

CHEMICAL HYGIENE PLAN

Reference 29 CFR 1910.1450
Occupational Exposure to
Hazardous Chemicals in Laboratories

Revised
September 8, 2021
by
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1601 N Benton Ave
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Foreword

The Occupational Safety and Health Administration's (OSHA) final standard, OSHA 1910.1450 Occupational exposure to hazardous chemicals in laboratories, became effective on May 1, 1990. All employers covered by the standard are required to develop a Chemical Hygiene Plan (CHP). The standard requires that the CHP be developed and implemented by January 31, 1991.

A CHP is defined in the standard as a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that are capable of protecting employees from the health hazards presented by chemicals used in that particular workplace, and meets the requirements of paragraph (e) of the standard.

The CHP must include operating procedures capable of protecting employees from health hazards associated with hazardous chemicals and keeping exposures below allowed limits. Standard operating procedures must include engineering controls and the use of personal protective equipment. The CHP must provide for employee information and training. The CHP must make provisions for medical consultation and examinations. Personnel responsible for the CHP must be designated. Provisions must be made for working with particularly hazardous substances.

This Chemical Hygiene Plan has been developed for Carroll College, 1601 N. Benton Ave., Helena, Montana. This CHP is available to Carroll employees in the Carroll Facilities Office and on the portion of Carroll College's website devoted to Environmental Health and Safety at <https://www.carroll.edu/safety-emergency/environmental-health-safety>. All laboratory personnel must know and follow the procedures outlined in this plan. This CHP will be reviewed, evaluated and updated at least annually and be readily available to employees, their representatives and any representative of the Assistant Secretary of Labor for OSHA.

President of Carroll College

John Cech

Chemical Hygiene Officer

Kyle Strode

Chemical Hygiene Committee

EJ Blitzer

Stefanie Otto-Hitt

Kyle Strode

David Hitt

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1.0 Standard Operating Procedures

1.1 Chemical Procurement and Distribution

The decision to procure a chemical is a commitment to handle and use the chemical properly from initial receipt to ultimate disposal.

All chemicals shall be received at the mailroom, Saint Central in St. Charles Hall. Authorized personnel shall transfer chemicals to the Fortin Center (FC), Room 114 or to the Simperman Hall (SH) Room 218. Personnel who transfer chemicals shall be knowledgeable of the procedures for handling and storing chemicals. Chemicals requiring refrigeration shall be transferred to an appropriate refrigeration unit as soon as possible.

Chemicals should be purchased in the smallest quantity that will suit the needs of an experiment. Chemicals should be purchased in an amount that can be expected to be consumed within five years. No chemicals shall be purchased in containers larger than four liters.

1.2 Chemical Storage

All shipping containers for chemicals shall be opened in FC 114 or SH 218. As the shipping containers are opened all chemicals shall be

1. initialed
2. dated with the month and year
3. labeled with tape of the appropriate color
 - a. blue-health hazard
 - b. gray-general
 - c. red-flammable
 - d. white-corrosive
 - e. yellow-reactive and oxidative
4. labeled with room number where it will be stored
5. entered into the chemical inventory
6. placed into proper storage

Compressed gas cylinders shall be delivered and secured by the company supplying the gases.

Only authorized personnel shall be allowed in the chemical storage rooms outside of the teaching laboratories. Authorized personnel include the science faculty, students designated as Laboratory Aides and research students under the supervision of a member of the science faculty.

Chemicals shall not be stored above head level. Corrosives and flammables shall be stored below eye level. Large bottles larger than three liters shall not be stored more than two feet above the floor.

Chemicals shall be stored by their characteristic hazards and segregated by compatibility. The Fisher Scientific Storage Code and fire diamond of the National Fire Protection Association (NFPA) shall be used to classify chemicals. (see Appendices H, K, and L) Organic solvents shall be segregated and stored in ventilated, storage cabinets. Solvents shall not be stored in containers larger than 5 gallons. Future procurements of solvents shall not be in containers larger than 4 liters.

Mineral acids, especially strong oxidizers such as nitric acid, perchloric acid and sulfuric acid, should be stored on acid resistant trays or coasters and separated from flammable and combustible materials.

Acid-sensitive chemicals such as cyanides and sulfides should be stored separately from acids or protected from contact with acids.

The designated laboratory preparation areas are FC 111, FC 114, FC 115, FC 116, FC 211, FC 212, FC 213, FC 214, FC 215, SH 215, SH 217, SH 218, SH 221 and SH 316. All chemical preparations shall be properly labeled. The amount of chemicals at a lab bench should be limited to those amounts needed for one experiment. Chemicals shall not be permanently stored in chemical fume hoods. Only chemicals needed for current experiments shall be kept in the chemical fume hoods.

The following faculty are responsible for periodic safety checks in these labs that use chemicals.

Room	Name	Room	Name
FC 111	John Rowley	SH 215	EJ Blitzer
FC 111B	Kyle Strode	SH 216	Stefanie Otto-Hitt
FC 115	John Rowley	SH 216A	Stefanie Otto-Hitt
FC 114	Kyle Strode	SH 216B	Stefanie Otto-Hitt
FC 116	John Rowley	SH 217	EJ Blitzer
FC 211	Kyle Strode	SH 218	EJ Blitzer
FC 212	Caroline Pharr	SH 220	EJ Blitzer
FC 213	Kyle Strode	SH 221	EJ Blitzer
FC 214	David Hitt	SH 222	Alyssa Hahn
FC 215	Caroline Pharr	SH 223	EJ Blitzer
FC 217A	John Rowley	SH 316	Brandon Sheafor
		SH 316A	Brandon Sheafor
		SH 316B	Brandon Sheafor
		SH 316C	Brandon Sheafor
		SH 316D	Brandon Sheafor
		SH 320	EJ Blitzer
		SH 321	EJ Blitzer
		SH 400	Beth Sheafor

The Chemical Hygiene Officer shall inspect the chemical storage areas at least annually. This inspection should determine whether storage procedures are being followed. The inspection should also determine whether any containers are leaking, corroded, or deteriorated.

1.3 Chemical Handling

1.3.1 General procedures

1. Never work alone in a laboratory or chemical storage area.
2. No unauthorized experiments shall be conducted.
3. When working with flammable chemicals, be sure that no sources of ignition are nearby.
4. Food and beverages shall not be stored or consumed in storage areas or laboratories in which chemicals are used or stored. Food and beverages shall not be stored in refrigerators used for chemical storage.
5. Tasting chemicals is prohibited.
6. Chemicals are smelled only by using the proper wafting technique.
7. The mouth shall not be used to pipette or to start a siphon.
8. Every chemical is assumed toxic and handled accordingly unless is known not to be toxic.
9. Work areas shall be kept clean and uncluttered. The work area shall be cleaned at the end of each work day or laboratory exercise.
10. Aisles must remain unblocked. Access to safety equipment such as showers, eyewash stations, fire extinguishers and exits must not be blocked.
11. Glassware and equipment shall be thoroughly cleaned prior to returning it to storage. Chipped or broken glassware shall be promptly disposed of in the container provided for broken glass.
12. All chemical containers must be properly labeled (see sec. 1.5). All chemicals in unlabeled containers are considered waste at the end of each day and must be disposed of properly.
13. Waste must be kept in properly labeled containers.
14. Spills must be promptly cleaned up and wastes put into the proper containers.
15. Horseplay of any kind is forbidden in the laboratory.
16. Each laboratory supervisor is responsible for ensuring that employees in that laboratory know and follow the rules and procedures.
17. In the case of a chemical spill immediate action should be taken to contain the spill and the laboratory supervisor should be notified so that proper cleanup can be performed.

