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Pocket Reference of Important Numbers

All campus phone numbers are (801) 58x-xxxx.  
All other phone numbers are area code (801) unless otherwise indicated.

Department Contacts:

<table>
<thead>
<tr>
<th>Name</th>
<th>Email</th>
<th>Phone</th>
<th>Area Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harold Simpson</td>
<td><a href="mailto:hsimpson@physics.utah.edu">hsimpson@physics.utah.edu</a></td>
<td>1-3839</td>
<td>801-244-1017</td>
</tr>
<tr>
<td>Matt DeLong</td>
<td><a href="mailto:delong@physics.utah.edu">delong@physics.utah.edu</a></td>
<td>1-7462</td>
<td>801-580-7246</td>
</tr>
<tr>
<td>Zhiheng Liu</td>
<td><a href="mailto:zhliu@physics.utah.edu">zhliu@physics.utah.edu</a></td>
<td>1-7001</td>
<td></td>
</tr>
<tr>
<td>Dave Kieda</td>
<td><a href="mailto:kieda@physics.utah.edu">kieda@physics.utah.edu</a></td>
<td>1-3538</td>
<td></td>
</tr>
</tbody>
</table>

Fire, Police, Ambulance .......... 801-585-2677

Please note: 911 calls for on-campus emergencies will be re-routed to the above number for dispatch.

When You Make an Emergency Call
Give your name, location & phone number.
Describe what happened.
Do not hang up until asked to do so.

For Information During an Emergency
Radio: KUER FM 90.1
Public Relations ......................1-6773
Online: www.utah.edu
Television: KUED Channel 7
Local news media will also be alerted.

Report Campus Utility Failures

<table>
<thead>
<tr>
<th>Department</th>
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<tr>
<td>Plant Operations Dispatch</td>
<td>1-7221</td>
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<tr>
<td>University Police Dispatch</td>
<td>5-2677</td>
</tr>
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Student Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Phone</th>
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<tbody>
<tr>
<td>Student Health Center</td>
<td>1-6431</td>
</tr>
<tr>
<td>Campus Wellness Connection</td>
<td>1-7776</td>
</tr>
<tr>
<td>Student Government</td>
<td>1-2788</td>
</tr>
<tr>
<td>Student Advocate</td>
<td>1-8613</td>
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<tr>
<td>Student Affairs</td>
<td>1-7793</td>
</tr>
<tr>
<td>University Student Apartments</td>
<td>1-8667</td>
</tr>
<tr>
<td>Housing &amp; Residential Ed</td>
<td>7-2002</td>
</tr>
<tr>
<td>Center for Disability Services</td>
<td>1-5020</td>
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</table>

Transportation

<table>
<thead>
<tr>
<th>Service</th>
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<tbody>
<tr>
<td>Commuter Services</td>
<td>1-6415</td>
</tr>
<tr>
<td>Utah Transit Authority *</td>
<td>801-743-3882</td>
</tr>
<tr>
<td>U of U Public Safety Escort</td>
<td>5-2677</td>
</tr>
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</table>

Emergency Services

<table>
<thead>
<tr>
<th>Service</th>
<th>Phone</th>
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<tbody>
<tr>
<td>University Police:</td>
<td>5-2677</td>
</tr>
<tr>
<td>University Hospital</td>
<td></td>
</tr>
<tr>
<td>ER</td>
<td>1-2291</td>
</tr>
<tr>
<td>Security</td>
<td>1-2294</td>
</tr>
<tr>
<td>Primary Children's Hospital *</td>
<td>801-588-2000</td>
</tr>
<tr>
<td>ER</td>
<td>801-662-1255</td>
</tr>
<tr>
<td>Security</td>
<td>801-662-1020</td>
</tr>
<tr>
<td>Poison Control *</td>
<td>1-800-222-1222</td>
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Emergency Preparation

Environmental Health & Safety .........1-6590

Counseling Services

<table>
<thead>
<tr>
<th>Service</th>
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</thead>
<tbody>
<tr>
<td>University Counseling Center</td>
<td>1-6826</td>
</tr>
<tr>
<td>Women's Resource Center</td>
<td>1-8030</td>
</tr>
<tr>
<td>Valley Mental Health *</td>
<td>801-261-1442</td>
</tr>
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Rape & Domestic Violence

<table>
<thead>
<tr>
<th>Service</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt Lake Rape Recovery Center *</td>
<td>801-467-7273</td>
</tr>
<tr>
<td>24-hour Crisis Line</td>
<td>801-467-7273</td>
</tr>
<tr>
<td>Utah Rape/Sexual Assault</td>
<td></td>
</tr>
<tr>
<td>24-hour Crisis Line *</td>
<td>1-888-421-1100</td>
</tr>
<tr>
<td>State of Utah Domestic Violence *</td>
<td>1-800-897-LINK (5465)</td>
</tr>
<tr>
<td>24-hour Info-line</td>
<td>1-800-897-LINK (5465)</td>
</tr>
<tr>
<td>Rape Defense Training (RAD)</td>
<td>5-1166</td>
</tr>
</tbody>
</table>

Legal

Office of General Counsel ............5-7002

* Non-University Resource
### IN CASE OF EMERGENCY

<table>
<thead>
<tr>
<th>EMERGENCY EVENT</th>
<th>FIRST ACTION</th>
<th>THEN DO THIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARDIAC ARREST</td>
<td>801-585-2677 24 hrs/University Police</td>
<td>Ensure access to the area, CPR if qualified.</td>
</tr>
<tr>
<td>CHEMICAL SPILL IS or MIGHT BE LIFE THREATENING</td>
<td>801-585-2677 24 hrs/University Police</td>
<td>Evacuate to a nearby area, remove victims clothing, douse with water for 15 minutes.</td>
</tr>
<tr>
<td>CHEMICAL SPILL NOT LIFE THREATENING</td>
<td>801-581-6590 7a-5p/Enviro Health &amp; Safety 801-585-2677 24hrs/University Police</td>
<td>Secure spill area, notify others in the vicinity, institute clean up procedures.</td>
</tr>
<tr>
<td>EARTHQUAKE</td>
<td>Do not call. - unless a gas leak is detected 801-585-2677 24 hrs/University Police</td>
<td>Inside: get under a stable structure; Outdoors: get into open area after the tremor</td>
</tr>
<tr>
<td>FIRE OR EXPLOSION</td>
<td>Pull local alarm</td>
<td>Close doors, evacuate nearby Call University Police 801-585-2677</td>
</tr>
<tr>
<td>MEDICAL ASSIST</td>
<td>801-585-2677 24 hrs/University Police</td>
<td>Complete reporting form - Employees: &quot;First Report&quot; E-1 Student/Visitor: Accident/Injury</td>
</tr>
<tr>
<td>RADIOACTIVE SPILL</td>
<td>801-581-6141 8a-5p Radiological Health 801-585-2677 24 hrs/University Police</td>
<td>Detain those contaminated; consult Radiation Safety Manual</td>
</tr>
<tr>
<td>SECURITY PROBLEMS PERSON OR ANIMAL</td>
<td>801-585-2677 24 hrs/University Police</td>
<td>Get a complete description.</td>
</tr>
<tr>
<td>ODD ODOR</td>
<td>801-581-6590 7a-5p/Enviro Health &amp; Safety</td>
<td>Try to identify the odor and the source.</td>
</tr>
</tbody>
</table>

**EMERGENCY ASSEMBLY POINT (OUTSIDE) IDENTIFIED BY MY DEPARTMENT:**

Fountain to the west of the Student Services Bldg.
Chapter 1: Overview

A Message from the Chair

We in the Physics & Astronomy Department are very concerned about safety for several reasons. The most important reason, of course, is that we care about your health and welfare. It is also the case that unsafe practices are costly to the Department and are usually illegal. They may also injure others in the Department. Safety rules have evolved with experience and they exist for very simple and common-sense reasons. By learning and following these rules you can help the Physics & Astronomy Department maintain its excellent safety record.

David Kieda
Department Chairman

Overview

The Occupational Safety and Health Administration (OSHA) requires that work places be made as safe as possible for the protection of all individuals who might be exposed to physical hazards. Not only is it a federal law to make the work place a safe environment, it makes good sense to keep people from being injured.

This Safety Program has been set up by the University of Utah Physics & Astronomy Department to train individuals about the hazards that might be encountered in the Department’s laboratories and shops. No program could cover every possible way in which a person can be injured. The intent here is to make everyone aware of the general areas where potential safety hazards could arise, as well as educate them as to the resources available for identifying and minimizing the hazards from specific sources in their individual work environments. Everyone must take personal responsibility for the safety of themselves and others and everyone must perform all activities in a professional and safe manner. Most of the faculty, staff and student lab work is done individually. Usually, there is no one watching over your shoulder. If you don't take lab safety seriously, it's only a matter of time before you injure yourself or an associate. Work place safety is an important part of professionalism.

We would also like to stress that a general knowledge of the concepts discussed in this manual is important to all Departmental employees and visitors because from time to time all of you will be in a laboratory or shop. You need to know how to act safely there.

There are several elements of a good safety and health program. The most important one is the awareness training of each individual involved. The MSDS's are in the grey file cabinet inside on the west wall of the Physics & Astronomy Department Stockroom, Room 114 JFB. (MSDS's), as well as an extensive collection in the bottom of the file cabinet in 329, south wall. In addition, an overview of the information contained in this text is available in video form from the Accounting Office in the Physics & Astronomy room 203 JFB. The best resource for MSDS and safety information will be the internet and Wikipedia.

In the following sections, you will encounter some material which may be of intrinsic interest to you, and some which will certainly not be. We realize that for many, if not most, of you the exercise of reading through pages of safety procedures and requirements will not be the most stimulating activity in
which you could engage. We also fully appreciate that this document is aimed at two distinct audiences with very different backgrounds and requirements: (1) Faculty, students and members of the technical staff who work in the labs and shops and who need in-depth technical training on materials and equipment with which they work and (2) non-technical staff and casual visitors who may be in the labs and shops for professional reasons unrelated to materials and equipment or simply to enjoy the stimulating ambience. Recognizing that it is impossible to treat all situations with a finite amount of effort, it is expected that technical personnel will master all details of this document relevant to their jobs. Both technical and non-technical personnel should have a general overview of potential hazards in all areas of our working environment. The introductory sections of chapters 4, 6, 7, and 8 have been explicitly written with the latter group in mind, and along with the shorter or more general chapters, should be studied in detail by all personnel. Nevertheless, it is essential that you conscientiously read through this material, and absorb enough so that you are able to pass the Safety Exam, which we require of all faculty, staff and students. This is part of your job. Repeated failure to pass the Safety Exam will result in loss of shop and laboratory privileges.

Request to the Reader

This document is the product of mortal physicists. If you find any errors, typographical or factual, or would like to recommend that a particularly arcane piece of prose be clarified, please bring these shortcomings to the attention of Harold Simpson (1-3839 or 801-244-1017). Thank you.
Chapter 2: General Considerations

- To summon help in an emergency, dial the University Public Safety dispatcher at 5-2677 (COPS) (24 hours a day). If for some reason you cannot reach Public Safety, call Salt Lake City Emergency Services at 9-911 (24 hours a day). If someone is injured, **DO NOT ATTEMPT TO TRANSPORT THE INDIVIDUAL TO THE HOSPITAL.** Too often, the assisting individual will overreact, possibly causing further injury to the injured individual. All labs must have an Emergency Response Guide, which lists emergency phone numbers and is posted next to the door. You are expected to look through this Guide and at least have a general knowledge of the available information.

- Whenever anyone is injured in a work-related accident, State of Utah Department of Administrative Services Division of Risk Management Form 122 must be filled out by the involved person’s immediate supervisor. Form 122 is available on the Web at [www.hr.utah.edu/forms/lib/E1.pdf](http://www.hr.utah.edu/forms/lib/E1.pdf) You may FAX this form to the Benefits office at 5-7375. Note that the costs of repairing your injury are covered by Workers’ Compensation Fund; you will not be charged. However, if you are late in submitting Form 122 to the Benefits Office, you will get nasty letters from your insurance company and/or the doctor/hospital who repaired you. See Appendix A for examples and instructions.

- If anyone (students, visitors, volunteers, etc.) is injured in a non-work-related accident while on University property or in conjunction with an off-campus University activity, University personnel (presumably whoever is their sponsor on campus) must submit an Incident/Accident form to Risk & Insurance Management. The University of Utah Incident/Accident report form, available at [web.utah.edu/risk_management/insurance/pdf/incident_accident_online2.pdf](http://web.utah.edu/risk_management/insurance/pdf/incident_accident_online2.pdf) can be printed and sent to University Risk & Insurance Management, 110 Park Bldg. (It may also be filled out and submitted online.) This form must be submitted in conjunction with workers' compensation claims only if you believe that your injury was the result of the U's negligence or an unsafe condition.

- Finally, if you are involved in an auto accident in your personal vehicle while you are performing U business or in a University vehicle, including one you rent with "University" (i.e. grant) money, the University Risk & Insurance Management Vehicle Accident form must be completed and submitted. This form is available at: [web.utah.edu/risk_management/vehicle/html/vehicle_accident_form.htm](http://web.utah.edu/risk_management/vehicle/html/vehicle_accident_form.htm)

- All halls are to be kept clear of clutter including ladders, tables, packing boxes, liquid helium Dewars, etc. This is required to permit unobstructed evacuation routes and to allow access for emergency personnel.

- All **hall doors** are to be kept closed to prevent the spread of a fire or chemical spill. Realistically, remember that if the fire alarm sounds, it is your responsibility to remove all door props as you pass them on your way out!

- All labs are to be kept clear of unnecessary clutter. The National Electric Code requires an
unobstructed space 30 inches wide and 3 feet deep in front of all electrical panels.

- All high-pressure gas cylinders must be secured with a chain. Cylinders must not be moved unless the protective valve bonnet is in place. Cylinders not in use must also have the valve bonnet in place. Without the valve bonnet protecting the valve, an accident could knock off the valve stem, creating a lethal rocket that can easily penetrate a masonry wall. Always use a pressure-reducing regulator when withdrawing high-pressure gases. Before installing the regulator, clean the cylinder fitting to remove dirt, including bugs and spider webs. Do not allow any grease or other contaminant to come in contact with a gas regulator or cylinder. Specifically, grease and high pressure oxygen will explode. Always move gas cylinders with a gas cart.

