_\_\_\_\_\_

How many Spill Kits:\_\_\_\_\_\_\_\_\_\_ Available and Accessible?\_\_\_\_\_\_\_\_ Adequately Stocked?\_\_\_\_\_\_

**Fume Hoods:**

Functioning Properly (indicator or tissue paper)?\_\_\_\_\_\_\_\_ If "NO", indicate which hood has malfunctioned

and notify your supervisor\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Are the inspection tags current?\_\_\_\_\_\_\_\_\_\_\_\_ Improperly Used for Storage and Disposal?\_\_\_\_\_\_\_\_\_\_\_\_\_

**Miscellaneous:**

Personal Protective Equipment available (gloves, safety glasses, etc.)?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Gas cylinders secured?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Evidence of food or drink in the laboratory?\_\_\_\_\_\_\_

Training Records Up-to-Date?\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Chemical Inventory Up-to-Date?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Chemicals Properly Stored?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Are all bottles properly labeled?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Vacuum Pumps Properly Guarded?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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

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**Monthly Inspection Explanation Sheet**

Self-inspections should take place at least monthly. According to the CHP (page 10), the supervisor should appoint two inspectors. If there are any problems, questions, or concerns, please indicate them in the “Comments” section at the bottom of the page.

Emergency Equipment

Safety showers and eye wash units should be tagged and the last inspection date should be indicated. Drench hoses should not be used as eye wash units and should not have a tag. If they are the only source of water in the area, however, they should be tagged and inspected. Test the eye wash for adequate flow and run until the water is clear. Each safety shower / eye wash unit area should be free of clutter and thus is accessible. All emergency equipment must be accessible at all times.

Each lab must have at least one CO2 fire extinguisher. Some labs have other types depending on need. Each extinguisher should be inspected for damage, pin in place, and gauge pressure (if it has a gauge). Missing or damaged extinguishers should be reported to the Safety Office. DO NOT “TEST” A FIRE EXTINGUISHER BY “FIRING” IT.

Fire blankets are not required, but if you have one, it must be accessible. Each lab or lab area must have a first-aid kit and it must be stocked. The first-aid kit has an inventory of its contents as well as the re-order numbers. Replacement items are available from Stores/Fisher Scientific. Fire doors (most lab doors leading into hallways) should remain closed. They should not be blocked (preventing egress) or blocked open (potentially spreading fire). Spill-kits, like first-aid kits, must be maintained. See the Safety Office for replacement items. Each lab or lab area must have a spill-kit.

Fume Hoods

Fume hoods must be inspected for operation and clutter before each use or daily. A flow indicator and/or a tissue ribbon on the sash indicates flow. Mark the date on the inspection tag near the hood face. If you suspect a problem with the fume hood, notify your supervisor and the Safety Office and indicate the problem on the tag.

Miscellaneous

Appropriate personal protective equipment (PPE) should be available and in good condition. See the Safety Handbook or the Safety Webpage for more details. Gas cylinders, whether in use or in storage, must be secured with a strap or chain. Food or drink must not be consumed in the lab. Evidence of consumption is usually found in the form of wrappers or cups on bench tops or in the trash can. Vacuum pump belts and pulleys must be guarded per 29 CFR 1910.219.

Supervisors should maintain a chemical inventory. The chemicals themselves should be inspected to make sure that labels aren’t damaged or falling off. The chemicals must be stored according to hazard class. Reactive chemicals should be stored by themselves away from other chemicals. See the Safety Handbook or the Safety Webpage for more details.

Each lab has its own, potentially unique, hazards. The supervisor is obligated to train the student on those unique hazards, processes, or pieces of equipment. That training must be documented (names, dates, and subject material covered)

1. DEPARTMENT FORMS RELATING TO THE CHP

Form 2-Operations Requiring Prior Approval

**Operations Requiring Prior Approval**

Using and storing certain chemicals may require prior approval. Some of these compounds include, but are not limited to: Fluorine; Chlorine; Phosgene; Phosphine; Arsine; anhydrous Hydrofluoric Acid; Carbon Monoxide; Hydrogen Sulfide; Boron Hydrides; highly reactive or explosive chemicals such as Boron Hydrides, unstable Hydrogen Peroxides, Heavy Metal Azides and Acetylides; or highly toxic chemicals such as cholinesterase inhibitors, some pesticides and magic methyl or related compounds.

The intent of this document is to ensure that the hazards associated with these compounds are thoroughly understood AND that every reasonable precaution is taken to protect the health and safety of those involved.

Use the Back of the sheet and/or attachments as necessary.

Name of Responsible Party\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_

Location of Operation \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Types of materials requiring prior approval and amounts \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Describe the available personal safety devices and engineering controls that will be used to minimize hazards while using and storing these materials i.e. fume hoods, glove hoods, exhaust systems, vacuum systems, etc.:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Approved \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

25.0 DEPARTMENT FORMS RELATING TO THE CHP

Form 3-Job Hazard Assessment and PPE Recommendation

Job Hazard Assessment And

**Personal Protective Equipment (PPE) Recommendation**

All laboratory supervisors must survey the work areas and activities under their control to determine: what hazards exist, steps to take to minimize those hazards, and what PPE may be required.

**Instructions:** Identify the workplace location and the general nature of the task. Conduct a walkthrough survey of the workplace and list the task or job functions or pieces of equipment that are hazardous and/or require PPE. Consult the Safety Coordinator/CHO for assistance. Sign and date this assessment. Keep this form with your other safety and training records.

**Please note:**

When determining if a potential hazard exists, consideration should be given to the following:

* history of injuries or illnesses related to the workplace or job
* history of employee complaints or concerns
* employees perception of hazards

**Location** **Task Name**

|  |  |  |
| --- | --- | --- |
| **Specific Tasks or Steps or Pieces of Equipment** | **Potential Hazard(s)** | **Methods to Reduce Hazard and Specific PPE Required** |
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I, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ , certify that the above location has been evaluated for potential hazards and the appropriate PPE, and that training has been performed.

Signature of Assessor\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

25.0 DEPARTMENT FORMS RELATING TO THE CHP

Form 4-Sample Training Documentation Sheet

Training Date and Time:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Building and Room\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Training Topic:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Trainer and/or the training media used:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Content or Outline of Topics Covered:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Attendees:

Print Name Signature

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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26.0 STANDARD OPERATING PROCEDURES (refer to the Safety Web Page)

23.1 APPENDIX I - Figure 2. Designated Area Marking for Carcinogens

23.1 APPENDIX I - Figure 2. Designated Area Marking for Carcinogens

27.0 BUILDING EVACUATION MAPS (refer to the Safety Web Page)

23.1 APPENDIX I - Figure 2. Designated Area Marking for Carcinogens

23.1 APPENDIX I - Figure 2. Designated Area Marking for Carcinogens

28.0 HAZARDOUS CHEMICAL INVENTORY

23.1 APPENDIX I - Figure 2. Designated Area Marking for Carcinogens

23.1 APPENDIX I - Figure 2. Designated Area Marking for Carcinogens

29.0 MATERIAL SAFETY DATA SHEETS

23.1 APPENDIX I - Figure 2. Designated Area Marking for Carcinogens

23.1 APPENDIX I - Figure 2. Designated Area Marking for Carcinogens

23.1 APPENDIX I - Figure 2. Designated Area Marking for Carcinogens

23.1 APPENDIX I - Figure 2. Designated Area Marking for Carcinogens

30.0 PREVIOUS INSPECTION SHEETS