1.3.2 Personal Hygiene

1. Appropriate eye protection shall be worn at all times.
2. Any chemical contact with the skin should be minimized. Wash promptly whenever a chemical comes into contact with the skin.
3. Wash all areas of exposed skin prior to leaving the laboratory.

4. No eating or drinking shall be done in the laboratory.
5. Cosmetics shall not be applied in the laboratory.
6. Long hair must be tied back.

1.3.3 Protective Clothing and Equipment

1. Appropriate eye protection shall be worn at all times. The safety glasses or goggles must comply with the American National Standard Practice for Occupational and Educational Eye and Face Protection., ANSI Z87.1. They must have protection from direct entry of chemicals from the sides, top and bottom.
2. Lab coats or aprons shall be worn. Lab coats must be laundered regularly. Lab coats and aprons are also the personal responsibility of and are purchased by each individual worker and student.
3. A face shield meeting ANSI Z87.1 shall be used when handling large amounts of corrosive chemicals.
4. Shoes must be worn. Sandals or footwear with open tops are prohibited.
5. Long pants or skirts should cover the legs.
6. Thermal-resistant, non-asbestos gloves shall be worn when handling heated equipment or exothermic reactions.
7. Appropriate gloves (see Appendix J) to prevent chemicals coming into contact with the skin must be worn when necessary. Gloves shall be washed before removal.

1.4 Specific Procedures and Precautions

Incidents of exposure to allergens, embryotoxins, chemicals with moderate or high chronic toxicity, or chemicals with high acute toxicity must be reported to the Chemical Hygiene Officer. Medical consultation or examination will be made available to the employee if needed.

1.4.1 Allergens, Embryotoxins and Teratogens

1. Appropriate gloves must be worn when working with allergens, embryotoxins, or teratogens.
2. Women of childbearing age may work with embryotoxins and teratogens only in a chemical fume hood.
3. Women who are pregnant shall not work with embryotoxins or teratogens.

1.4.2 Chemicals with Moderate Chronic or High Acute Toxicity

1. The MSDS's are the source of information regarding recommended limits for chemical exposure. In no case shall the Permissible Exposure Limits (PEL) of OSHA or the Threshold Limit Values (TLV) of the American Conference of Governmental Industrial Hygienist (ACGIH) be exceeded.
2. When toxic substances are handled which are likely to exceed the recommended limits, they shall be worked with in a chemical fume hood.
3. Gloves and a lab coat with long sleeves shall be worn.
4. Two people shall be present at all times with working with toxic chemicals.
5. Anyone working with toxic chemicals shall be familiar with the symptoms of exposure for those chemicals.
6. Spills of toxic chemicals will be reported to the Chemical Hygiene Officer.

1.4.3 Chemicals with High Chronic Toxicity

1. In addition to the procedures above for working with chemicals with moderate chronic or high acute toxicity, when working with chemicals of high chronic toxicity the following procedures apply.
2. Approval of the laboratory supervisor must be obtained.
3. Any contaminated glassware or other equipment must be cleaned prior to removal from the chemical fume hood.

1.4.4 Radioisotopes

Radioisotopes shall not be used.

1.4.5 Compressed Gas Cylinders

1. Gas Cylinders must be upright and securely attached to a lab bench or a wall whenever the cap is not in place.
2. The cap must be on any gas cylinder being moved. Gas cylinders shall be moved only with a dolly designed for gas cylinders.
3. When gas cylinders are empty, they shall be labeled as empty.
4. When opening a gas cylinder, be sure that the regulator valve is closed (counterclockwise) before opening the cylinder valve.
5. When closing a gas cylinder, close the cylinder valve and bleed the gas out of the system before closing the regulator valve (counterclockwise).

1.4.6 Unattended Operations

The following procedures are to be used when unattended operations such as overnight reactions are performed.

1. The laboratory supervisor shall be made aware of the operation.
2. A sign shall be posted at the door to the laboratory.
3. The lights shall be left on in the laboratory.
4. Appropriate precautions shall be taken against the possibility of loss of electricity, gas, or water during the unattended operation.

1.4.7 Sole Occupancy

No one shall work alone in a chemistry laboratory

1.5 Labeling

1.5.1 Chemical Stores

The label on chemical storage containers shall identify contents, source, date of acquisition, and indication of hazard. All labels must be durable.

1.5.2 Laboratory Chemicals

Any temporary chemical container used for a laboratory exercise shall at a minimum be labeled with the identity and concentration of its contents. If a chemical is to be kept in the laboratory for more than one laboratory exercise, it shall be fully labeled like the chemicals in the chemical storage area are labeled. The following label may be used for temporary containers:

1.5.3
Glass

Name _____

Conc. _____

Circle a Signal Word if Necessary

Danger Warning Caution

Circle a Hazard Classification if Necessary

Flammable	Corrosive	Oxidative/Reactive	Health
-----------	-----------	--------------------	--------

Date _____ Prep. by _____

Broken

Each laboratory shall have a labeled container for the disposal of broken glass.

1.5.4 Chemical Waste

All waste containers in laboratories must be clearly labeled as to the type of waste.

2.0 Control Measures and Equipment

Signs shall be posted to indicate the location of safety and emergency equipment. Emergency telephone numbers (see Appendix A) are to be posted in laboratories, chemical storage rooms, and near the hallway telephones.

The engineering controls and safety equipment in the laboratory shall be utilized and inspected in accordance with Appendix B.

2.1 Ventilation

2.1.1 Laboratory Ventilation

A chemistry laboratory should have at least eight air changes per hour.

2.1.2 Chemical Fume Hoods

The laboratory hoods shall be utilized for all chemical procedures that might result in release of hazardous chemical vapors or dust. As a general rule, the hood shall be used for all chemical procedures involving substances which are appreciably volatile and have a permissible exposure limit (PEL) less than 50 ppm.

1. The fume hoods shall have a face velocity of 60 to 100 feet per minute.
2. The fume hoods shall not be used to dispose of volatile waste.
3. Apparatus within the hood should be at least six inches away from the front.
4. The fume hood doors shall be kept closed except when adjusting apparatus.
5. If chemicals are left in the hood, the fans shall remain turned on.
6. Chemical fume hoods shall not be used as chemical or equipment storage areas.

2.2 Other Equipment

2.2.1 Safety Showers and Eyewash Stations

Eyewash stations and emergency showers must meet the requirements of ANSIZ358.1. They must be unobstructed at all times. They shall be inspected and tested at least once each month when classes are in session, and records of the inspections shall be kept.