- Approximately three-fourths of the Physics & Astronomy Department ceiling tiles contain asbestos. If left alone, they present minimal health hazard. Because there can be asbestos in the ceiling air return plenum, all ceiling tiles are to be kept in place. Keeping the tiles in place also maximizes the efficiency of the building air circulating system. Because there is an asbestos hazard, no ceiling tiles are to be removed without first contacting Harold Simpson at 1-3839 to determine if your specific room has asbestos ceiling tiles.

- As per the Utah Clean Air Act and by University Presidential decree, the Physics & Astronomy Department is a smoke-free environment. This restriction includes every room in every building as well as within 25 feet of any building entrance or air intake.

- Do not eat or drink anything in labs where chemicals or radioactive materials are used or stored. Airborne and loose toxins are readily consumed in this manner.

- All belt driven devices, specifically including vacuum pumps, must have belt guards installed. Vacuum pumps must be vented into the building exhaust system or filtered.

- All electrical equipment requiring electrical grounding must be properly grounded. Power cables with a ground conductor must be in good condition.

- Horseplay ("practical jokes", playing tricks on other employees or students...) is a serious threat to safety. Horseplay will not be tolerated in labs or around equipment.

- Wear eye protection when handling chemicals, using glassware, in the machine shops, etc. Wear rubber gloves and a rubber apron when handling corrosives. Handle volatile corrosives only in a fume hood that is clearly labeled for volatile corrosive use, such as those in the OptoElectronic Materials Laboratories, Room 326 or 328 JFB.

- Bare feet, thongs, and sandals are not permitted in the shops and labs. The use of roller blades, roller skates, skate boards, bicycles etc. is not allowed within any of the Physics & Astronomy facilities.

- Serious burns should be treated by a visit to the University of Utah Hospital Burn Center.
Minor burns can be soothed with the sap of aloe vera leaves, which is a marvelous burn treatment. A plant is located at the east end of the third floor of JFB. To use, break off a small piece of stem and smear the "sap" onto the burned area. Serious burns should be followed by a visit to the Burn Center at the University Hospital.

- Never use Tygon® tubing for plumbing **liquids under pressure**. Always use a metal or reinforced plastic tubing that is compatible with the liquid. Tygon tubing is famous for failing, especially on weekends, thus flooding an entire lab or building.

- All unwanted University Property must go to Surplus, please contact Harold Simpson (1-3839 or 801-244-1017). No exceptions!

- When filling/using the Liquid Nitrogen stations, the dewar must be attended at all times during filling. No exceptions!

- Disposable Protective Gloves are only to be used one time and they must be disposed of upon removal.

- Label and cover/close all containers with the Content, Your Name and the Date. This is especially important for beakers in fume hoods!

- Clean up all spills immediately!

- **Lab safety products** can be purchased through Lab Safety Supply: 1-800-356-0783 (order phone), or 1-800-356-0722 (customer service), or Direct Safety Company, 1-800-528-7405 (or 1-602-968-7009).

- Never run in the halls.

- There is a wealth of health and safety information available to you on the Internet from the University of Utah Department of **Environmental Health and Safety Web page**. The Home Page address is: [http://ehs.utah.edu](http://ehs.utah.edu) Specific entries will be referenced throughout this document.

- Remember that the **first aid** supplies available in the shops, main office (201 JFB) and various labs are "self administered". This means that you may use the contents only on yourself; to administer first aid to someone else requires that you be trained in and comply with the requirements for the blood-borne pathogen standard. You are also encouraged to take the Red Cross First Aid and CPR courses, offered regularly by the Red Cross and occasionally through the Physics & Astronomy Department.

- Know the location of emergency facilities:
  - **Eye washes** are located in room 328 JFB, and in the hallway outside 331 JFB. In the hall on the first floor of JFB across from the elevator.
  - **Emergency showers** are located between the rest rooms on the east end of the first
and second floors of JFB, outside B 20, 119 and 328 JFB. In the hall on the first floor of JFB across from the elevator.

- Check now to memorize the location(s) of the fire extinguisher(s) nearest to your office, lab or other place you frequent, at least one fire extinguisher is located on every floor of the Department (JFB, South Physic, INSCC).

- In order to use a respirator, you must be trained in its proper use, cleaning and maintenance.

- Use ladders only under the conditions for which they were designed. All modern ladders are labeled as to which steps may be safely used, general safe practices and the inadvisability of using aluminum ladders for electrical work. Read and follow these cautions. Needless to say, when your work requires elevating your body use a ladder, not a chair, stool or other unstable structure! Standing on a chair with wheels is particularly dangerous.

- Employ ergonomic considerations in your work: when lifting heavy objects, lift with your legs while keeping your back straight; when using a keyboard, minimize the amount you must bend your wrists.

- NEVER dispose of pyrophoric substances by throwing them into a trash can (which often contain organics). (Pyrophoric substances ignite spontaneously in air.) NEVER dispose of any hazardous material in a sink or trash can. The correct and legally required procedures are given in Chapter 4 of this manual.

- Be particularly careful of high voltage if you are on a (metal) ladder or other elevated location. The shock can cause you to fall.

- Working alone in a laboratory is never a good idea. You certainly never want to be alone when working with chemicals that are explosive, pyrophoric or toxic by inhalation or if you are performing a uniquely hazardous procedure such as one requiring both a flammable material and an open flame. (The latter is a good example of a poorly designed experiment that needs to be redesigned or just not done.) The same is true for working with high voltage or any other hazardous situation. As always, think about the hazards in your experiment while designing it, design to minimize them, then have a backup plan for "when things go to heck". It is the responsibility of each PI to determine the procedures in their labs which may not be performed alone. (They will be the first one sued if an employee gets hurt.) You may not work alone in the student shop after hours, make sure the doors are unlocked whenever you are working in the student shop.

**List of Available Resources**

Physics & Astronomy Department Safety Manual: you’re reading it!
Your personal copy: every Department employee should have one
Also available on video from the Department accounting office and the Web
(www.physics.utah.edu/facilities/safety/contents.htm)
U Environmental Health and Safety Web Page: http://ehs.utah.edu
- Emergency Procedures
- Enforcement
- Safety Manual
- University of Utah
- Programs
- Abbreviations/Acronyms and Links
- Forms
- EHS Staff
- FAQ
- Site Index

Material Safety Data Sheets
- Vermont SIRI MSDS archive: http://hazard.com/msds/
  http://msds.pdc.cornell.edu/msdssrch.asp
- The U Chemistry Department: www.chem.utah.edu/MSDS/msds.html
- Grey cabinet in Physics & Astronomy Stockroom
- U MSDS coordinator in the Receiving Department: 1-8671
- OptoElectronic Materials Lab 329 JFB

Physics & Astronomy Department Safety Committee: ask questions; report problems
Harold Simpson 301 South Physics hsimpson@physics.utah.edu (1-3839 or 801-244-1017).
Standard Operating Procedures (SOPs) for routine procedures in your lab. Ask your PI for a copy of the
SOP for any routine, repeated task you are required to perform. The following SOPs are available from
the OptoElectronic Materials Lab:

- Vacuum systems
- Cryogenics
- Pellet press
- Thermolyne 30400 furnace
- Gas handling system
- Rocking furnace
- Vacuum drying oven (Rm 328)
- Fume hood
- OEML Dry box
- Electronic balances
- Vacuum dessicators
- Buehler low-speed diamond saw
- Buehler low-speed polisher
- Olympus microscope
- Wire saws, diamond and slurry

Chapter 3: Machine Shop & Wood Shop Equipment

The Physics & Astronomy Department operates a Research Machine Shop, a Student
Machine Shop, a Welding Shop, a Sheet Metal Shop, and a Woodworking Shop. All faculty,
staff, and students have access to these facilities after taking a supervised shop safety course.
Ed Munford trains all individuals in the metal working areas and Harold Simpson trains those
who use the Wood Shop. Only after passing the requirements of these courses can a person
operate the machinery. After successfully passing the shop courses, a picture ID is mounted on
the Student Machine Shop wall. Also, a door access code is assigned, which will allow after-
hours access to these facilities. It is advisable to never work alone around machinery. **If you must work on a project after normal work hours (7am-5pm, 0700 - 1700 MDT for the Student Shop), it is required that you bring a friend who could make emergency phone calls** and turn off the power to a machine that has trapped or injured you in some way. However, you are responsible for the safety of your safety observer. Specifically, safety glasses must be worn at all times by everyone in the shop, including your safety observer. In principle your 6-year-old can babysit for you; in practice they need sufficient patience to not get in trouble while being bored. If an unauthorized safety observer operates any machinery, the individual who allowed him or her into the machine shop will lose shop privileges. First violation of policy: stern warning; second violation: 2-week suspension of privileges; third violation: loss of shop privileges. **You may not work in the shops alone after hours!** Remember to lock the door before leaving!

When using the machine shop after normal working hours, it is your responsibility to insure that everyone working in the shop with you is authorized to use the equipment (i.e. they must have a photo posted on the machine shop authorization board). If an unauthorized individual refuses to leave the shop on your request, you are to call for assistance from the University Police at 5-2677 (5-COPS). Note that you are not required to confront any person in the Student Shop whose photo is not on the board: you may simply call the police.

In addition to work performed in the shops, tools are available from the Tool Crib for use away from the shops. Instructions for the safe use of the power tools in the tool crib are included in the Machine Shop course. Provisions have also been made for Department members to be instructed and approved in use of the tools in the Tool Crib, independent of the shop courses. Access to the Tool Crib will be monitored by the Student Shop Supervisor.
Chapter 4: Chemicals

4.1 Introduction

Many materials encountered in the Physics & Astronomy Department are classified as "chemicals", although this term is difficult to define. For purposes of the following discussion, "chemicals" will be defined as "...any material which was or could have been purchased from a chemical company." Most chemicals are not inherently dangerous but can become so under some circumstances: (1) when handled carelessly, (2) when the person is not trained in general procedures for safe handling of chemicals, or (3) when the person is unaware of specific hazardous properties of the material. It is the intent of the following section to give you general safe chemical handling techniques as well as apprise you of the location of information detailing specific hazards associated with specific chemicals.

Materials classified as "chemicals" are found in virtually all areas of the Department, specifically including research and teaching labs, shops and the stockroom. Since all employees work in or pass through one or more of these areas, it is important that everyone have at least a general knowledge of "do's and don'ts" for these materials. The most general admonition is simply "...be careful around materials you don't understand." A bottle of acid will not jump off a bench top and burn you, but you can be harmed if you knock the bottle off the bench top and break it or if you carelessly walk into someone carrying an open container of the material. Your interest in being able to read the hazard information on a chemical label could increase if you rest your elbow in the powder next to a bottle of some chemical while discussing last night's ball game. The same applies when you don't go outside for a smoke during a snowstorm but step into a closet where someone forgot to put the cap onto a bottle of flammable solvent. Hence the general prohibitions against eating, drinking and smoking in any area where chemicals are used or stored.

The general classes of hazards associated with chemicals are discussed in section 1 of 4.4.1, which should be studied by everyone. They include health, flammability, reactivity and skin contact. Health and skin contact are most relevant to "casual visitors." The routes by which chemicals attack you are ingestion (eating), inhalation (breathing), and skin contact. You may therefore minimize both your need to understand details of chemical properties and your suffering from exposure if you avoid eating, drinking, inhaling and touching these materials. The general rule remains the same: think about how chemicals could hurt you (ingestion, inhalation, skin contact, fire...) and avoid those situations.

4.2 General Procedures for Working with Chemicals

4.2.1: Labels

All chemical containers must be labeled defining the chemical contents. It is also a good idea to note the date received and the expected shelf life. Chemicals that are rebottled for use in a laboratory should have secure, waterproof (or "solvent-proof") labels that contain information about hazards as well as the name, formula, date packaged, and the strength or...
purity. Do not use any substance in an unlabeled or improperly labeled container. Particularly irresponsible behavior is to place hazardous materials, including wastes, into containers which originally contained food, such as water bottles and coffee cups, both of which have been done. Unlabeled containers and those with printed labels that have been partly obliterated, scratched over, or crudely labeled by hand should be returned to your supervisor. The chemicals in your laboratory should be:

1. clearly identified so they can be used
2. made nonhazardous and disposed of locally or
3. disposed of through the Department of Environmental Health and Safety (1-6590) as hazardous waste, as described below.

4.2.2: General Rules For Working With Chemicals
1. Because there are undesirable effects of chemicals that scale with tissue softness, always wear safety glasses or a face shield when using chemicals; eyes are the most sensitive.

2. Wear gloves and a rubber apron (available in the OEML Chem Room, 328 JFB) when handling acids and other corrosives. A table listing the chemicals from which one is protected by different kinds of gloves is included in this manual as Appendix D.

3. Never handle acids in open containers outside a fume hood. Use a fume hood that has been approved for use with corrosives (326 and 328 JFB, as labeled). Vapors are particularly corrosive to delicate electronic equipment in the lab (YOUR equipment in YOUR lab!).

4. The hazard typically increases with increasing concentration.

5. Chemical reactivity increases with temperature.

6. Working alone in a laboratory is never a good idea. You certainly never want to be alone when working with chemicals that are explosive, pyrophoric or toxic by inhalation or if you are performing a uniquely hazardous procedure such as one requiring both a flammable material and an open flame. (The latter is a good example of a poorly designed experiment that needs to be redesigned or just not done.) As always, think about the hazards in your experiment while designing it, design to minimize them, then have a backup plan for "when things go to heck".