- 2.2.2 Respirators
Procedures which require the use of a respirator shall not be performed.
- 2.2.3 Fire Extinguishers
Fire extinguishers shall be appropriate for the chemicals used or stored in laboratories and storage areas. Employees shall be trained in the use of the fire extinguishers.
- 2.1.3 Flammable Liquid Storage
Flammable liquids shall be stored in ventilated cabinets.

2.3 Chemical Wastes

Each laboratory shall have clearly labeled waste containers for each type of waste. All chemical wastes will be disposed of in accordance with the waste disposal plan. Halogenated and non-halogenated solvents will be stored temporarily in a chemical fume hood in FC 212. FC 111B will be the location for permanent storage for these wastes.

3.0 Employee Information and Training

All employees, faculty and laboratory assistants who work in the laboratories shall be trained prior to working in the laboratory. Previously-trained employees shall be updated in a formal training session whenever materials, procedures or chemical hazards change. The formal in-person training for new laboratory aides will be completed least annually. Records shall be kept of the training received and the exams given to employees.

MSDS's and SDS's are made available to employees via the online service, MSDSOnline, which can be accessed through the Environmental Health and Safety Moodle page.

Training shall be performed or supervised by the Chemical Hygiene Officer. The primary reference materials shall be the Chemical Hygiene Plan and "Safety in the Academic Laboratory, Volume 2," 7th ed., American Chemical Society, Washington, D.C., 2003.

3.1 Training

This training shall include;

1. Contents and location of the Chemical Hygiene Plan.
2. Chemical, physical and health hazards; symptoms of exposure
3. Emergency procedures, evacuation
4. Use of safety and emergency equipment
5. Contents of the OSHA laboratory standard
6. Hazard Communication Standard: labels and pictograms
7. Location of and the interpreting of MSDS's and SDS's
8. Location and availability of reference material on chemical hygiene

3.2 Forms

The forms in Appendices B-D shall be used for the implementation of this Chemical Hygiene Plan.

Appendix B Laboratory Safety Equipment Inspection

Appendix C Laboratory Safety Inspection Checklist

Appendix D Accident Report Form

4.0 Medical Consultations and Examinations

Employees who work with hazardous chemicals are entitled to a medical consultation in the event that chemical exposure is suspected. The medical consultation and examination shall be provided without cost to the employee and without loss of salary or wages for the time spent in the consultation.

See *Human Resources Emergency Procedures Manual* in the Office of Human Resources

5.0 Chemical Hygiene Responsibilities

5.1 Chief Executive Officer

The President of Carroll College has the ultimate responsibility for chemical hygiene.

5.2 Chemical Hygiene Committee

The Chemical Hygiene Committee through the Chemical Hygiene Officer shall:

1. Implement the Chemical Hygiene Plan.
2. Annually review and revise the Chemical Hygiene Plan as needed.
3. Regularly inspect the chemical laboratories to see that proper housekeeping procedures are being followed and that all safety and emergency equipment is in proper working order. Records of the inspections must be kept.
4. Maintain the chemical inventory.
5. Maintain the MSDS/SDS database.
6. Train all employees who work with hazardous chemicals.
7. Implement and carry out the waste disposal program.

5.3 Laboratory Employees

The employees must be knowledgeable of the Chemical Hygiene Plan and must maintain good chemical hygiene practices.

6.0 Records

1. Records shall be kept in the office of the Chemical Hygiene Officer and in FC 214A.
2. Employee training records will be maintained for ten years.
3. Equipment and laboratory inspection records will be maintained for ten years.
4. Accident reports will be maintained for ten years.
5. Exposure records for hazardous chemicals and harmful physical agents will be maintained for 30 years per 29 CFR 1910.20.
6. Medical records for employees exposed to hazardous chemicals and harmful physical agents will be maintained for the duration of employment plus 30 years per 29 CFR 1910.20.

7.0 References

7.1 Books

These references are available by contacting the Chemical Hygiene Officer. They are kept in either Fortin 114, chemical storage area, or Fortin 217, CHO office.

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

Chemical Guide to the OSHA Hazard Communication Standard, Clansky, Kenneth B., Editor, Roytech Publications, Inc., Burlingame, CA, 1987

NIOSH Pocket Guide to Chemical Hazards, U. S. Department of Health and Human Services, 1985

Improving Safety in the Chemical Laboratory: A Practical Guide, Young, Jay A., Editor, John Wiley & Sons, Inc., New York, 1991.

National Research Council, *Prudent Practices for Disposal of Chemicals from Laboratories*, National Academy Press, Washington, D.C., 1983.

Kaufman, James A., *Waste Disposal in Academic Institutions*, Lewis Publishers, Inc., Chelsea, MI, 1990

Pipitone, David A., *Safe Storage of Laboratory Chemicals*, Wiley & Sons, Inc. 1984.

7.2 Important Internet Sites

7.2.1 OSHA Laboratory Standard

Occupational Exposure to Hazardous Chemicals in Laboratories

29 CFR 1910.1450

OSHA Hazard Communication Standard

29 CFR 1910.1200

<https://www.osha.gov/hazcom>

Appendices

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Appendix A
Emergency Telephone Numbers

<u>General Emergency</u>	9-911		
Rocky Mountain <u>Poison</u> Center (Montana Branch)	9-1-800-222-1222	English – 1	Emergency – 2
<u>Carroll College</u>			
Facilities Management	ext. 5420		
Cell Phone (Butch)	9-594-4570		
Campus Nurse	ext. 5439		
Safety Coordinator	ext. 5500		
Security (Guad. desk)	ext. 510		

Appendix C
Laboratory Safety Inspection Checklist
Laboratory Safety Inspection Checklist
Chemistry Laboratories

Laboratory		Date
Laboratory Supervisor		
Inspector(s)		
✓	Item	Comments
	Room	
	Exits, aisles, and safety equipment unobstructed	
	Laboratory and storage cabinets uncluttered	
	Bench tops clean and uncontaminated	
	Fume hoods not used for permanent chemical storage	
	Electrical equipment, cords, and grounds in good condition	
	No heavy items on high shelves	
	Broken glass container available	
	First aid supplies available	
	No food or drinks in chemical refrigerators	
	Procedures and Personal Safety Equipment	
	No food or drinks in laboratory	
	Safety goggles being worn	
	Lab coats or aprons being worn	
	Proper lab techniques, e.g. pipetting, being used	
	Chemicals	
	Chemical storage segregated by hazard	
	Flammables in proper cabinets and below eye level	
	Corrosives in proper cabinets and below eye level	
	Nothing stored on top of flammable cabinets	
	Waste containers properly labeled	
	Secondary chemical containers properly labeled	
	Unnecessary chemicals moved from labs to storage	
	Gas Cylinders	
	Gas cylinders secured	
	Unused cylinders capped	
	Empty gas cylinders labeled as “empty” or “MT”	
	Regulators, tubing, hoses in good condition	
	Gas lines labeled	
	Oxygen gas stored 20 ft from fuel gases	

Appendix E

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
CAS	Chemical Abstract Service
CFR	Code of Federal Regulations
CHO	Chemical hygiene officer
CHP	Chemical hygiene plan
CPSC	Consumer Product Safety Commission
DOT	Department of Transportation
EPA	Environmental Protection Agency
HCS	Hazard Communication Standard
IARC	International Agency for Research on Cancer
LD 50	Lethal dose 50%
LEL	Lower explosive limit (synonym: LFL)
LFL	Lower flammability limit (synonym: LEL)
LNG	Liquefied natural gas
LQG	Large quantity generator (of hazardous waste)
MEL	Maximum exposure limits
MSDS	Material safety data sheet
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
NRC	Nuclear Regulatory Commission
NTP	National Toxicology Program
OES	Occupational exposure standards
OSHA	Occupational Safety and Health Administration
PEL	Permissible exposure limit
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
SOP	Standard operating procedure
SQG	Small quantity generator (of hazardous waste)
STEL	Short term exposure limit
TLV	Threshold limit value
TSCA	Toxic Substances Control Act
UEL	Upper explosive limit (synonym: UFL)
UFL	Upper flammability limit (synonym: UEL)
UL	Underwriters Laboratory

Appendix F

Definitions

Acute toxicity	Describes a substance that causes harm in a single exposure.
Asphyxiant	A gas or vapor that causes harm by suffocation, lack of oxygen.
Carcinogen	A substance that can cause cancer or cancerous growths in mammals. (See Select Carcinogen)
Caustic	A chemical that forms soaps with fatty acids. Also called alkali or a base.
Combustible liquid	A liquid with a flashpoint above 100 ⁰ F and below 200 ⁰ F.
Corrosive	A substance that damages tissue on contact.
Chronic toxicity	Describes a chemical which accumulates to cause injury after long term exposure.
Embryotoxin	A substance that can cause damage to an embryo at concentrations that cause no harm to the mother.
Flammable liquid	A liquid with a flashpoint below 100 ⁰ F.
Flashpoint	The temperature at which there is sufficient vapor to ignite.
Hazardous chemical	A chemical which has been shown to cause acute or chronic health problems.
Heavy metal	Elements beyond calcium on the periodic table which can be expected to be toxic if ingested or inhaled.
Hematopoietic	Refers to the blood forming system.
Hepatotoxin	A chemical that damages the liver.
Hypergolic mixture	Two chemicals that will ignite when mixed without an external ignition source.
Irritant	A substance that will induce a local inflammatory reaction.
Laboratory scale	Work where containers are designed to be handled safely and easily by one person.
Mutagen	A substance that can cause genetic changes in DNA on chromosomes.
Nephrotoxin	A chemical that damages the kidneys.
Neurotoxin	A chemical that damages nerve cells. They may effect behavior.
Oxidizer	A chemical that initiates or promotes the combustion of other materials.
Permissible Exposure	The limit set by OSHA for exposure to a chemical during an 8-hour shift. Limit (PEL)
Photosensitized	One who has a reaction to sunlight after exposure to a substance.
Pyrophoric	A chemical which oxidizes so rapidly in air that it will spontaneously ignite.
Reproductive toxin	A substance that has a harmful effect on an adult reproductive system, a developing fetus or a child.
Select carcinogen	1. Is regulated by OSHA as a carcinogen, 2. Is listed as “known to be carcinogen” in the Annual Report on Carcinogens by NTP, 3. Is listed under Group 1 (“carcinogenic to humans”) by IARC, or 4. Is listed under Group 2A or 2B (“reasonably anticipated to be a carcinogen”) by IRAC.

Sensitized	One who has developed a reaction to a substance after having been repeatedly exposed to it. Contact dermatitis is the most common reaction.
Teratogen	A substance that causes defects in a developing fetus.
Toxic	<p>A substance capable of injuring biological tissue. Highly toxic means that the substance can cause death, disablement or severe illness when inhaled, adsorbed or ingested in small amounts. By definition, a toxic substance has an LD₅₀ of;</p> <ol style="list-style-type: none"> 1. 50 to 500 mg per kg of body weight administered orally to albino rats. 2. 200 to 1000 mg per kg of body weight when in continuous contact for 24 hours to albino rats. 3. 200 to 2000 PPM by volume of gas or vapor, 2 to 20 mg per liter of mist, fume or dust inhaled by albino rats for one hour. <p>Highly toxic chemicals have an LD₅₀ less than the figures given above.</p>

Appendix G Incompatible Chemicals

These lists should not be considered to be inclusive. They include the commonly encountered chemicals. The best source of accurate information about a chemical is in the MSDS.

<u>Chemical</u>	<u>Incompatible Chemicals</u>
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 metals	Water, carbon tetrachloride or chlorinated hydrocarbons, carbon dioxide, halogens
Ammonia (anhydrous)	Mercury, chlorine, calcium, hypochlorite, iodine, bromide, hydrofluoric acid (anhydrous)
Aniline	Nitric Acid, hydrogen peroxide
Arsenical materials	Reducing agents
Azides	Acids
Bromine, Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals, turpentine
Calcium Oxide	Water
Carbon (activated)	Calcium hypochlorite, oxidizing agents
Carbon tetrachloride	Alkali metals
Chlorates	Ammonium salts, powdered metals sulfur, finely divided organic or combustible materials
Chromic acid & Chromium trioxide	Acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids in general
Chlorine	See bromine
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulfide
Copper	Acetylene, hydrogen peroxide
Cyanides	Acids
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Hydrocarbons	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic Acid	Nitric acid, alkali metals
Hydrofluoric Acid (anhydrous)	Ammonia (aqueous or anhydrous)

Chemical

Hydrogen Peroxide

Hydrogen Sulfide

Hypochlorites

Iodine

Mercury

Nitrates

Nitric Acid (concentrated)

Nitrites

Nitroparaffins

Oxalic acid

Oxygen

Perchloric acid

Peroxides, organic

Phosphorus (white)

Potassium & sodium

Potassium chlorate and perchlorate

Potassium permanganate

Selenides

Silver

Sodium

Sodium Nitrite

Sodium Peroxide

Sulfides

Sulfuric Acid

Tellurides

Incompatible Chemicals

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

Fuming nitric acid, oxidizing gases

Acid, activated carbon

Acetylene, ammonia (aqueous or anhydrous), hydrogen

Acetylene, fulminic acid, ammonia

Sulfuric acid

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

Acids

Inorganic bases, amines

Silver, mercury

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

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

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

Air, oxygen, alkali metals, reducing agents

Carbon tetrachloride, carbon dioxide, water

Sulfuric and other acids

Glycerol, ethylene glycol, benzaldehyde, sulfuric acid

Reducing agents

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

See Potassium

Ammonium nitrate, other ammonium salts

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

Acids

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

Reducing Agents

Appendix H Common Hazardous Chemicals by Category

These lists should not be considered to be inclusive. They include the commonly encountered chemicals. The best source of accurate information about a chemical is in the MSDS.