4.2.3: Storage
All chemicals in the stockroom and laboratories should be stored so as to avoid
incompatibilities. The best segregation scheme is as follows:

<table>
<thead>
<tr>
<th>Class 1</th>
<th>Flammable or combustible &amp; not highly toxic &amp; compatible with water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 2</td>
<td>Flammable or combustible &amp; not highly toxic &amp; incompatible with water</td>
</tr>
<tr>
<td>Class 3</td>
<td>Oxidizers &amp; non-flammables, compatible with water</td>
</tr>
<tr>
<td>Class 4</td>
<td>Oxidizers &amp; non-flammables, incompatible with water</td>
</tr>
<tr>
<td>Class 5</td>
<td>Air sensitive</td>
</tr>
<tr>
<td>Class 6</td>
<td>Chemicals requiring refrigeration</td>
</tr>
<tr>
<td>Class 7</td>
<td>Compressed gas cylinders, separated as to oxidizers, reducers, corrosives, toxics</td>
</tr>
<tr>
<td>Class 8</td>
<td>Unstable chemicals (explosives).</td>
</tr>
</tbody>
</table>

- Store flammable liquids in approved flammable cabinets. Such cabinets are located in the OptoElectronic Materials Lab or you may purchase one for your own lab.
- Make sure shelves holding containers are secure, restrained by shelf fronts or wires that will restrain chemicals during a mild earthquake.
- When opening newly received chemicals, immediately read the warning label to be aware of any special storage precautions like refrigeration or inert atmosphere storage.
- No chemicals are to be stored in aisles or stairwells, on desks or laboratory benches, on floors or in hallways.
- Mark the acquisition dates on all peroxide-forming chemicals and dispose of them after six months.
  Have spill cleanup supplies (absorbents, neutralizers) in any room used for chemical storage or use.

Lists of compatible and incompatible chemicals and rules for their storage are given in Appendix E.

4.2.4: Hoods

1. Fume hoods serve to exhaust toxic, offensive, or flammable vapors from the laboratory and, with the hood sash in its lowest position, to provide a physical barrier between the laboratory worker and the chemical reaction. Apparatus used in hoods should additionally be fitted with condensers, traps, or scrubbers to contain or collect waste solvents or toxic vapors. The hood is not a means for disposing of chemicals.

2. Before each use, be sure that the hood is working properly. Check it. If your hood does not have a flow monitor, you can improvise with a piece of soft paper like a Kimwipe. Adequate air flow and the absence of excessive turbulence are necessary for safe
operation. Equipment should be placed as far back in the hood as practical and activities carried out at least 6 inches from the front edge of the hood. Keep your head outside of the hood face.

3. Hoods should not be used for storage of chemicals. Chemicals should be removed from hoods at the end of each day or completion of each experiment and stored in appropriate locations.

4. Fume hoods are recommended for most experiments involving use of chemicals. They are particularly important when flammable vapors are involved as a gaseous product, as in the distillation of ether. Most vapors have a density greater than that of air and will settle on a bench top where they may diffuse to a distant burner or ignition source. These vapors will roll out over astonishingly long distances, and any ignition will flash back to the source.

5. Always use a hood with the sash lowered as far as possible.

6. Clean up all working areas in the hood when finished.

7. Use perchloric acid only in hoods designed for its use and then only after washing down to remove organics. Organic wastes deposit on hood and duct surfaces. Volatile peroxides react with those deposits to form explosive organic peroxides.

8. All Chemicals in the fume hoods must be labeled with Contents, Name and Date. A Sharpie marker is a the perfect tool for this. Label the container and cover/close it.

4.2.5 Chemical Spills
1. Spill avoidance is much more important than cleanup. If you want to avoid cleaning up a spill, plan beforehand how to avoid making it. Pay attention to what you are doing!

2. The Physics & Astronomy Dept. Stockroom stocks chemical absorbent pillows for large spills and special absorbent paper towels for small spills. They are located on shelves 6-1-1 and 6-2-1, directly in from the door. Purchase cleanup materials (or at least know where you can get them quickly) before beginning any use of chemicals.

3. Large mercury spills are to be vacuumed up with a special Hg vacuum, available from the OptoElectronic Materials Lab, which also has a container of dirty mercury for recycling. Residual mercury which cannot be removed from cracks may be amalgamated with a powder called "HgAbsorb", available from the Stockroom.

4.2.6: Disposal Procedures
The University Department of Environmental Health and Safety (EHS) is charged with
the responsibility of removing all hazardous materials, both used and unused, from University facilities. Generators are responsible for waste storage and handling prior to pickup by EHS personnel.

Hazardous plastic waste containers for liquids are available in the Stockroom 114 on the east wall. Solids can be in the original container or bagged, labeled and put in a cardboard box. When the waste container is full and labeled with the waste contents place the container in room 328 JFB and EHS will be contacted for a pickup. Currently, Matt DeLong is the interim department contact for Hazardous Waste Disposal. Matt DeLong 329 JFB delong@physics.utah.edu 801-581-7462. Please contact him with any questions.

Hazardous materials are defined as those materials that are flammable, corrosive, reactive or toxic. (The complete legal definition of these terms is given in Section 40, Code of Federal Regulations, Part 260, available from a link from the EHS Web page: www.ehs.utah.edu/enviro/dispose.htm#definition

The simplest legal way to dispose of sodium hydroxide (NaOH - base) is to dilute it to a pH of less than 12.5 and flush it down the sink.

Special note. A mixture of dichromate in sulfuric acid is particularly corrosive. Many years ago it was popular for cleaning glassware. Aside from being extremely corrosive to tissue, the chromate is very toxic to the bacteria that work at the sewage treatment plant. NEVER DUMP DICROMATE SOLUTIONS DOWN THE SINK! These must be disposed of as hazardous waste.

It is much more expensive to dispose of chlorinated solvents than simple flammables. Hence it is a good idea to keep two hazardous waste containers: one for chlorinated solvents, another for non-chlorinated wastes. In the OEML we have a third hazardous waste container for oils (pump and cutting), which may be recycled at no cost to the University.

Packaging Requirements for All Hazardous Materials
1. The outside of the containers must be clean and free of chemical contamination.
2. Use appropriate containers. All glass containers must be securely packaged to prevent breakage during transport.
3. All containers of liquids must have screw lids and must not leak when inverted. If possible use the same container for the disposal of used material that held the new material originally.
4. Metal cans are not acceptable for accumulating hazardous solvents—except for waste oil. Five gallon polyethylene containers are available at no cost from EHS. These containers are also available (at no cost) in the Physics & Astronomy Stockroom. DO NOT!, however, use these labeled hazardous waste containers for other applications. You will be guilty of violating federal regulations by mislabeling hazardous waste.
5. Solid materials must be placed in a sealed container or in a cardboard box lined with
two polyethylene bags.

6. Remember that EPA regulations require that containers storing hazardous materials must be kept closed, except when adding or removing the contents.

Definitions of Hazardous Materials

Hazardous materials are those that “could cause injury or death; or damage or pollute land, air, or water”. Hazardous wastes are defined as substances that are ignitable (flammable), corrosive, toxic, explosive, or reactive, (i.e., react with air, water, acids, etc). To make your life as difficult as possible, there are numerous different definitions and classifications depending on the federal agency regulating the chemical. OSHA regulates chemicals in the workplace; EPA regulates wastes and DOT regulates chemicals with respect to their transportation. Specific definitions from the EPA, which are fairly generally applicable, are found in the Code of Federal Regulations (40 CFR 261). These are summarized below.

**Ignitable:** This category contains materials that are easily combustible or flammable. This includes (1) liquids that have a flash point less than 60º C (140º F); (2) non-liquids that are capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture, or spontaneous chemical change and, when ignited, burn so vigorously and persistently that they create a hazard; and (3) any ignitable compressed gas described in 40 CFR 173.300. Examples include (1) solvents and spent solvents: acetone, benzene, ethyl acetate, ethanol, diethyl ether, methanol, methyl isobutyl ketone (MIBK), Stoddard solvent, xylene; (2) ignitable paint waste: some paint removers, brush cleaners, and stripping agents; epoxy resins and adhesives - epoxies, rubber cements and marine glues; inks containing flammable solvents, and some degreasers. Information on flash points is available from the Condensed Chemical Dictionary and Merck Index. The OptoElectronic Materials Lab has copies of both these references. For additional information see 40 CFR 261.21.

**Corrosive:** This category includes: acids and bases or mixtures having a pH less than or equal to 2 or greater than or equal to 12.5; and materials that burn the skin or dissolve metals. Examples are: strong mineral acids (chromic, sulfuric, hydrochloric, hydrofluoric, and nitric), strong alkalis (ammonium, sodium, and potassium hydroxide), rust removers and acid or alkaline cleaning fluids. This category also includes solids that when mixed with water form solutions that are strongly acidic or basic (ferric chloride, sodium hydroxide). For additional information see 40 CFR 261.22

**Reactive:** This category includes materials that are unstable or undergo rapid or violent chemical reaction when exposed to air, water or other material, generate toxic gases or vapors when mixed with water or when exposed to pH conditions between 2 and 12.5 (as is the case with cyanide- or sulfide- containing materials), forms potentially explosive mixtures with water, are capable of detonation or explosive reaction when heated or subjected to shock. Examples include alkali metals, acetyl chloride, chromic acid, cyanides, hypochlorites, organic peroxides, perchlorates, permanganates, some sulfides (NOT arsenic sulfide), some plating materials and bleaches. For additional information see 40 CFR 261.23.
**Toxic:** This category includes heavy metal elements and their compounds, including arsenic, barium, cadmium, chromium, lead, mercury, silver, selenium, etc., as well as carbon tetrachloride, chloroform, methyl ethyl ketone, trichloroethylene, and benzene; pesticides such as Aldrin, arsenic pentoxide, arsenic trioxide, cacodylic acid, chlordane, copper cyanides, DDT, Dieldrin, dimethylcarbamoyl chloride, Endrin, Lindane, pentachlorophenol, strychnine, etc.

**Pathogenic, Carcinogenic, Infectious, & Etiologic agents:** Includes any material that will directly cause serious health problems such as, "a viable microorganism, or its toxin, which causes or may cause disease in humans or animals" (41 CFR 173.134). Infectious waste includes blood borne pathogens (for example, hepatitis or AIDS virus). For a more detailed definition see the University of Utah's Biosafety Manual and Blood borne Pathogens Exposure Control Plan, available from the Department of Environmental Health and Safety (phone 1-6590).

Additionally, please be aware that the EPA has imposed severe penalties and fines (up to $25,000.00) on individuals submitting false information concerning hazardous waste. These fines also apply to individuals improperly disposing of hazardous waste. To insure compliance with EPA regulations it is your responsibility, as the person generating the waste, to be knowledgeable about the process that produced the waste. This insures that the waste is described accurately on the container; thus, correct information is provided to the disposal facility. Failure to do so may result in a fine and imprisonment. The Department has already been hit with a $500 fine for leaving a hazardous waste disposal container uncovered.

There is another class of materials which are classified as hazardous by the Salt Lake City-County Health Department. These are called "sharps". Sharps are defined as any non-contaminated sharp object that can penetrate the skin, including, but not limited to: broken glass tubing, pipettes and other glassware, razor blades, blades from power tools, glass microscope slides and cover plates, and hypodermic and non-hypodermic needles...basically anything someone could cut themselves on. These may be disposed of in the local dumpster after packaging so that they are not easily accessible to janitorial staff, children or scrap scavengers. (Yes, there are people who scavenge the U dumpsters for cans and other items of value!)

There may be other hazardous substances that are not included here. It is your responsibility to determine if the materials you use are hazardous to human health or the environment.

If you need assistance with disposal of hazardous materials, contact: Matt DeLong, 329 JFB, at 801-581-7462, delong@physics.utah.edu

4.2.7: Hazardous Materials Shipping

To ship Hazardous Materials go to the EH&S web page http://ehs.utah.edu and scroll down to Unwanted Hazardous Material Pickup.

Click on this, fill out the form and EH&S will pick up your material and ship it.
4.3: Properties of Common Chemicals You May Encounter in the Department

1. **Common corrosives.** These are not "extremely hazardous" to the tough skin on your hands but will cause serious chemical burns, essentially instantaneously, if the chemical is hot or the tissue is soft. Goji Kodama, Professor of Chemistry, once spilled hot concentrated nitric acid on the soft inner side of his forearm. Despite the fact that his arm was under flowing cold water within 2 seconds and held there for 15 minutes, plastic surgery was required to replace the skin. Eye tissue is much softer and irreplaceable. Examples of strong corrosives commonly found in the Physics & Astronomy Department include but are not limited to:

   - **Acids:** HCl (hydrochloric), HNO₃ (nitric), H₂SO₄ (sulfuric), CH₃COOH (acetic), H₃PO₄ (phosphoric), HF (hydrofluoric)
   - **Bases:** NaOH, KOH, NH₄OH (sodium, potassium and ammonium hydroxide)

   If any of these substances comes in contact with your skin, wash them off immediately: hold under cold water for at least 5 minutes. Again, the temperature of the acid and softness of the exposed tissue are important. If the burn is more than superficial, immediately contact the Burn Center at the University Hospital, 1-2700.

2. Fairly common materials that are, or can be, extremely hazardous:

   - Concentrated (anhydrous) sulfuric acid is bad; "30% fuming sulfuric" is even worse. Not only are these corrosive to tissue, but they are extremely hygroscopic. This means they extract water from your skin in a reaction which generates sufficient heat to also cause thermal burns!

   - Red fuming nitric acid is not only very corrosive, but also is a very strong oxidizer and hence will cause combustible materials to ignite.

   - Aqueous HF is very bad; therefore, never handle without gloves. Anhydrous HF (the pure liquid, not the standard 48% water solution) is much worse. In either case the burning pain associated with tissue damage does not occur until after the damage has been done. Worse, skin is fairly transparent to HF, allowing it to diffuse to bones where it reacts with the calcium to make insoluble CaF₂. Any significant exposure, particularly to anhydrous HF, must be immediately followed by a visit to the Burn Center at the University Hospital. Sometimes a good plastic surgeon can repair the damage. A very skillful plastic surgeon was able to repair the damage caused by 3 drops of anhydrous HF on Matt DeLong's finger without transplanting tissue. The associated nerve damage healed in about 10 years.
• H₂S (hydrogen sulfide) is relatively common and popularly regarded as "cute" because of its offensive odor. It is as toxic as HCN (hydrogen cyanide) and deadens the nasal detection system.