Common Strong Oxidizing Agents

Gases

Chlorine
Fluorine
Oxygen
Ozone
Nitrous Oxide
Nitromethane
Steam

Liquids

Bromine
Hydrogen Peroxide
Nitric Acid
Perchloric Acid
Sulfuric Acid
Chlorosulfonic Acid
Water

Solids

Bromates
Chlorates
Chlorites
Chromates
Dichromates
Hypochlorites
Iodates
Nitrates
Nitrites
Perchlorates
Permanganates
Peroxides
Persulfates
Picrates

Common Strong Reducing Agents

Gases

Hydrogen
Butadiene

Solids

Finely divided metals
Hydrides
Lithium
Potassium
Sodium
Acetylides

Liquids

Hydrazine
Aniline

Common Reactive Chemicals (Violent fires/explosions)

Ammonium nitrate	Hydrazine hydrate
Ammonium perchlorate	Hydrazinium chlorate
Benzoyl peroxide	Hydrazinium chlorite
2-Butanone peroxide	Hydrogen Peroxide, concentrated
tert-Butyl hydroperoxide	Hydroxylammonium nitrate
tert-Butyl peroxide	Lauroyl peroxide
Calcium hydride	Lithium acetylde
Carbon disulfide	Magnesium Perchlorate
Cesium	Mercury (I) perchlorate
Chromium nitrate	Nitroethane
Chromium trioxide	Nitromethane
Diborane	2-Nitropropane
Diethylaluminum hydride	o-Nitrotoluene
Dimethyl phosphine	p-Nitrotoluene
m-Dinitrobenzene	Peroxides
p-Dinitrobenzene	Phosphorus, white
Divinylbenzene	Picric Acid
Germane	Potassium
Hydrazine	Trinitrotoluene

Water Reactive Chemicals

Class

Alkali Metals
Organometallics
Metal halides
Nonmetal halides
Metal Hydrides
Peroxides
Carbides
Metal Oxides
Nonmetal oxides
Phosphides
Anhydrides
Other hydrolyzables

Examples

Sodium
Tetramethylaluminum
Aluminum bromide, titanium tetrachloride
Acetyl chloride, boron tribromide
Sodium Hydride, diborane
Sodium peroxide
Calcium carbide
Sodium oxide
Sulfur trioxide
Aluminum phosphide
Acetic anhydride
Chlorosulfonic acid, aluminum tribromide

Common Chemicals Which Can Cause Dust Explosions

Aluminum	Polyamide
Alkyl alcohol resin	Polyethylene
Cellulose acetate	Polystyrene
Coal	Tin
Methyl methacrylate	Titanium
Magnesium	Zinc

Some Common Corrosive Chemicals

Liquids

Inorganic

Chromic acid
Chlorosulfonic acid
Hydrochloric acid
Hydrofluoric acid
Nitric acid
Sulfuric acid
Ammonia (solution or gas)
Bromine
Peroxides
Phosphorus trichloride
Silicon tetrachloride
Sulfuryl chloride
Thionyl chloride

Organic

Acetic acid
Butyric acid
Chloroacetic acid
Formic acid
Ethylene chlorohydrin
Perchloroethylene
Methyl ethyl ketone
Acetic anhydride
Liquified phenol
Triethanolamine
2-Aminoethanol

Solids

Inorganic

Iodine
Lithium
Phosphorus
Potassium
Sodium
Calcium oxide
Calcium hydroxide
Potassium hydroxide (also solution)
Sodium hydroxide (also solution.)
Sodium phosphate
Mercury (II) chloride
Tin chloride
Phosphorus pentoxide
Potassium chromate

Organic

Oxalic acid
Phenol
Salicylic acid
Trichloroacetic acid

Peroxidizable Chemicals

Acetal	Diethyl ether
Allyl ether	Diethyl fumerate
Allyl phenyl ether	Dioxane
Isoamyl benzyl ether	1,3-Dioxepane
Benzyl n-butyl ether	1,2-Epoxy-3-iso-propoxypropane
Dibenzyl ether	Isophorone
Benzyl ethyl ether	Dimethoxymethane
Benzyl 1-naphthyl ether	2,2-Dimethoxypropane
p-Dibenzoyloxybenzene	1,3,3-Trimethoxypropene
1,2-Dibenzoyloxyethane	Di-n-propoxymethane
Chloroacetaldehyde diethylacetal	beta-Isopropoxypropionitrile
2-Chlorobutadiene	Diisopropyl ether
Cyclohexene	n-Propyl isopropyl ether
Cyclooctene	Tetrahydrofuran
Decalin	Tetralin
Diethoxymethane	Vinylidene chloride

Appendix I Symptoms of Chemical Exposure

Terms used in MSDSs

(Jay A. Young, Ed., *Improving Safety in the Chemical Laboratory*,
John Wiley & Sons, Inc., New York, 1991.)

Abdominal cramps	Painful spasms of the stomach area
Alopecia	Loss of hair; baldness
Amenorrhea	Stoppage of menstruation
Amnesia	Loss of memory
Anesthesia	Loss of feeling
Angina pectoris	Chest pain
Anorexia	Loss of appetite
Anosmia	Loss of sense of smell
Anuria	Lack of urination
Anxiety	Troubled feeling
Apathy	Lack of emotion
Aphasia	Inability to speak coherently
Areflexia	Loss of reflexes
Arrhythmia	Irregular heartbeat
Arthralgia	Joint pain
Asphyxia	Suffocation
Asthenia	Loss of strength or energy
Asthma	Difficulty breathing
Ataxia	Inability to walk straight
Athetosis	Slow writhing movements of fingers
Back pain	Aching of back area
Blackened teeth	Darkening of the tooth surface
Blindness	Inability to see
Blurred vision	Not in focus
Bronchitis/bronchospasm	Coughing; difficulty breathing
Burn	Tissue damage
Cachexia	Wasting away
Cancer	Abnormal tissue growth
Cataracts	Progressive loss of eyesight
Changes in body/ breath odor	Abnormal body/breath odor
Cheilitis	Inflammation of the lips
Chills	Shivering with cold plus fever
Chloracne	Reddish skin rash
Chorea	Rapid, jerky, uncontrollable movements of the limbs
Colic	Abdominal pain, usually due to intestinal gas
Collapse	Loss of ability to stand
Coma/comatose	Extreme unconsciousness
Confusion	State of bewilderment
Conjunctivitis	Inflamed and reddened eyes

Constipation	Infrequent/difficult bowel movements
Constriction	Binding or contraction
Convulsions	Violent body spasms
Coughing	Forceful expiration of air
Coughing blood	Forceful expectoration of blood
Cyanosis	Bluish skin color
Dark urine	Discoloration of the urine
Dehydration	Excessive loss of body water
Delirium	State of mental confusion
Dental erosion	Loss of tooth surface
Depression, bodily	Decrease in activity
Depression, mental	Feeling of great sadness
Dermatitis	Inflamed, reddened skin
Diarrhea	Frequent, loose bowel movement
Dilated	Expanded; opened up
Disequilibrium	Inability to maintain balance
Disordered gait	Change in walking pattern
Dizziness	Feeling faint; light-headed
Drooling	Excess saliva from mouth
Drowsiness	Falling asleep
Dysarthria	Difficulty speaking clearly, as in stammering
Dysosmia	Impaired sense of smell
Dysphagia	Difficulty in swallowing
Dyspnea	Difficulty in breathing
Dysuria	Painful or difficult urination
Eczema	Inflammatory skin disease with itching and burning
Edema	Fluid retention; swelling
Emaciation	Extreme low weight; skinniness
Emphysema	Difficulty breathing
Epistaxis	Nosebleed
Erythema	Reddened skin
Euphoria	Exaggerated feeling of well-being
Fasciculation	Muscle twitching under skin
Fainting	Loss of consciousness
Fatigue	Tiredness; sluggishness
Fever	Increased body temperature
Fibrillation	Rapid muscle contraction
Finger clubbing	Rounded, swollen fingertips
Fluorosis	Darkening of the teeth
Footdrop	Dragging of the foot while walking
Frostbite	Freezing of tissue
Gangrene	Tissue death
Gasping	Difficulty catching breath
Giddiness	Dizziness; silliness
Gingival Lead Line	Dark line formed on gums
Glossitis	Tongue swelling
Halitosis	Foul-smelling breath
Hallucination	A sense of things that are not real

Headache	Pain in head or neck area
Hemiparesis	Paralysis of one side of the body
Hemorrhage	Bleeding
Hyperkinesia	Excess activity or motion
Hyperpigmentation	Excess coloring of the skin
Hyperthermia	Elevated body temperature
Hyperventilation	Sudden rapid breathing
Hypothermia	Lowered body temperature
Icterus	Yellow tissue discoloration
Impotence	Loss of sexual desire
Incoordination	Inability to move a limb accurately
Inflammation	Swelling, redness, warmth
Inflexibility	Rigidity; inability to move
Insomnia	Inability to maintain normal sleep
Involuntary defecation	Uncontrollable bowel movements
Involuntary urination	Uncontrollable urine passage
Irritability	Quickly becoming annoyed
Itch	Skin sensation causing scratching
Jaundice	Yellow discoloration of skin and eyes
Keratinosis	Horny growths on skin
Laborer	Not easy or natural
Lacrimation	Excessive eye tearing
Lactation changes	Decrease/increase in amount of breast milk
Lassitude	Sense of weariness
Light-headedness	Dizziness
Malaise	Uneasiness; discomfort; feeling ill
Malnutrition	Inadequate diet
Melena	Black, tarry vomitus or stools
Menstrual changes	Change in menstrual cycle (period)
Metallic taste	Taste in mouth resembling metal
Miosis	Pupil contraction
Miscarriage	Loss of baby by pregnant woman
Myotonia	Temporary muscle rigidity and spasm
Narcosis	Stupor or sleep
Nasal ulceration	Perforation of nasal tissue
Nausea	Feeling of need to vomit
Nervousness	State of unrest/uneasiness
Nocturia	Excessive urination at night
Numbness	Loss of feeling; prickly feeling
Nystagmus	Rhythmical movement of eyes
Ocular opacity	Loss of eyesight
Ochronosis	Dark spots on skin
Oliguria	Decreased urination
Opisthotonos	Spasms with body arched from head to heels
Pallor	Paleness of skin
Palpitations	Forceful heartbeat
Paralysis	Loss of ability to move limbs
Paresthesia	Abnormal sensation; tingling

Paroxysmal	Sudden recurrence of disease
Perforation	Opening through a tissue
Pharyngitis	Sore throat; hoarse voice
Phlebitis	Swollen, painful vein
Photophobia	Inability to tolerate light
Photosensitization	Allergic reaction to light
Phototoxicity	Irritant reaction to light
Pigmentation	Coloration
Prostration	Marked loss of strength; exhaustion
Ptosis	Drooping of upper eyelid
Pyorrhea	Swollen, bleeding gums
Pyuria	Pus in urine
Red blood cells in stool	Blood in bowel movement
Respiratory distress	Difficulty breathing
Rhinorrhea	Excessive nasal discharge
Salivation	Discharge of saliva
Scotoma	Blind spot in field of sight
Seizure	Convulsion
Sensitization	Allergic reaction
Shock	Depression of all body functions
Somnolence	Prolonged sleepiness
Spasm	Convulsive muscular contraction
Stomatitis	Swelling of mouth lining
Strabismus	Lack of coordinated eye movement, crossed eyes
Stupor	Unconsciousness
Sweating	Excessive moisture on skin
Swelling	Enlargement
Tachycardia	Abnormal, rapid heartbeat
Tenderness	Painful to pressure/contact
Tetany	Intermittent muscle spasms
Tick/Tic	Skin twitch
Tinnitus	Ringing in the ears
Tracheobronchitis	Coughing; difficulty breathing
Tremors	Shaking; trembling
Tumor	Swelling or growth
Ulceration	Tissue destruction
Unconsciousness	Not awake
Urticaria	Skin eruption
Vertigo	Feeling of whirling motion
Vesiculation	Blisters
Visual disturbance	Abnormal eyesight
Vomiting	Forceful expulsion of stomach fluid
Vomit	Expelled stomach contents
Weakness	Lack of normal strength
Wheezing	Noisy breath
Wrist drop	Inability to extend hand at wrist

Terms to Describe and Identify Toxic Effects

(Jay A. Young, Ed., *Improving Safety in the Chemical Laboratory*,
John Wiley & Sons, Inc., New York, 1991.)

Acidosis	body acid imbalance, pH below 7.2
Acute hepatitis	liver damage without jaundice
Adrenal gland	organ attached to kidney
Aerosol	a suspension of very small particles of a liquid or solid in a gas
Albuminuria	protein in the urine
Alkalosis	increase in body alkalinity
Anaphylactic	pertaining to an extreme allergic reaction
Anemia	fewer red blood cells than normal
Arteriosclerosis	hardening of arteries
Aspirate	to inhale liquid into the lungs
Atrophy	to decrease in size or waste away
Autonomic nervous system	controls involuntary bodily functions, such as heartbeat
Bilirubinuria	bilirubin in urine
Bone marrow depression	inactivity of the blood-forming organ
Calcification	deposition of calcium in tissues
Carcinogenic	capable of causing cancer
Carcinoma	cancerous growth (tumor)
Cardiovascular system	bodily system consisting of the heart and blood vessels (CVS)
Central nervous system	autonomic nervous system and cerebrospinal nervous system (CNS)
Cerebral	pertaining to the brain
Cerebrospinal nervous	controls voluntary movements system
Cholinesterase	chemical in the body that relays nerve cell signals
Chloracne	a skin disease resembling childhood acne but caused by exposure chlorinated aromatic compounds
Chromosome	material inside a cell that carries the genetic information
Cirrhosis	progressive disease of the liver
Colitis	inflammation of the large intestine
Cornea	transparent covering of the eye
Cystitis	inflammation of the bladder
Degeneration	deterioration; worsening
Demyelination	destruction of the sheaths that surround the nerves
Emetic	a chemical that induces vomiting
Emphysema	debilitating disease of the lung
Encephalitis	inflammation of the brain
Encephalopathy	brain disease
Endocrine gland	hormone-secreting disease
Epileptiform fits	seizures
Epithelium	outermost living layer of the skin
Esophagus	tube connecting the mouth and stomach
Fibrosis	fibrous scars