• Anything toxic dissolved in DMSO (dimethyl sulfoxide) is potentially very hazardous. The skin is transparent to DMSO; whatever is dissolved in it goes along.

• Solutions of strong bases in ethanol are hazardous for reasons similar to DMSO solutions, but the hazards are not as extreme.

• Cyanides are relatively common in the Physics & Astronomy Dept. Solid cyanide salts are relatively innocuous with two exceptions: 1) ingesting small amounts can be fatal (see calculation in section 4.4.5) and 2) contact with an acid produces HCN gas, which is also extremely toxic and fatal in small doses.

• Alkali metals, particularly the heavier ones, may ignite spontaneously in air (lithium to a limited extent) and react violently with water. The reaction with water generates hydrogen which explodes and throws out pieces of burning metal. Alkali metals are typically stored under mineral oil and used only in an inert (including vacuum) atmosphere.

• Laser dyes may be a highly toxic powder dissolved in an organic solvent, although the dyes themselves are usually listed as "hazard unknown". The dye powder should be handled in a fume hood; rubber gloves appropriate for the particular solvent must be worn when handling the solution. The dyes themselves have no EPA number. Spent dye solutions must be disposed of in accordance with the hazard of the solvent.

• Many chlorinated solvents (carbon tetrachloride, 1,1,1-trichloroethane...) are carcinogenic (cancer causing). Wear gloves appropriate for chlorinated hydrocarbons and work in a fume hood. Both the PVC and neoprene gloves sold in the stockroom are acceptable for brief exposures to CCl₄; PVC is not recommended for trichloroethylene.

4.4 Use and Location of a Material Safety Data Sheet (MSDS)
   4.4.1: Reading a Material Data Safety Sheet

MSDS's are organized into sections. All have the same format, so corresponding information is found in the same place in all of them. A glossary of terms used in Material Safety Data Sheets, as well as many other aspects of general chemistry, may be found in Appendix F. Another, more extensive, glossary is found at:

www.pp.okstate.edu/ehs/hazcom/MANUAL/hc--a-e.htm
Section 1: Chemical Identification

This section lists the chemical name and formula as well as trade names and common names of the material, allowing you to identify the contents. It also gives the formula weight, allowing you to distinguish among various forms of the chemical, e.g. dimers and hydrates. Based on the identity of the chemical established in this section, you can consult other sources (e.g. those referenced at the end of this section of this document) to get additional information. The name, address and phone number of the manufacturer as well as the phone number of a 24 hour emergency center are also listed. This section also includes a quick, general synopsis of the hazards of the material. Hazards with respect to health, flammability, reactivity and skin contact are rated on a scale of 0-4 where 0 indicates the material is harmless and 4 means extremely hazardous. Similar information is found on the labels of chemicals produced in the last few years. The hazard information specifically refers to:

- **Health**: the ability of the material to make you sick. Example: NaCN (sodium cyanide) is poisonous; eating or inhaling it will be harmful or fatal.

- **Flammability**: the ease with which the material burns or supports combustion. Example: gasoline and acetone are highly flammable.

- **Reactivity**: the possibilities for potentially hazardous chemical reactions (evolution of toxic products, evolution of heat, evolution of large quantities of gas...) with other materials. Example: NaCN reacts with strong acids to liberate HCN gas, which is extremely toxic; Na metal reacts with water to liberate flammable H2 gas.

- **Skin contact**: the ability of the material to damage your skin or other external tissues. Example: strong mineral acids and bases destroy tissue (some faster than others).

Section 2: Hazardous Ingredients

The information in this section is rarely useful in the laboratory. Example: Household dry bleach contains about 10% dichloroiso-cyanurate, a strong oxidizer and source of active chlorine.

Section 3: Physical Data

Listed in this section are data for the melting and boiling points, vapor pressure, density, water solubility, color, and odor. This information may help you recognize that the container is mislabeled; hence that the hazards may be different from those stated on the label! A flammable material with a low boiling point will be hazardous at a considerable distance from an open flame, particularly in a poorly ventilated room.

Section 4: Fire & Explosion Hazard

Data given in this section include the flash point and explosive concentrations. The flash
point is an operational temperature related to both the "intrinsic flammability" and vapor pressure of the material. The lower the flash point, the greater the hazard. Any material with a flash point below room temperature is dangerous when used "in the vicinity of" an open flame. Examples: (ethyl) ether: \(-45^\circ C = -49^\circ F\); ethanol: \(13^\circ C = 55^\circ F\); peanut oil: \(280^\circ C = 540^\circ F\). So peanut oil can be used in your wok; ethanol at room temperature will burn immediately when exposed to a flame, and ether is sufficiently combustible and volatile to be hazardous at a considerable distance from the actual flame. The autoignition temperature is the temperature at which combustion will begin in the absence of an external initiator (flame or spark). This number is extremely important for storage. The autoignition temperature of ethyl ether is \(180^\circ C = 356^\circ F\). The upper and lower explosive limits are the concentrations of the material, in air, which will explode if exposed to a spark or flame. If the ratio of the vapor pressure of the material at ambient (i.e. storage) temperature to atmospheric pressure exceeds the lower explosive limit, an open container constitutes an explosion hazard. The upper explosive limit is typically rendered useless by ventilation.

Section 5: Health Hazard Data

This section gives information about the quantities or concentrations of the material which will probably make you sick when ingested (eaten), inhaled (breathed), gotten on your skin or in your eyes. Values given are for acute (direct, immediate) and chronic (long term) exposure. Chronic exposure is typically not relevant in a laboratory environment. Information includes symptoms of overexposure: how you can tell if you are being harmed by the material. In some cases this is obvious (strong mineral acid on your skin or in your eyes); in other cases it is not (breathing too much acetone vapor for too long while cleaning a pump). Values given include the TLV (Threshold Limit Value), the concentration in which you can safely work for 40 hours a week. Coupled with a knowledge of the vapor pressure at room (or other appropriate) temperature, you can use this number to get an idea as to whether the work you are doing can be performed in an open room, or must be done in a fume hood. "LD\(_{50}\) for..." is extremely important. It gives the lethal dose that kills 50% of the test animals by a specified route (typically ingestion). The units are mg chemical per kg of body weight. LD\(_{50}\) = 6.4 mg/kg for NaCN (sodium cyanide) and LD\(_{50}\) = 3.75 g/kg for NaCl, (sodium chloride, table salt) both orally in white rats. To the extent you are willing to model yourself as a 70 kg white rat; this means that eating 448 mg of NaCN or 263 g (a little more than a half pound) of NaCl will probably kill you. This is extremely important information in both positive and negative senses. It not only tells you that NaCN is quite toxic, but also that the volume associated with 448 mg is .28 cm\(^3\), corresponding to a cube 6.5 mm (almost exactly 1/4 inch) on a side; this is not an invisible speck. Hence, you won't be killed by eating an invisibly small piece of sodium cyanide. Proper care and respect are warranted; total paranoia is not.

Section 6: Reactivity Data

Information is given on other materials that are incompatible with the one being described. Strong oxidizers are incompatible with combustibles; strong acids are incompatible with strong bases (in the sense that violent reactions liberating large quantities of heat occur). Cyanide salts are incompatible with strong acids; the reaction product is highly toxic HCN gas.
Alkali metals are incompatible with water.

**Section 7: Spill & Leak Procedures**

Information is given on proper procedures for cleaning up spills or dealing with leaking containers. This information helps you identify the equipment (absorbent pillows, Hg vacuum pump...) necessary to deal with a spill before the spill happens. Hence you can purchase the required spill cleanup equipment beforehand or at least know where to find it quickly. You don't want to be thumbing through the Yellow Pages with five gallons of acetone or a gallon of sulfuric acid through your floor!

**Section 8: Special Protection Information**

This section lists protective equipment to be used in conjunction with handling or using the material: glasses, face shields, gloves, ventilation, etc.

**4.4.2: Sources of Material Safety Data Sheets**

Material Safety Data Sheets (MSDS) are available to Departmental personnel from a variety of sources.

- A great place to start is the University of Vermont: [http://hazard.com/msds/](http://hazard.com/msds/)
- The MSDS's for a large fraction of the chemicals found in the Department are found in the grey file cabinet just inside the stockroom door. When any chemical is received in the stockroom, a copy of the MSDS is made. One copy goes to the recipient of the chemical, and the other goes into this file.
- Another source of MSDS's is the University MSDS coordinator at 1-8671. The collection is actually quite complete.
- There are also a few weirdos in the collection in the OptoElectronic Materials Laboratory, 329 JFB.

*Final comment*: Unfortunately, the primary objective of writers of MSDS's is to avoid product liability litigation; communication of information useful to the lab worker or student is secondary. Hence, extracting useful information from an MSDS is often not easy. For example, the MSDS for nominally pure ethanol (from one manufacturer) states that it is incompatible with acids and moisture. It is well known that ethanol can safely be mixed with citric acid (orange or grapefruit juice) or water. On the other hand, explosive products result from mixing it with strong oxidizers like nitric acid. NaCN is also blandly listed as being incompatible with strong acids without driving home the point that the reaction being described is the one very effectively used in the San Quentin gas chamber! Similarly, one MSDS for ethanol lists under spill procedures "...wear self-contained breathing apparatus, rubber boots and heavy rubber gloves..." which may be appropriate if a 55 gal. drum is emptied in a small room, but gives no useful information applicable in a laboratory. This may seem a trivial point, but if the same caution is given for a material for which the user has no previous experience, the results can be highly undesirable.
4.5: References, Sources of Additional Information

1. Safety in Academic Chemistry Laboratories: Available from the MSDS drawer of the file cabinet in the stockroom (114 JFB)

2. The Merck Index: Source of hazard information on a huge number of chemicals. Available in OptoElectronic Materials Lab.


6. Toxic Gases - First Aid and Medical Treatment, Matheson (OptoElectronic Materials Lab).

Sources of safety equipment (not intended as an endorsement or recommendation, simply a place to start looking). Catalogs available from the Stockroom (114 JFB):

- Direct Safety Co., 7815 S. 46th St., Phoenix AZ 85040; 800-528-7405.
- Lab Safety Supply, PO Box 1368, Janesville WI 53547-1368; 800-356-0783.
Chapter 5: Cryogenic Fluids

The two main cryogenic fluids used in Physics & Astronomy Dept. labs are liquid nitrogen and liquid helium. The three principal hazards associated with these materials are the possibilities of asphyxiation, frostbite and explosion. Death by asphyxiation can occur if the liquids are allowed to boil off or are spilled in confined, poorly ventilated areas. When in the liquid or cold gas phase, they can cause severe frostbite to the eyes or skin. Do not touch frosted pipes, valves, or other metal parts that have been in contact with liquid nitrogen, particularly if you have wet skin. (Yes, the stories you have heard are true, your tongue will freeze to metal at liquid nitrogen temperature and have to be surgically removed.) “Generally, frostbite is accompanied with discoloration of the skin, along with burning and/or tingling sensations, partial or complete numbness, and possibly intense pain.” (Wikipedia) If you observe any of these symptoms, immediately remove the affected body parts from the LN2 transfer system and warm them, e.g. by contact with other body parts or with running water in the adjacent shop.

Protect your eyes with safety goggles or a face shield, and cover skin to prevent contact with the liquid or cold gas. Protective gloves that can be quickly and easily removed and long sleeves are recommended for arm protection. Wear cuffless trousers outside boots or over high-top shoes to shed spilled liquid. If accidental exposure occurs that causes an injury, a physician should be consulted immediately. Tissue suffering from the severity of frostbite that can be inflicted by cryogenic fluids may die, eventually leading to gangrene.

Liquid helium is cold enough to freeze air solid. If a helium container is left open to the air, even for a relatively short time, air may freeze and clog the line. Evaporation of helium gas in the container will cause the pressure to rise, leading to a possibly catastrophic result. Although rare, this is the most serious hazard associated with liquid helium. Liquid nitrogen is cold enough to condense liquid oxygen from the air. It can also freeze water vapor from the air into ice. Ice can clog tubes, leading to a pressure explosion. Concentrated liquid oxygen is an explosion hazard and can also greatly enhance the flammability of any nearby combustibles.

All glass dewars must be wrapped with tape to avoid flying glass if the Dewar is broken. Do not dispense or transport cryogenic fluids in a container that can be easily broken or spilled; certain plastics can shatter easily when chilled to extremely low temperatures. If a non-standard dewar is to be used, that container must be within a container such as a wooden box to avoid a catastrophic spill. A large spill could expose an individual to frostbite and/or asphyxiation.

Issues have arisen concerning riding the elevator with LHe and LN2 containers, specifically in the event the elevator becomes stuck between floors. While this risk in not zero, a much greater concern is dropping and breaking a glass dewar of LN2 in an elevator. Be extra careful not to do this: this act will quickly generate a lot of gas in a confined space.
Chapter 6: Electrical & RF Safety

6.1: The Hazards

6.1.1: Electrocution
- Typically, it is the current passing through the chest area that causes electrocution. Though current passing through the head alone can be fatal, contact is usually made with one arm, the current passing through to the other arm or to a leg. The amount of current passed, not the voltage involved, is critical.

- The most dangerous current range is roughly from 100 mA to 3 A. In this range the heart is sent into unsynchronized contractions called ventricular fibrillation. Without medical defibrillation intervention death will follow.

- At currents higher than about 6 A the heart and breathing muscles are paralyzed, but often may be restarted by someone with CPR (Cardio-pulmonary Resuscitation) training.

- It is primarily skin resistance that (combined with the applied voltage) determines the current passed through the body. There have been electrocutions with a 22 volt source when the skin resistance was lowered by abrasion. There are two reasons why many accidental electrocutions involve people in water: (1) the water provides a relatively low resistance current path outside the body and (2) the water substantially reduces the resistance of your skin. Solutions of electrolytes (salts, Gatorade, etc.) are even more effective.

- The most dangerous voltage source is the 110 Vac that powers the labs, shops and offices. Not only is it sufficient in many cases to pass the deadly 100 mA of current, but there are so many opportunities to come in contact with it.

6.1.2: Damage Due to Reflex Action
- Currents over 10 mA can cause violent involuntary muscle contraction. Such contractions can result in bodily damage and/or equipment damage. In addition, such contractions may make it impossible to release one's grasp on the voltage source.

6.1.3: Burns
- Currents over about 2 A will result in burns at the point of contact. This is a major factor only for those working with extremely high (many kV) sources.

6.1.4: Burned Out Electronics
- Instead of damaging or killing yourself, your electrical accident may destroy your electronics. The destroying currents may either pass through your body or through some tool. It takes less than 50 volts to cause major damage in some CMOS circuits, so it is clear that 110 Vac is again a major hazard.
6.1.5: Radio Frequency (RF) Field Injury

- Microwave fields are efficiently absorbed by water-containing materials, such as the human body. This fact is put to use in microwave ovens. The threshold is only about one milliwatt/cm² for damage to the eyes. This damage is not associated with pain, so one must take care not to work with microwaves that are not enclosed in waveguides if the power densities can exceed this level.

6.2: Safety Procedures

Be extremely careful about touching any metallic equipment if there is water on the floor. Such water enables the hand-through-body-to-leg current path.

Whenever possible unplug a circuit before working on it. Additionally, ensure that someone else does not try to use a piece of electrical equipment that you are working on: if you leave it; at the very least put a note on it. Do not just turn off the switch; you may make contact with the "hot" side of the power line on the source side of the switch. If the circuit involves voltages over about 100 volts, you should use a grounded insulated wire to touch all possible high voltage points before working on the circuit. Capacitors can store dangerous charges for fairly long periods of time (up to hours or more).

Do not try to help someone ensnared in an electrical shock situation without first turning off the power source involved, preferably at the breaker box. If you do not take this precaution you are likely to also become ensnared.

If you must work on an energized circuit there are several precautions you can take to minimize the danger. Do not work alone. In case of an accident you need someone to turn off the power, or do CPR, or call for help. Keep one hand in your pocket. This simple stratagem avoids the arm-to-arm shock. Be sure your legs and seat are not grounded to avoid other shock paths. Wear rubber-soled shoes; sit on a wooden or plastic stool...the objective is to maximize the resistance through all paths that include your heart. THINK!

Be sure power cords are correctly wired using the conventional color code. An amazing number of Physics & Astronomy students do not know proper wiring; one of them could have built the equipment you are using! Always use three wire plugs for your circuits. The blade with the brass screw (this is the "hot" line, the line with potential 110 Vac different from ground) should be connected to the black lead in the power cord. This black lead is also the one in which the mandatory on/off switch and fuse are inserted. The blade with the silver screw is the neutral and should be connected to the white lead in the cord. This is the lead that carries the current back to the source. The third (middle) prong on the plug is the ground connection, and should be connected to the green wire in the cord. This green wire should be connected to the metal part of your instrument (such as the cabinet), which would be most dangerous if accidentally electrified from the black lead. The green wire is for your protection. Never cut off the ground prong on a plug. Without the case-to-ground connection, an internal short of the
hot line to the case results in a death trap. With the case-to-ground connection this same short will announce itself by blowing a fuse or tripping a circuit breaker. Some special circuit breakers, called Ground Fault Interrupters (GFls), sense the difference in current between the “hot” and neutral leads and will open the power lead if even a few mA difference is measured. (It is assumed that this difference is following some other path, like through your body.) The same color rules hold when wiring an outlet as when wiring a plug.

**Quick Reference Table**

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Avoid exposed dangerous voltages; replace worn cords before they cause a shock, or possibly a fire. Enclose circuits. If the voltages involved are high, place interlocks on the doors to the enclosure in which the high voltage exists; these will de-energize the voltage should the doors be accidentally opened.

If you work with very high voltage, you should keep in mind that the breakdown electric field of air is about 10 kV/cm. Thus, you do not need to actually touch a conductor to be shocked. This is particularly important if you are using an exposed coil from an induction heater.
Chapter 7: Principles of Laser Radiation Safety  
7.1: Laser Radiation Safety for Non-Technical Staff

Non-technical staff should read Sections 8.1 and 8.2 of this chapter to get a feeling for what hazards may exist in labs using lasers. Again, the basic laser radiation safety principle for non-technical staff is a simple one: avoid going into labs that bear the universal laser-radiation hazard sign, shown below.

![Caution: Laser in Use](image)

If you must go into a laser lab, make sure that a qualified technical staff member or student is present in the lab with you so that you do not suffer accidental exposure to either laser radiation or to associated toxic chemicals. Take note: looking into a laser lab and seeing no laser radiation does not mean that no lasers are operating. Some lasers emit in the invisible light region and can be quite hazardous. For example, carbon dioxide lasers are used to cut thick steel plate (imagine what such a beam would do to your eyeballs or other valuable body parts), and yet their radiation is completely invisible.

Figuring out why laser light is hazardous is not difficult. We’ve all set black paper on fire by focusing sunlight with a lens. The lens in your eye is very high quality and the retina is the same shade of black as the paper we have burned. Looking at the sun with your eyes burns holes in your retina. The power density of sunlight is something like 500 mW/cm². But this power density of sunlight is spread over a very broad range of the spectrum. Some of it is not even transmitted to the retina. Also your eye suffers from chromatic aberrations. This means that sunlight is not all focused at one spot but the different colors get spread around to different areas. The green light from an Ar laser is more dangerous than sunlight for two reasons: all of the light is in the green part of the spectrum, where the eye is most sensitive and there are no chromatic aberrations; hence all of the laser light is focused to one small spot.
Hence 500 mW/cm² of green laser light (about 15 mW beam intensity) is much more dangerous than looking at the sun. Most laser beams used in research labs are more intense than 15 mW.

The result of the calculations done in section 8.3 is that essentially any direct laser beam or any beam reflected from a smooth, flat surface, like a mirror, window or neutral density filter, is sufficiently intense to burn holes in your retina. If the beam is sufficiently intense to do useful physics, it is sufficiently intense to burn tiny holes in your retina. Avoid getting any direct or reflected (except from a rough surface) laser beam into your eyes. If you look directly into a laser beam, you will suffer permanent degradation of your eyesight. An extensive laser safety manual is given by the University of California at San Diego website: www-ehs.ucsd.edu/lasers.htm.

7.2: Primary Health Dangers due to Lasers

- Damage of the retina or other eye tissue from direct laser beams;
- Damage of skin tissue (burns) from direct exposure to laser beams;
- Toxicity of various chemicals commonly encountered in laser systems, such as carcinogenic dyes in dye lasers, or extremely toxic gases such as fluorine, used in excimer lasers.
- Electrocuton by the high-voltage power supplies required by many lasers.

Before entering a laser lab, you must determine whether any lasers are operating outside the visible region of the spectrum. (Any laser operating in the visible region of the spectrum you can see and know to avoid.) As discussed below, even lasers used as pointers can burn the retina of your eye. Hence it is reasonable to assume that any operating laser can harm you if gotten directly into your eye.

7.3: Permissible Exposures

If one does the calculation of permissible laser beam intensities that you may actually get into your eyes, based on ANSI Standards, the numbers are extremely small. Because the eye is most sensitive in the green region of the spectrum, the permissible level is the lowest there: about 3 microwatts in the oft-cited aversion time your eye needs to blink or look away! At the 632 nm wavelength characteristic of HeNe lasers, because your eyes are considerably less sensitive, the permissible level increases to 50 microwatts. (Similar powers are acceptable for the diode lasers used in laser pointers. Since most laser pointers have powers in the mW range, they exceed the permissible levels by about a factor of 100!)

What does this all mean? It means that if you are operating an argon ion laser at 10 mW, a very modest power, the 4% reflection you get from any lens surface in your optical system will exceed the permissible level by a factor or 100! It means that all direct laser beams and their specular reflections can cause irreparable damage to your retina in the 0.25 sec it
takes you to avert or close your eyes. All direct laser beams and their specular reflections must be terminated by absorbing beam stops. No exceptions! Note that this factor of 100 was based on a 10 mW beam. Most of the argon ion lasers in the Department are capable of emitting 1-25 Watts!

A similar calculation may be done for skin exposure. Because the skin is not at the focal point of a high quality lens, permissible exposure levels are much higher. The permissible level specified by the ANSI Standard for visible lasers is 200 mW/cm², which is equivalent to something like 5 mW laser power. There is a Web site run by a manufacturer of laser light show equipment that has much less conservative levels. They state that below 5 W you will experience a burning sensation that will motivate your reflexes to move the burning part of your body to get out of the beam before skin damage occurs. Above 5 W skin damage occurs before you can react. Also according to this site, an average of two people per year die from laser electrocution.

There is one worse case: pulsed lasers. The damage threshold for laser pulses shorter than about 1 microsecond is three orders of magnitude lower than for CW lasers.

Make sure that the path of your laser beam is such that it will not be accidentally encountered by persons in your lab. Keep the beam level at an elevation not the eye level of a person walking, sitting or moving in a wheel chair. Note that if the beam is reflected at an angle rather than horizontally, there is a good chance that the beam will be at eye level somewhere in the room. Always terminate laser beams and their specular reflections with an appropriate target, one that is neither reflective nor flammable.

Always be vigilant around high-voltage power supplies for lasers. Tragically, graduate students have died by electrocution from the high voltage that is present in many laser systems. If voltages above 15 kV are used, ensure that your exposure to potential x-ray emission is negligible.

Some lasers, such as dye lasers and excimer lasers, require toxic liquids and gases for their operation. These can be quite dangerous, and you should be familiar with their risks before you use the laser. MSDS sheets should be available to you for each potentially toxic substance that you use, and you should read them. If laser dyes are dissolved in toxic solvents, the spent solutions must be disposed of as hazardous wastes. Hazardous waste disposal procedures are given in chapter 4. Dyes are discussed in detail in the next section.

For high-power lasers, protective gloves and clothing may be required so that you do not suffer accidental burns. One incident of eye damage from a laser is the following.

#280: Graduate student receives macular lesion from picosecond laser.
Picosecond Nd:YAG pulsed laser operating at 1064 nm was on a laser optics table. The beam was directed from one table to another across an aisle. The beam went onto the second table, where it was directed onto a liquid sample holder. Here, apparently, the beam was bigger than the liquid sample holder. The edges of the beam went past the sample bottle - then off that table into the room area where a strip chart recorder was located.

A graduate student working on the experiment looked at the strip chart recorder [remember that 1064 nm is outside the visible region of the spectrum, so the student could not see the reflected beam] and it was here that the student received the beam into the eye. It was estimated that he received about 10% of the beam into the eye. The student reportedly "heard a popping sound" which was followed by a white spot in the vision center. The professor took the student to an eye doctor for a retinal exam which confirmed the burn exposure. The student did not experience shock. The beam caused a retinal burn. The student now complains that his "eyes get tired" while reading.

7.4: Laser Dyes & Their Solvents

The Materials Safety Data Sheets supplied with most laser dyes are nearly useless because the dyes have not been tested. A number of laser dyes have been tested for mutagenic effects with the following results:

- DCM is by far the worst. Handle it only with gloves in a fume hood.
- Of the eight coumarins tested, 102/480, LD 490 and 7/535 showed mutagenic effects.
- Of the multiphenyls tested, only terphenyl was found to be mutagenic.
- Cresyl violet and Nile blue are mutagenic and toxic.
- Kiton Red, oxazine and carbazine are not mutagenic.
- No mutagenic effects were found among rhodamines.

(A material that shows mutagenic effects has the potential to be carcinogenic - i.e. it can cause cancer. All carcinogens are mutagens; the inverse relation is much more difficult to prove. Look at how long it took to establish cigarette smoke as a carcinogen. Remember also that carcinogenic effects are generally cumulative: the risk increases with exposure.)

Important information about the hazards of laser dye solvents (as well as a wealth of spectroscopic information on the dyes themselves) is given by Brackmann. Essentially all laser dye solvents are hazardous. All except water and ethylene glycol must be disposed of as hazardous waste. As with other chemicals, chlorinated hydrocarbons must be segregated and disposed of separately from flammable solvents. In all cases the hazard of the dye solution for disposal purposes is determined by the solvent.
7.5 References


Chapter 8: Principles of Magnet Safety

One may not think of magnets as potentially hazardous objects, but in fact they can be, especially superconducting magnets that achieve very high fields when their coils are cooled to liquid helium temperatures.

8.1: Magnet Safety for Non-Technical Staff

Non-technical staff should read the whole of this short chapter, without worrying about the technical details. The basic safety principles can be summarized as follows:

- Never carry any iron or steel object anywhere near an operational magnet. You may suddenly find the object flying out of your hand (or pocket) with little or no warning. To be safe, avoid carrying any metallic object near operating magnets, unless you know for sure that it is non-magnetic (i.e., not attracted by a magnetic field).

- If you have a pacemaker, never go near an operational magnet, as it may interfere with the proper operation of the pacemaker.

- Be especially careful in the vicinity of superconducting magnets, as these have the largest fields and require extremely cold liquid helium for their operation.

- Avoid exposing credit cards to magnetic fields greater than 10-20 G.

8.2: Major Hazards Associated with Magnets

Carrying ferromagnetic objects near an energized magnet can be quite hazardous. The induced force on a ferromagnetic object by a dipole magnetic field goes as $1/r^2$, a very steep function of the distance $r$ from the magnet. This means that the force on a steel tool will behave as though it suddenly "turns on" as you approach the magnet; you will have little if any warning before a very strong force acts on the tool. Flying tools can be quite destructive. To prevent this, always use special non-magnetic tools (such as CuBe or plastic tools) in the vicinity of an energized magnet. It is good practice in your lab to mark a border around the magnet within which non-magnetic tools are required. There are many true stories of accidents that have been caused by flying tools near superconducting magnets. One classic involved a flying wrench that trashed a million-dollar multiple-wire chamber at a particle accelerator. Another accident occurred at a magnetic resonance imaging (MRI) facility at a major hospital, in which a lab tech was wheeling a metal cart past an active superconducting magnet. When told not to bring the cart into the room, the tech replied that he had wheeled carts past the magnet many times, and knew what he was doing. What he did not know, apparently, was the $1/r^2$ force law, and on this specific occasion the cart was suddenly pulled from his grasp by the magnet and smashed into the magnet at high velocity, destroying the cart. Had a patient been in the imaging magnet at the time (fortunately, there was none), he or she might very well have been killed by the collision.