Gallbladder	organ that secretes bile
Gastric	pertaining to the stomach
Gastrointestinal	pertaining to the stomach and intestines
Genotoxic	capable of damaging the genetic material
Glaucoma	increased pressure inside the eyes
Glycosuria	glucose in the urine
Hematoma	swelling containing blood
Hematopoietic	formation of blood cells
Hemoglobinuria	hemoglobin in the urine
Hemolysis	destruction of red blood cells
Hemolytic anemia	loss of red blood cells resulting from destruction
Hormone	a biochemical secreted by the body that exerts an effect on An organ elsewhere in the body
Hyperemia	congestion of blood vessels from excess blood
Hyperglycemia	high blood sugar level
Hypertension	high blood pressure
Hypertrophy	exaggerated growth of a tissue
Hypotension	low blood pressure
Intoxication	state of being poisoned by a toxic chemical
Keratosi	horny, thickened skin growth
Laryngeal	upper throat area
Larynx	voice box
Lesion	diseased or damaged tissue
Leukemia	cancer of the blood cells
Lymph	clear, yellow fluid found throughout the body
Lymph nodes	glands that produce lymph
Lymphatic system	vessels that carry the lymph to the blood
Malignant	very injurious or deadly
Mammary tissue	milk-producing tissue of the breast
Metabolism	the sum total of all the biochemical reactions that occur in cells
Methemoglobinemia	type of blood disease
Mucous membrane	tissue lining of the nose, mouth, esophagus, stomach, and intestine
Mutagenic	capable of producing changes in the genetic material
Mutant	an organism that has undergone a genetic change
Narcosis	state of stupor or unconsciousness
Nausea	upset stomach; feeling of need to vomit
Necrosis	state of being necrotic
Necrotic	dead (tissue)
Neoplasm	abnormal tissue growth
Nephritis	inflammation of the kidneys
Nephrosis	kidney degeneration
Neurogenic	pertaining to the formation of nerves; or originating in the nervous system
Neurologic	pertaining to the nervous system
Ocular	pertaining to the eye
Olfactory	pertaining to the sense of smell

Osteoporosis	a condition in which bones become very fragile
Ovarian	pertaining to the egg-forming organ in the female reproductive system
Pancreas	insulin-producing gland
Pancreatitis	inflammation of the pancreas
Papilloma	type of tumor
Periorbital	area surrounding the eye socket
Peripheral nervous system	nervous system controlling the arms and legs
peripheral neuritis	inflammation of the peripheral nerves
Peritoneal	pertaining to the body cavity that surrounds the abdominal organs
Pharyngeal	pertaining to the pharynx
Pharynx	a part of the body between the mouth and the esophagus
Phlebitis	inflammation of a vein
Photoallergy	allergic response to a combination of a chemical and sunlight
Photosensitization	word used to describe either photoallergy or phototoxicity
Phototoxicity	irritant response to a combination of a chemical and sunlight
Pigmentation	coloration
Plasma	fluid part of blood and lymph
Pleural thickening	thickening of tissue surrounding the lungs
Pleurisy	inflammation of the lung cavity
Pneumoconiosis	degenerative respiratory disease
Pneumonia	infectious disease of the lungs that impairs breathing
Pneumonitis	inflammation of the lungs
Polyneuropathy	disease of several peripheral nerves
Proteinuria	protein in the urine
Ptosis	drooping of the upper eyelid
Pulmonary fibrosis	fibrous tissue formed in the lung
Reproductive effects	pertaining to birth defects, death of a developing baby prior to birth, inability to have children (both men and women), and so on
Respirable	capable of being inhaled
Respiration	inhalation of air; breathing
Salivary glands	glands in the mouth that secrete saliva
Sarcoma	type of cancerous tumor
Sensitization	becoming allergic
Silicosis	lung disease caused by inhaling silica
Spleen	organ that disintegrates red blood cells
Teratogenic	capable of producing birth defects
Testicular atrophy	wasting away of male reproductive organs
Testis	male reproductive organs
Tetany	intermittent spasms
Thrombosis	blood clot
Thymus	organ that forms cells involved in the immune response
Thyroid	hormone producing gland in the throat
Trachea	passageway from nose to lungs

Transplacental	across the placenta, from mother to developing baby
Tumor	benign or cancerous growth
Ulcer or Ulceration	a disruption caused by the destruction of tissue
Urinary system	kidney, bladder, and connecting tubules
Urologic	pertaining to the urinary system
Uterine	pertaining to the uterus or womb (part of female reproductive systems)
Vascular thrombosis	blood clot
Vasoconstriction	narrowing of the blood vessels
Ventricular fibrillation	rapid contractions of the ventricles of the heart

Appendix J

Chemical Resistance of Common Glove Materials

Chemical Resistance Chart

This Chemical Resistance Chart is intended to provide general information about the reactions of different glove materials to the chemicals listed. SAS Safety gloves have not been individually tested against these chemicals. Variability in glove thickness, chemical concentration, temperature, and length of exposure to chemicals will affect the performance.

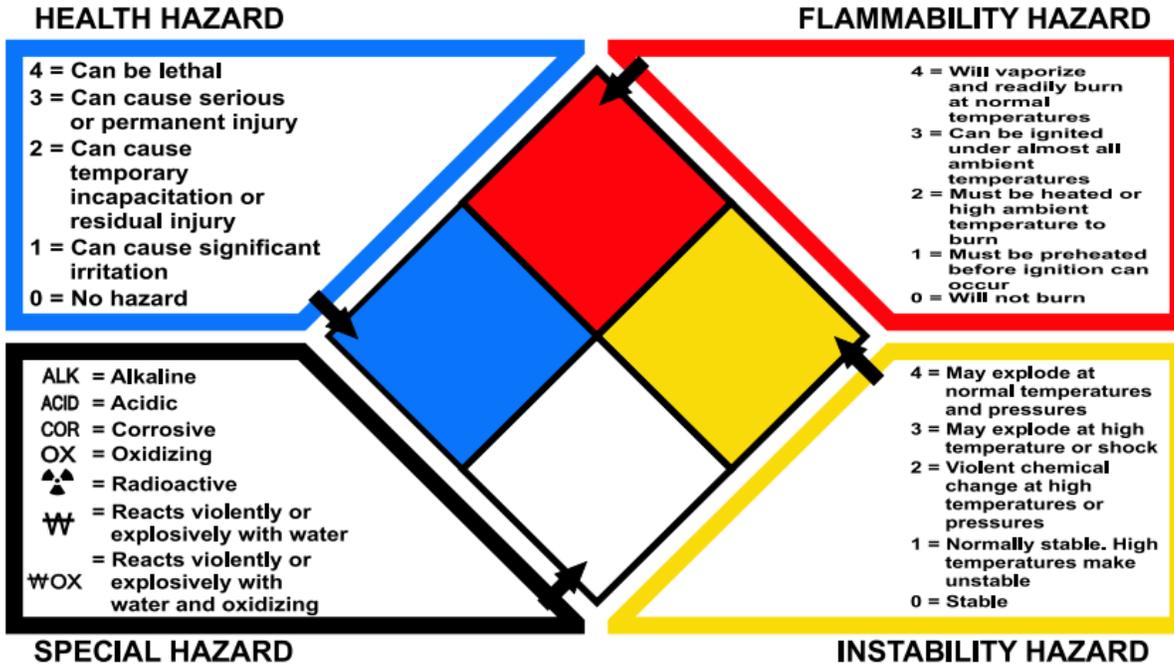
Key: P=Poor, F=Fair, G=Good, E=Excellent, NR=Not Recommended