The biological effects of strong magnetic fields on humans are not well known, but are

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potential hazards that should not be ignored. There are a few unofficial regulation standards for human exposure that have been set up at national accelerator laboratories, which are listed here:

**Unofficial National Accelerator Laboratory Standards (dc fields)**
- >10 kG (>1.0 T): to be avoided for even short periods
- 5 - 10 kG (0.5-1.0 T): whole body exposure up to one hour max
- 100 G - 5 kG (0.01-0.5 T): work in area should be minimized

**Unofficial Stanford Linear Accelerator Standards (dc fields)**
- whole body or head, extended periods, < 200 G
- arms and hands, extended periods, < 2000 G
- whole body or head, short periods (minutes), < 2000 G
- arms and hands, short periods (minutes), < 20,000 G

Persons with cardiac pacemakers must not go near energized magnets; the high magnetic field can interfere with the operation of the pacemaker.

Remove all ferromagnetic items on your person before approaching an energized magnet, for the same reasons discussed above. Also, remove all magnetized credit cards from your wallet if you wish to ever use them again.

Quenching of superconducting magnet coils can also be hazardous. This occurs when (for some reason) the current-carrying coil goes from the superconducting to the normal state, thereby suddenly changing its resistance from zero to a finite value. The tremendous $I^2R$ energy generated in the coils vaporizes the liquid helium, creating large internal pressures within the magnet dewar (the section that holds the liquified helium coolant) and a large He gas outflow from the magnet's pressure relief valves. Superconducting magnets are designed to safely weather a quench, but accidents sometimes happen. At the time of this writing, a colleague's magnet had just experienced its fourth quench (one tries to avoid quenches!); the first three were uneventful, but the fourth literally blew apart the magnet! Not only is there a mechanical danger from such mishaps, but one also has to worry about the possibility of suffocation due to the sudden displacement of air by the large volume of gaseous helium generated in such an event. In summary, the dangers of a quench are a) mechanical failure of magnet; fortunately, this is a very rare event, b) suffocation from the displacement of air by gaseous helium (a much more likely hazard).

8.3 References
1. T.S. Tenforde, ed., "Magnetic Field Effects on Biological Systems" (Plenum Press,
Afterword

In 1967 Matt DeLong was taught a lesson whose value to the philosophy and intent of this document cannot be overstated. The lesson is based on a physical law that we all know to supersede all others. "If anything can go wrong, it will." Therefore, before beginning any task, figure out what are the most disastrous things that can go wrong and take precautions to assure they don't happen, AND that contingency plans are available if they do.

Appendix A: First Report of Injury or Illness

Go to the Human Resources website, [www.hr.utah.edu](http://www.hr.utah.edu), click on Forms at the top of the page and scroll down to Employer's First Report of Injury or Illness Form, or type in [www.hr.utah.edu/forms/lib/E1.pdf](http://www.hr.utah.edu/forms/lib/E1.pdf) You can fill in the form on line. Ignore the first two sections; fill in only the sections labeled “Employee” through “OTH”, near the bottom. (see next page)
Form 122

For your protection Utah Law requires notice that worker’s compensation fraud is a crime. Please see back of this form for the full fraud statement.

Workers’ Compensation Employer’s First Report of Injury or Illness
State of Utah – The Labor Commission – Division of Industrial Accidents
160 E 300 S, P. O. Box 146610
Salt Lake City, Utah 84114-6610

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<thead>
<tr>
<th>Cause of Injury Code</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

| How Injury or Illness/Abnormal Health Condition Occurred, Describe the Sequence of Events and Include Objects or Substances that Directly Injured The Employee or Made The Employee Ill |
|                                                                                                                                   |

<table>
<thead>
<tr>
<th>Date Returned to Work</th>
<th>If Fatal, Give Date of Death</th>
<th>Safeguard or Safety Equipment Provided?</th>
<th>Were They Used?</th>
<th>YES</th>
<th>YES</th>
<th>NO</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

**TREATMENT**

<table>
<thead>
<tr>
<th>Physician/Health Care Provider (Name &amp; Address)</th>
<th>Hospital (Name &amp; Address)</th>
<th>Initial Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Date Administrator Notified</th>
<th>Date Prepared</th>
<th>Preparer’s Name &amp; Title</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

**OTHER**

<table>
<thead>
<tr>
<th>Witnesses (Name &amp; Phone Number)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

**SEE BACK FOR IMPORTANT INFORMATION**

© IAIABC 2002

CC: Labor Commission
Insurance Carrier
Employee
Employer’s File

39
FRAUD – “Any person who knowingly presents false or fraudulent underwriting information, files or causes to be filed a false or fraudulent claim for disability compensation or medical benefits, or submits a false or fraudulent report or billing for health care fees or other professional services is guilty of a crime and may be subject to fines and confinement in state prison.”

INSTRUCTIONS TO EMPLOYER

The Employer’s First Report of Injury or Illness must be submitted to the Labor Commission, Division of Industrial Accidents, per Sections §34A-2-407 and §34A-3-10B, Utah Code Annotated (U.C.A.), 1997. Each employer shall file the report within seven days after the occurrence, or the employee’s notification of the same, which results in medical treatment by a physician, loss of consciousness, loss of work, restriction of work, or transfer to another job. Each employer shall file a subsequent report with the commission of any previously reported injury; or occupational disease that later resulted in death. Also, for your information, Section §34A-6-301(3)(d)(ii) states that each employer shall, within 8 hours of occurrence, notify the Division of Occupational Safety and Health, at (801) 530-6901 or (800) 530-5090, of any; work related fatality; disabling, serious, or significant injury; or occupational disease incident. A serious injury includes; amputation, fractures of major bones (both simple and compound), and hospitalization for medical treatment.

* All information requested on this form is of vital importance. Please answer all items in detail in order to avoid additional correspondence or the return of this report for completion. Do not enter data in the shaded areas.

* The box titled “OSHA Log Number” must be filled in with the employer assigned Case Number from OSHA’s new 300 Injury Log. The Case Number needs to reflect the year of the injury – for example, your first injury in 2002 should reflect the first injury and the year 00/02 with the next injury being 00202, etc.

* Please provide WAGE information. This information is needed by the insurance company for paying the correct amount on a claim.

* The injury report on file with the Labor Commission, Division of Industrial Accidents, is private information and is only released to parties to the claim.

* Please make sure the EMPLOYER NAME is correct, as well as your FEIN # (Federal Tax ID Number). The employer’s name should be the same as reported to The Department of Workforce Services and as it appears on your WORKERS’ COMPENSATION insurance policy.

* The Labor Commission is to receive the original of this report, Worker’s Compensation Insurance Carrier gets the second copy, the employee gets the third copy, and the employer gets the fourth and should maintain a copy of this report.

* Failure to file this report with the Labor Commission or failure to provide the employee with copy of the report, is a Class C misdemeanor and can also result in a citation and a civil penalty for each violation as per §34A-2-407(7), §34-a-30108(7), §34A-6-302, and §34A-6-307, U.C.A.

* If you dispute the validity of this claim you need to contact your insurance carrier, but you must still file the “Employer’s First Report of Injury or Illness” form with the Labor Commission.

* Reminder: Inform your injured employee of his/her rights and obligations (as outlined on the back of the employee’s copy) of Utah’s Workers’ Compensation Act.

For additional Information please contact:
State of Utah – Labor Commission
Division of Industrial Accidents
160 East 300 South, 3rd Floor
P O Box 146610
Salt Lake City, Utah 84114-6610
(801) 530-6800 (800) 530-5090
Appendix B: Filling out an Incident/Accident Report

- If anyone (students, visitors, volunteers, etc.) is injured in a non-work-related accident while on University property or in conjunction with an off-campus University activity, University personnel (presumably whoever is their sponsor on campus) must submit an Incident/Accident form to Risk & Insurance Management. The University of Utah Incident/Accident report form, available at [web.utah.edu/risk_management/insurance/pdf/incident_accident_online2.pdf](http://web.utah.edu/risk_management/insurance/pdf/incident_accident_online2.pdf) can be printed and sent to University Risk & Insurance Management, 110 Park Bldg. (It may also be filled out and submitted online.) This form must be submitted in conjunction with workers' compensation claims only if you believe that your injury was the result of the U's negligence or an unsafe condition.
UNIVERSITY OF UTAH
INCIDENT/ACCIDENT REPORT

INSTRUCTIONS:
1. This form should be completed by University Personnel whenever anyone is involved in an incident which could have/did result in personal injury or property loss, except for occupational or automobile related accidents. DO NOT issue a blank form to injured persons to complete and return.
2. Requests for a copy of the completed form should be directed to the University Risk Manager at 581-5590. All requests are subject to approval.
3. Keep a copy for your records and submit a completed form to Risk & Insurance Management, 408 Park Building, by fax (585-5257) or by clicking send above.

GENERAL INFORMATION

<table>
<thead>
<tr>
<th>1. Injured Person or Property Owner</th>
<th>2. Sex</th>
<th>3. Age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Address</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>5. Home Telephone</th>
<th>6. Work Telephone</th>
<th>7. Student</th>
<th>Faculty</th>
<th>Staff</th>
<th>Volunteer</th>
<th>Visitor</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>8. Date and time of loss/accident</th>
</tr>
</thead>
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<table>
<thead>
<tr>
<th>9. Exact location of loss/accident</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>10. Witness Name</th>
<th>11. Phone Number</th>
<th>12. Other Phone Number</th>
</tr>
</thead>
</table>

INCIDENT OR ACCIDENT

<table>
<thead>
<tr>
<th>13. How did the incident/accident occur? Describe fully the events, give details on all facts that led to the accident or injury. Identify the individual(s) who may have caused or contributed to the injury.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>14. Reported to Police</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>15. Name of Police Agency</th>
<th>16. Case Number</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>17. Apparent nature of injury</th>
<th>18. Part(s) of body injured</th>
</tr>
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<table>
<thead>
<tr>
<th>19. Describe immediate action taken</th>
</tr>
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<table>
<thead>
<tr>
<th>20. By Whom</th>
</tr>
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</table>

<table>
<thead>
<tr>
<th>21. Explain any first-aid given</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>22. By Whom</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>23. Method of transportation</th>
</tr>
</thead>
</table>

|-----------------------|-------------|

PROPERTY DAMAGE OR THEFT

<table>
<thead>
<tr>
<th>26. Exact description of loss</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>27. Describe property in detail</th>
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</table>

<table>
<thead>
<tr>
<th>28. Approximate dollar value</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>29. Reported to Police</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>30. Name of Police Agency</th>
<th>31. Case Number</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>32. First noticed by whom</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>33. Phone Number</th>
</tr>
</thead>
</table>

ADDITIONAL INFORMATION

<table>
<thead>
<tr>
<th>34. Person completing report</th>
<th>35. University Department</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>36. Phone Number</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>37. E-mail Address</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>38. Area Supervisor</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>39. Phone Number</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>41. Additional Comments or Information</th>
</tr>
</thead>
</table>

| 42.  | I attest that the information given here is accurate to the best of my knowledge. |
Appendix C: Emergency Response Procedures from the Departmental Disaster Plan

Local Emergency Response

- Anthrax and Similar Biohazards
- Bodily Injury
- Bomb Threats
- Chemical Spills
- Civil Disorder
- Fire
- Odors
- Radiological Accidents
- Snow
- Storms
- Utility Outages
Anthrax & Similar Biohazards

Anthrax has been maliciously used as a weapon of terror to infect those who come in contact with the bacterium. In most cases the bacterium has been delivered in powdered form through the mail. Although a tainted letter is an extremely rare occurrence, it is important to be alert for suspicious letters and parcels.

Response

- Stay calm. Anthrax is not contagious and can be treated. Affliction is the result of exposure. Your goal is to minimize exposure to yourself and others.
- Do not open, shake or sniff the article. If possible, place the item in a plastic bag.
- Isolate the suspect letter or parcel (close office door, etc.) and evacuate the immediate area of all personnel. DO NOT PULL the fire alarm station.
- Contact the University Police dispatcher at 5-COPS (5-2677) for assistance. Don’t worry about possible embarrassment if the item turns out to be innocent.

Follow-up

- Advise your supervisor of the incident if you haven’t already done so.
- Assist University Police in their investigation by providing background and detailed information about the incident.
- Obtain appropriate medical care and emotional support as needed. Personnel receiving potential exposure should be seen by medical professionals at the University Hospital Emergency Room. The supervisor to employee(s) to be seen should call ahead and explain the incident to emergency room personnel (1-2500). An Employee First Report of Injury form, (Appendix A) available from Human Resources, www.med.utah.edu/hr/E1.pdf, should accompany the employee.
- Prepare a written incident report (Appendix B) available at http://web.utah.edu/risk_management/insurance/html/incident_accident_info.htm stating the details of what occurred. Include the name of the investigating officer and the assigned case number. When the incident report is complete, submit it to your supervisor.
Bodily Injury

Every effort is made to insure that INSCC maintains a safe, hazard free work environment for employees, clients and guests. However, accidents may take place, causing an injury or a sudden illness.

Serious/Life Threatening
It is serious if it:

- Places a person’s life in jeopardy.
- Renders a person unconscious.
- Results in a substantial loss of blood.
- Involves a broken bone.
- Involves the amputation of an arm, leg, hand or foot.
- Consists of burns to major portions of the body.
- Is the result of a severe electrical shock: current passing through the head or chest or any shock in excess of 240 V.
- Causes loss of sight.

Response
- Contact the University Police dispatcher at 5-COPS (5-2677) or, if unavailable, dial 9-911 for assistance.
- Ask a first aid-trained coworker if he/she is willing to offer assistance and provide emergency first aid until medical assistance arrives.
- Do not exceed your training or knowledge when attempting to provide assistance.
- Do not transport the injured person to the hospital in your private vehicle.
- For poisoning or a drug overdose, call the Poison Control Center (1-2151) or 9-911 if the poisoning presents a significant medical emergency.

Follow-up
- Advise your supervisor of the incident if you haven’t already done so.
- Assist those responding to your call by providing background and details concerning the incident.
- Obtain appropriate medical care and emotional support as needed.
- Prepare a written incident report (Appendix B) stating the details of what occurred (see description below).

Non-Life Threatening

Response
- For emergencies requiring medical aid or transportation to the hospital, call the University Police dispatcher at 5-COPS (5-2677) or, if unavailable, dial 9-911.
- For non-life-threatening injuries or illnesses, call the University Family Health Center (1-8000) for a walk-in appointment or go to the University Hospital Emergency Room. Identify yourself as a University employee with a work injury.

Follow-up
- Notify Harold Simpson (1-3839 or 801-244-1017).
• Reporting job-related injuries or illnesses - *Employees*
• Employer’s First Report of Injury (E1) should be completed by the employee and signed by his or her supervisor.
• Submit the E1 to Workers Compensation and Environmental Health and Safety within 24 hours or as soon as practical. Forms, shown in Appendix A are available online at [www.personnel.utah.edu/forms.e1.pdf](http://www.personnel.utah.edu/forms.e1.pdf).
• Reporting job-related injuries or illnesses – *Visitors and students*
• Complete a University Incident Report and submit it to your department. The form should be forwarded by your Department to the University Risk Manager. Forms, shown in Appendix B, are available online at [www.utah.edu/risk-management/incidentaccdnt.htm](http://www.utah.edu/risk-management/incidentaccdnt.htm)
**Bomb Threats**

Most bomb threats received on campus come by way of the telephone; others are received by mail or found as unattended packages. Most threats are unfounded and are used as a way to disrupt normal University operations. While the majority of these incidents turn out to be a hoax, all must be treated as a serious threat to individual safety and University property.

**Suspicious Phone Call**

**Response**

- Stay calm.
- Keep the caller on the line as long as possible. Ask the caller to repeat the message. (Use the Bomb Threat Check List, attached at the end of this section).
- If the caller does not indicate the location of the bomb or the time of possible detonation, ask the caller for that specific information.
- Inform the caller that the building is occupied and the detonation of a bomb could result in the death and serious injury of many innocent people.
- Pay particular attention to any peculiar background sounds that might give even a remote clue to the location of the caller.
- Listen closely to the caller’s voice, and quality of speech. Does the caller have an accent or speech impediment?
- A bomb threat is a criminal offense and must be reported to University Police. Contact the University Police dispatcher at 5-COPS (5-2677) immediately for assistance. Notify the Building Committee Chair or alternate.
- **DO NOT activate the building alarm system to evacuate.** The investigating officer, in consultation with the Department of Public Safety, will determine if the building should be evacuated.
- Check your work area for any items that are unfamiliar to you. If you find a suspicious item, do not touch it. Report the location and description of the item to a police officer.
- If it is determined that the building must be evacuated:
  - Take your personal belongings with you when you leave.
  - Leave doors unlocked and open.
  - Do NOT turn lights or office equipment on or off. Do NOT use the telephone. Do NOT make cell phone calls.
  - Use the stairs to evacuate the building. Do NOT use the elevator.
  - Move to the Emergency Assembly Point by the fountain between the Student Union and Student Services Buildings. **Do not leave the area until you have reported in and been accounted for.**
  - Stay away from the building until cleared by Department of Public Safety personnel.

**Follow-up**

- Advise your supervisor of the incident if you haven’t already done so.
- Assist University Police in their investigation by providing background and details concerning the incident.
- Obtain appropriate medical care and emotional support as needed.
• Prepare a written incident report (Appendix B) stating the details of what occurred. Include the name of the investigating officer and the assigned case number. When the incident report is complete, submit it to your supervisor.

**Suspicious Parcel**

**Response**

- Contact the University Police dispatcher at 5-COPS (5-2677).
- Move people in the immediate area away, but **DO NOT activate the fire alarm system**.
- Do NOT move or open the package.
- Do NOT investigate too closely.
- Do NOT cover or insulate the package.
- If it is determined that the building must be evacuated, see instructions under Suspicious Phone Call.

**Follow-up**

- Same as Suspicious Phone Call.
BOMB THREAT CALL PROCEDURES

Most bomb threats are received by phone. Bomb threats are serious until proven otherwise. Act quickly, but remain calm and obtain information with the checklist on the reverse of this card.

If a bomb threat is received by phone:
1. Remain calm. Keep the caller on the line for as long as possible. DO NOT HANG UP, even if the caller does.
2. Listen carefully. Be polite and show interest.
3. Try to keep the caller talking to learn more information.
4. If possible, write a note to a colleague to call the authorities or, as soon as the caller hangs up, immediately notify them yourself.
5. If your phone has a display, copy the number and/or letters on the window display.
6. Complete the Bomb Threat Checklist (reverse side) immediately. Write down as much detail as you can remember. Try to get exact words.
7. Immediately upon termination of the call, do not hang up, but from a different phone, contact FPS immediately with information and await instructions.

If a bomb threat is received by handwritten note:
- Call
- Handle note as minimally as possible.

If a bomb threat is received by e-mail:
- Call
- Do not delete the message.

Signs of a suspicious package:
- No return address
- Excessive postage
- Stains
- Strange odor
- Strange sounds
- Unexpected Delivery
- Poorly handwritten
- Misspelled Words
- Incorrect Titles
- Foreign Postage
- Restrictive Notes

DO NOT:
- Use two-way radios or cellular phone; radio signals have the potential to detonate a bomb.
- Evacuate the building until police arrive and evaluate the threat.
- Activate the fire alarm.
- Touch or move a suspicious package.

WHO TO CONTACT (select one)
- Follow your local guidelines
- Federal Protective Service (FPS) Police
  1-877-4-FPS-411 (1-877-437-7411)
- 911
**Chemical Spills**  
(With thanks to the Medical College of Georgia)

The range and quantity of hazardous substances used in laboratories require preplanning to respond safely to chemical spills. The cleanup of chemical spills should only be attempted by knowledgeable and experienced people. (Obviously the same is true for their use!) The time to plan for spills is when you design the experiment – you don’t want to be thumbing through the Yellow Pages when you have a liter of hydrochloric acid on the floor.

It is the responsibility of each Emergency Response Team member to ascertain which researchers in their areas of responsibility are using hazardous materials and to compile lists of the identities of those materials. The lists must be updated at least once per year. In the event of a fire or bomb incident, it is important for the fire fighters to know what chemicals are burning or for the bomb squad to know what chemicals will be spread throughout the neighborhood in the event of a blast. Copies of these lists should be kept both in your office and at home. Chemical spill kits are in 328 JFB, Stockroom 114 and 151 INSCC.

**Is the chemical spill a major spill emergency?**

- How much was spilled? - if the material is hazardous and if the amount of the material spilled is more than one liter, it is considered a major spill. This is a judgment call that will rely heavily on your preparation. If the material spilled does not emit vapors hazardous in moderate quantities and you have the tools at hand to complete the cleanup in less time than is required to mobilize a response team from Environmental Health and Safety, it is probably acceptable to clean up the spill yourself.
- What are the hazards of the material spilled? - if the spill is less than one liter, but presents an immediate danger to health, safety, the environment, or is an immediate fire hazard, it is considered a major spill.
- Where is the spill? - if the spill is outside of the laboratory or outside of the area where the material is normally used, and/or there is no trained person available to clean up the spill, it is considered a major spill.

**Response (Major Spill)**

Large Spills (> 1 Liter or a material presents an immediate fire, safety, environmental, or health hazard regardless of quantity). Examples: Spill of greater than 1 Liter of ethanol, methanol, strong acids or bases or any quantity of highly volatile, hazardous organics, or mercury compounds.

- Stop work.
- Turn off any ignition sources
- Attend to any injured persons if you can do so without personal risk.
- Leave laboratory hood on.
- Evacuate laboratory and close door.
- Secure lab, i.e., keep others out of the lab.
- Call the Campus Police dispatcher at 5-COPS (5-2677). They will activate the appropriate response.

**Response (Minor Spill)**
Small spills (< 1 Liter and does not present an immediate fire, safety, environmental or health hazard).

- Alert people in immediate area of spill.
- Wear protective equipment - including safety goggles, gloves, long-sleeve lab coat.
- Avoid breathing vapors from the spill.
- Confine spill to small area.
- Use appropriate kit to neutralize and absorb inorganic acids and bases. Collect residue, place in container, fill out Hazardous Waste Disposal Form, and contact Environmental Health and Safety at ext. 1-6590 for disposal.
- For other chemicals, use appropriate kit or absorb spill with vermiculite, dry sand, or diatomaceous earth. Collect residue, place in container and dispose as chemical waste.
- The Chemical Spill Kit for INSCC is located in Room 130 on top of the yellow chemical storage cabinet. It includes:
  - Gloves and goggles for your protection
  - Absorbent “socks” which will absorb your spill
  - Spill response pocket guide
- Clean spill area with water.

**Follow-up (Major and Minor Spills)**

- After the spill has been cleaned up and appropriately disposed of, it is imperative that a post-incident review be held to discuss the causes of the spill and establish remedies to insure that the conditions permitting the spill do not occur again.
Civil Disorder

Civil disorder can take the form of a peaceful sit-in or be escalated all the way to a full-scale riot. Civil disorder generally refers to groups of people who choose not to observe the law, regulations or rules in an attempt to bring attention to their organization or cause. Civil disorder can take the form of small gatherings or large mob groups attempting to stop traffic flow, block building access and interrupt normal activities by generating disruptive noise and intimidating people outside their group.

Response

- Stay calm.
- Consider your own safety and act accordingly.
- Don’t respond to the intimidation of the group.
- Move away from the gathering crowd.
- Contact the University Police dispatcher at 5-COPS (5-2677) from a safe location to report the incident.

Follow-up

- Advise your Department Chair/Dean of the incident if you haven’t already done so.
- Notify Harold Simpson (1-3839 or 801-244-1017).
- Prepare a written incident report (Appendix B) stating the details of what occurred. When the incident report is complete, submit it to the director.

Fire

Fire kills over 4,000 and injures more than 23,000 Americans each year. Among the victims approximately 100 firefighters die each year in the line of duty. Direct property loss due to fire exceeds $8.5 billion a year. Most of these deaths and losses are preventable.

Small Fire

Response

- Activate the building’s fire alarm by pulling on a close pull station.
- If the fire is contained in a trash can, or other restricting container and you have been trained to use a fire extinguisher you may choose to fight small fires yourself.
- Never attempt to fight a fire alone. If you feel you can contain a small fire using a fire extinguisher, ask a coworker to back you up before an attempt is made.

Follow-up

- Notify Harold Simpson (1-3839 or 801-244-1017).
- Report all fires to Environmental Health and Safety (1-6590); submit an incident report (Appendix B).
- Report all fire extinguisher discharges to Environmental Health and Safety so the equipment may be recharged/filled and replaced.

Large Fire

- Response
- Activate the building’s fire alarm by pulling on a close pull station.
- Never attempt to fight a fire alone. Do not attempt to fight large, spreading fires.
• Leave the building.
• If possible close doors and window as you go to slow down the fire’s progress.
• Notify others working in your area when exiting.
• Assist those in need as you are leaving.
• Use the fastest way out of the building. Do not use the elevator as an escape route.
• If there is smoke in your work area or in the corridors, stay down near the floor.
• Feel the surface and hardware of any closed door before you attempt to open it. If either is hot to the touch do not open the door.
• Open all doors slowly. If heat or heavy smoke is present, close door and find another way out.
• If you become trapped, call the University Police dispatcher at 5-COPS (5-2677) and give them your location.
• Once outside, move to the Emergency Assembly Point by the fountain between the Student Union and Student Services Buildings.

Follow-up
• Once in a safe location, call the University Police dispatcher at 5-COPS (5-2677) for assistance. Give as much information as you possibly can including:
  • Name of the building and location of the fire.
  • Your location.
  • Do not re-enter the building until authorized by the University Fire Marshal or SLC Fire Department. Cessation of audible alarms does not mean that the emergency has ended.

Odors
Strong odors can be annoying and in some cases cause discomfort and/or nausea. Although annoying, these reactions do not always constitute a health or safety hazard.

Response
• Try to determine the odor’s origin and where the concentration seems the strongest.
• Check area trashcans for odor causing garbage such as spoiled food. If something is found, remove it from the building.
• If there is a floor drain in the area and the odors are sewer smells, dump water into the drain. Request that custodial services add some mineral oil to the drain to keep it from drying out.
• Ask operators to move of shut off vehicles idling by building air intake.
• Check if odors are related to building remodeling or maintenance such as roof sealants, carpet glue, paint, solvents, polish, new furniture, etc.
• Contact the Office of Environmental Health and Safety (1-6590) if:
  o Odors are related to building remodeling, construction or maintenance.
  o Odors are due to a chemical spill.
• Contact Plant Operations dispatch at (1-7221) if you smell natural gas or you cannot determine the source of the odor and it does not decrease over time. If the odor increases, contact the Building Committee Chair or alternate to consider activating your building evacuation procedure. DO NOT pull the fire alarm pull station to evacuate.
If occupants are experiencing real discomfort, leave the area and get some fresh air. DO NOT "evacuate" a building using the fire alarm in the event of odors. Notify Harold Simpson (1-3839 or 801-244-1017), about the need to evacuate for a predetermined amount of time.

- Notify Harold Simpson (1-3839 or 801-244-1017), Harold will broadcast the evacuation message throughout the building via email, phone message, and/or messenger.
- After the time determined has passed, if the odor is not resolved, establish a new time to check back.

**Follow-up**
- Advise your supervisor of the incident if you haven’t already done so.
- Assist those responding to your call by providing background & details concerning the incident.
- Obtain appropriate medical care if needed.
- Prepare a written incident report (Appendix B) stating the details of what occurred. When the incident report is complete, submit it to your supervisor.