Chemical	Neoprene	Nitrile	Latex	PVC	Chemical	Neoprene	Nitrile	Latex	PVC
Acetaldehyde	E	P	F	NR	Kerosene	E	E	P	F
Acetic Acid	E	G	G	F	Lactic Acid	E	E	E	E
Acetone	G	NR	G	NR	Lauric Acid	E	E	G	F
Acetonitrile	F	NR	F	NR	Linoleic Acid	E	E	P	G
Ammonium Hydroxide<30%	E	E	G	E	Linseed Oil	E	E	P	E
Amyle Acetate	NR	E	F	P	Maleic Acid	E	E	P	G
Amyl Alcohol	P	G	G	NR	Methyl Acetate	G	P	P	NR
Aniline	G	NR	P	F	Methyl Alcohol	E	E	E	G
Animal Fats	E	E	P	G	Methylamine	G	E	E	E
Battery Acids	E	E	G	E	Methyl Bromide	NR	NR	NR	NR
Benzaldehyde	NR	NR	F	NR	Methylene Chloride	NR	NR	NR	NR
Benzene	NR	P	NR	NR	Methyl Cellulose	E	F	P	-
Benzoyl Chloride	NR	NR	P	NR	Methyl Ethyl Ketone (MEK)	G	NR	G	NR
Butane	F	E	P	P	Methylisobutyl Ketone	NR	P	F	NR
Butyl Acetate	NR	F	P	NR	Methyl Methacrylate	NR	P	P	NR
Butyl Alcohol	E	P	E	G	Mineral Oil	E	E	P	F
Butyl Cellulose*	E	E	E	NR	Mineral Spirits	G	E	NR	F
Carbon Acid	E	P	P	G	Monoethanolamine	E	E	G	E
Carbon Disulfide	NR	NR	NR	NR	Morpholine	P	NR	G	NR
Carbon Tetrachloride	P	G	NR	NR	Muriatic Acids	E	G	G	G
Castor Oil	E	E	E	E	Naptha V.M & P.	G	E	NR	P
Celiosole Acetate	E	G	G	NR	Nitric Acid <30%	E	P	G	G
Celiosole Solvent	E	G	E	NR	Nitrile Acid 70%	G	NR	F	F
Chlorobenzene	NR	NR	NR	NR	Nitric Acid Red Fuming	NR	NR	P	P
Chloroform	F	F	NR	NR	Nitric Acid White Fuming	NR	NR	P	P
Chloronaphalens	NR	F	NR	NR	Nitrobenzene	NR	NR	P	NR
Chloroethene VG	NR	F	NR	P	Nitromethane	E	F	G	P
Chromic Acid	F	F	NR	G	Nitropropane	G	NR	E	NR
Citric Acid	E	E	E	E	Octyl Alcohol	E	E	G	F
Cottonseed Oil	E	E	P	G	Oleic Acid	E	E	P	F
Cresols	G	G	P	F	Paint Remover	G	G	F	P
Cutting Oil	E	E	F	P	Palmitic Acid	E	G	G	G
Cyclohexane	F	E	P	P	Pentachlorophenol	E	E	P	F
Cyclohexanol	E	E	P	G	Pentane	E	E	P	NR
Di-butyl Phthalate	F	G	P	G	Perchloric Acid 60%	E	E	P	E
Diethylamine	P	F	NR	NR	Potassium Hydroxide <50%*	E	G	E	E
Di-Isobutyl Ketone	P	E	P	P	Printing Ink	G	E	G	F
Dimethyl Formamide (DMF)	G	NR	E	NR	Propyl Acetate	P	F	P	NR
Dimethyl Sulfoxide (DMSO)	E	E	E	NR	Propyl Alcohol	E	E	E	F
Dicotyl Phthalate (DOP)	G	G	P	NR	Perchloroethylene	NR	G	NR	NR
Dioxane	NR	NR	NR	NR	Phenol	E	NR	G	G
Ethyl Acetate	F	NR	P	NR	Phosphoric Acid*	E	E	G	G
Ethyl Alcohol	E	E	E	G	Picric Acid	E	E	G	E
Ethylene Dichloride	NR	NR	P	NR	Propylene Oxide	NR	NR	P	NR
Ethylene Glycol	E	E	E	E	Rubber Solvent	G	E	NR	NR
Ethyl Ether	E	E	NR	NR	Sodium Hydroxide <50%	E	G	E	G
Ethylene Trichloride	P	P	P	NR	Stoddard Solvent	E	E	P	NR
Formaldehyde	E	E	E	E	Styrene*	NR	NR	NR	NR
Formic Acid	E	F	E	E	Sulfuric Acid 95%	F	G	NR	NR
Freon	G	F	NR	NR	Tannic Acid	E	E	E	E
Furfural	G	NR	E	NR	Tetrahydrofuran (THF)	NR	NR	NR	NR
Gasoline	P	E	NR	P	Toluene	P	G	NR	NR
Glycerine	E	E	E	E	Toluene Di-Isocyanate (TDI)	NR	NR	P	P
Hexane	E	E	NR	NR	Trichloroethylene (TCE)	P	G	NR	NR
Hydraulic Fluid Petro. Based	F	E	P	G	Tricrestyl Phosphatate (TCP)	F	E	G	F
Hydraulic Fluid Ester Based	P	P	P	P	Triethanolamine 85% (TEA)	E	E	G	E
Hydrazine 65%	E	E	G	E	Tung Oil	E	E	NR	F
Hydrochloric Acid*	G	E	E	E	Turbine Oil	E	G	P	F
Hydrofluoric Acid	G	E	E	E	Turpentine	G	E	P	P
Hydrogen Peroxide	E	E	E	E	Vegetable Oil	E	E	P	F
Hydroquinone	G	E	E	E	Xylene	P	G	NR	NR
Isobutyl Alcohol	E	E	E	F					
Iso-Octane	E	E	NR	P					
Isopropyl Alcohol*	E	E	E	G					

Chemical Resistance Chart

**Appendix K
National Fire Protection Agency (NFPA) Fire Diamond**

NFPA Rating Explanation Guide

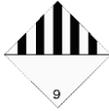


This chart for reference only - For complete specifications consult the NFPA 704 Standard

Appendix L Department of Transportation (DOT) Classifications

The Department of Transportation classifies materials by the type of hazard for the purpose of transportation. The details can be found in the Code of Federal Regulations (CFR).
<http://www.access.gpo.gov/nara/cfr/cfr-table-search.html>

Hazard Class	Label	Description
CLASS 1		Explosives
CLASS 2		Flammable Gases
		Non-Flammable Gases
		Poison Gases
CLASS 3		Flammable Liquids
CLASS 4		Flammable Solids
		Spontaneously Combustible Materials
		Dangerous When Wet Materials

CLASS 5		Oxidizers
		Organic Peroxides
CLASS 6		Poisons
		Keep Away From Foodstuffs (less toxic than above)
		Infectious Substances
CLASS 7		Radioactive I
		Radioactive II
		Radioactive III
CLASS 8		Corrosive
CLASS 9		Miscellaneous