**Snow**

_The University President decides whether to close campus and send personnel home or to continue on a normal schedule._

**In the event of a severe snow storm:**

**Response**
- Personnel are notified of a University closure during normal working hours through supervisory channels and University television and radio or TV station broadcasts (KUER –FM 90 and KUED Channel 7) as well as the University home page: www.utah.edu or by calling 1-6773.
- Once notified to leave campus, do so immediately.
- After an overnight storm, tune to the campus radio and television stations (KUER –FM 90 and KUED Channel 7) beginning from 6:30 AM to 7:00 AM, consult the University home page: www.utah.edu, or call 581-6773.

**Follow-up**
- Continue to monitor closures, etc. via campus radio and television stations (KUER –FM 90 and KUED Channel 7).

**Winter Storm Survival Kit for Cars**
- Keep your gas tank more than half full so if you do get stuck, you can run the engine once in a while to keep warm until help arrives.
- Things to keep in your car during the winter:
  - Cell phone to call for help
  - Blanket or sleeping bag
  - Extra coat, warm boots and gloves
  - High-calorie, non-perishable food (power bars, etc.)
- Flashlight w/ extra batteries
- First Aid Kit
- Knife
- Water-proof matches
- Sack of sand (or kitty litter)
- Shovel
- Windshield scraper and brush
- Booster cables & Tow rope
- Compass
- Tool kit

**Storms (Thunder and/or High Winds)**

**Response**
- Stay away from windows. Seek refuge in interior corridors or offices.
- If lightning is striking nearby, turn off and unplug all computers and other electronic devices not isolated from the building power by an Uninterruptible Power Supply (UPS) or other surge protector until the storm has passed.

**Follow-up**
- Report facility damage to the Plant Operations dispatcher at 1-7221.
Utility Outages

Computer/Internet

Response:
- Notify Brad Hawks (5-5801)
- If your data resides on the INSCC Building Servers maintained by CHPC, your data will automatically be backed up on a daily basis.
- If your data resides on your local machine, it is your responsibility to make sure your data is regularly backed up.

Electrical

Response
- Keep a flashlight in a drawer or cabinet where it can be easily found (in the dark!) if needed.
- Notify Harold Simpson (1-3839 or 801-244-1017)
- Assess the extent of the outage in your area. Report the outage to Plant Operations dispatch at 1-7221.
- Help co-workers in darkened work areas move to safe locations. If practical, secure current experimental work; move it to a safe location if necessary.
- Open window shades for additional light and, if operable, the window itself for additional ventilation.
- Keep lab refrigerators or freezers closed throughout the outage.
- Unplug personal computers, non-essential electrical equipment and appliances.
- If an extended outage is anticipated by the Building Committee Chair, personnel may be released, with concurrence from the Vice President for Research.
- If you are asked to evacuate your building, secure any hazardous materials work and leave the building immediately.
- Obtain information about a prolonged outage via campus radio and television stations (KUER – FM 90.1 and KUED Channel 7) or the University home page: www.utah.edu.

Phones

Response
- Determine if the problem is local or building-/university-wide.
- Notify Harold Simpson (1-3839, 801-244-1017) in this case, hsimpson@physics.utah.edu.
- If the problem is only local, find a working phone and call Netcom at 1-4000 to report the problem and request that someone repair it.
- Notify Netcom via e-mail, helpdesk@utah.edu, that your phone lines are down.

Sewer System

Response
- Call the Plant Operations dispatcher at 1-7221 and report the problem.
- Notify Harold Simpson (1-3839 or 801-244-1017)
- Try to keep people away from the problem area.
Water Leak or Broken Pipe or Water Outage

Response

- If it is a small local leak, try to hold a rag or tape over the leaking area while someone else calls the Plant Operations dispatcher (1-7221) to report the problem.
- If you have access to the water pipes to that area, turn the water off and then report the problem to the Plant Operations dispatcher.
- If a major water pipe is broken, make sure all electrical equipment is shut off. Do not enter the flooded area. Have someone call the Plant Operations dispatcher (1-7221) immediately.
- Emergency Response Team members who are accountable for research areas dependent on cooling water (lasers, diffusion pumps, photomultipliers...) are responsible for calling the Plant Operations dispatcher (1-7221) and having themselves added to the notification list for water shutdowns. When notified of a water shutdown, the ERT member (or alternate) must activate their phone and email trees to pass the information on to all researchers dependent on water. If the shutdown is immediate, the information should also be transmitted in person by visiting each lab immediately after sending phone and email messages.

IV. Major Disaster Response

- Earthquake
- Terrorist Attack
- Tornado

Earthquake

The site of the University of Utah campus happens to be located on one of the most active earthquake zones in the world. Earthquakes strike suddenly, violently and without warning. Identifying potential hazards ahead of time and proper action during and immediately after an earthquake could literally mean the difference between life and death: yours!

Response

- Stay calm. The motion may be frightening, but unless it causes something to fall on you, the motion is harmless.
- Stay indoors until the shaking stops. Go to a safe place under a desk, table, bench, doorframe, between seating rows in a lecture hall or against an inside wall. Sitting at your desk with several shelves of heavy books above your head is not smart!
- Stay away from glass that could fall on you.
- If outdoors move away from buildings and utility wires. Once you are in an open area, stay there until the shaking stops.
- Do not run through or near damaged buildings. The greatest danger from falling debris is just outside doorways and close to outside walls.
After Minor Tremor (brief rolling motion)
- Examine your area for damage
- Report damage to the Plant Operations dispatcher at 1-7221; report hazardous materials releases to Environmental Health and Safety at 1-6950.
- Await instructions; evacuations are unlikely.

After Major Tremor (violent shaking)
- Check your work area for any coworkers who might have been injured.
- Do not attempt to move seriously injured people unless there is a danger of additional life threatening injury.
- Report injuries to the University Police dispatcher at 5-COPS (5-2677) or, if unavailable, 9-911 if you are able to.
- Do not use elevators.
- If the building is severely damaged, leave immediately. Move to the Emergency Assembly Point in the parking lot south of the Naval Science Building.
- Do not turn lights or office equipment on or off.
- Do not use any type of open flame for any purpose.
- If you smell natural gas, open a window if possible, and leave the building.
- Don’t reenter the building until cleared by the Department of Public Safety.
- Don’t use the telephone except to report the location of those seriously injured that cannot be moved safely.
- Notify Harold Simpson (1-3839 or 801-244-1017)
- Await instruction, be patient, help others.
**Terrorist Attack**

The whole concept of a terrorist attack is so new and foreign to people in this country that we aren’t really able to establish reasonable scenarios for responding because we don’t yet have scenarios for the forms the attack could take. Hopefully we won’t get any more data! Examples to date are the bombing of the Murrah Federal Building in Oklahoma City, the attack on the World Trade Center, and the attack on Columbine High School. Anthrax was covered earlier.

**Response**

- In the event of a bomb attack, as in Oklahoma City, or “missile” attack, as in the World Trade Towers, the effect would be the same as fire and/or earthquake. Follow the instructions given previously for those events.
- Contact the Facilities Director, Harold Simpson, 304C South Physics, 1-3839 (801-244-1017), or alternate so that the building can be evacuated as quickly and quietly as possible. Never use the elevator for an emergency evacuation unless you are disabled and have no other option.
- If the attack is only on our building and not campus wide, move to the Emergency Assembly Point by the fountain between the Union and Student Services Buildings so we can get an accurate accounting of survivors.
- If the attack is campus-wide, move to a safe location off campus.
- If the attack is by an armed individual or group (as in the Columbine case):
  (1) if the attackers are nearby, try to barricade yourself in a secure space
  (2) if the attackers are not nearby, evacuate by a route that takes you away from the attackers.

**Follow-up**

- Notify Harold Simpson (1-3839 or 801-244-1017)
- Contact your Emergency Response Team member (see list on p. 3) so we can get an accurate accounting of survivors.
Tornado Response

- Go to the basement or to an inside hallway at the lowest level.
- Avoid places with wide-span roofs such as auditoriums and large hallways. Stay away from windows and open spaces.
- Get under a piece of sturdy furniture such as a workbench or heavy table or desk and hold on to it. If there is no sturdy furniture, squat low to the ground and cover head and neck.

Follow-up

- Evacuate carefully and do not reenter the building. Move to the Emergency Assembly Point by the fountain between the Student Union and Student Services Buildings.
- Report injuries to 9-911 if possible.
- Report building damage to the Plant Operations dispatcher at 1-7221 and hazardous material releases to Environmental Health and Safety at 1-6590.
- Notify Harold Simpson (1-3839 or 801-244-1017)
- Remain calm, assist injured, and await instructions.

Personal Mental Preparation for Dealing with Emergencies

Because emergency situations occur rarely and because they demand immediate response, most of us are ill-prepared when they do occur. Television gives no useful information because it focuses on what trained professionals do. Even Red Cross First Aid courses have largely devolved to “...call 911”. NOW is the time for you to mentally prepare yourself to deal with emergency situations, should you find yourself in one. YOU are the one who has to live with the consequences of your actions...or inactions. Consider a few scenarios. Be prepared for what your response will be when one of these occurs. What other scenarios can you anticipate? What should your response be to them?

- You smell a strange, unidentifiable odor. Possible responses: We have trained chemists in the Department who may be able to help. Start in the OptoElectronic Materials Lab. George Williams is also a reformed chemist. EHS is used to dealing with such situations. Call them at 1-6590. If the odor is strong and nasty, do not hesitate to call the U dispatcher at 5-COPS, then pull the fire alarm to (a) evacuate the building and (b) summon help with self-contained breathing apparatus and a Hazmat team.
  You see smoke coming from a lab or classroom. You have three choices: pull the fire alarm (which evacuates the building), call the fire department directly at 911, which does not evacuate the building, or try to identify the source. Doing nothing is not an option! If you try to identify the source yourself, be sure to have a back-up person prepared to (a) summon help immediately and (b) drag you out from your search. The only justifications for identifying the
source yourself are to reduce damage and search for injured persons. You get relatively few points for being an hero. And dead heroes are still dead.

• You see fire. This is an easy call. Pull the fire alarm. Now the options are what to do until the fire department arrives. If the fire is small and you want to try to reduce damage to our facilities by fighting it, start with the nearest fire extinguisher. This is your choice. Be aware that pointing a fire extinguisher at the flames sucks in air and makes it burn faster (Bernoulli Effect for the physics buffs). POINT THE EXTINGUISHER AT THE BASE OF AND IN FRONT OF THE FIRE ITSELF.

You encounter an injured person (including yourself). Call an ambulance via the U dispatcher: 5-COPS. In some cases, particularly if the person’s head or ego is injured, they may refuse assistance. Again, you have to live with the consequences if they really need assistance and don’t get it because of your actions (inactions in this case). You make the judgment call. As mentioned elsewhere, transporting the injured party to the hospital yourself is NOT a good idea. One of our colleagues did this and caused a car accident because they were unable to deal with the stress.

Appendix D: Chemical Resistance of Gloves

The following is from the University of Florida Department of Environmental Health & Safety. For more information, visit: www.ehs.ufl.edu/Lab/CHP/gloves.htm

Note that the U Physics & Astronomy Stockroom stocks Microflex Latex gloves and Safety Choice Nitrile gloves. There appears to be no compatibility chart available for the latter, but the nitrile listing from other manufacturers should be applicable. (Microflex lists the two on the same chart.) Note that the websites can be accessed from the logos below with CTRL+click, or by visiting www.microflex.com/Products/~/media/Files/Literature/Microflex%20Chemical%20Resistance%20Guide.ashx

Glove Use in Laboratories

No glove may be used as protection from all chemicals. A glove may protect against a specific chemical, but it may not protect the wearer from another. If a glove protects the wearer, it will not protect the wearer forever, as the glove material will deteriorate. Therefore, the following must be considered when choosing which gloves to be worn to protect against chemical exposures. Disposable Glove’s are to be discarded of after they are removed, one use only!
Factors to consider when choosing gloves:

- Chemical to be used: Consult the compatibility charts to ensure that the gloves will protect you.
- Dexterity needed: The thicker the glove, typically the better the chemical protection, as the glove will be more resistant to physical damage, like tears and cracks, but it will harder be to handle and feel the work.
- Extent of the protection required: Determine if a wrist length glove provides adequate protection, or will a glove that extends further up the arm be required.
- Type of work to be done: gloves are specific to the task. Ensure the correct glove is chosen to avoid injuries. Examples: A nylon cryogenic glove will be damaged if a hot item is handled, where as a “hot mitt” will not protect the wearer when liquid nitrogen is used, as it may be too porous.

Rules for Glove Use in the Labs:

- Wear the correct gloves when needed.
- Wear gloves no longer than 2 hours.
- Wash hands once gloves have been removed.
- Disposable gloves must be discarded once removed. Do not save for future use.
- Dispose of gloves into the proper container (biologically contaminated gloves will need to go into a red bag); while other chemically contaminated gloves may not.
- Non-disposable/reusable gloves must be washed and dried, as needed, and then inspected for tears and holes prior to reuse.
- Remove gloves before touching personal items, such as phones, computers, pens and one’s skin. Remember the “designated area rule” where “science” does not mix with personal space (one’s desk or lunch space). Gloves used in research are considered “science”.
- Do not wear gloves out of the lab. If gloves are needed to transport anything, wear one glove to handle the transported item. The free hand is then used to touch door knobs, elevator buttons, etc. If you are wearing gloves to “protect your sample from you” and are in the hall, no one else understands this and will be concerned about the items you have contaminated with those gloves.
- If for any reason a glove fails, and chemicals come into contact with skin, consider it an exposure and seek medical attention.
Glove Compatibility Charts

The following are links to various companies providing gloves that may be used at the University of Utah. Available on each site are the glove compatibility or chemical resistance charts for those gloves supplied by those companies. Please use these charts to ensure the gloves being used to handle chemicals are providing adequate protection to the wearer. It is important to note that all chemicals will not be listed on these charts. It is also essential to note that two similar gloves supplied by two separate manufacturers may not provide the same level of protection to a specific chemical. Therefore, it will necessary to consult the manufacturer’s specific compatibility chart for the brand of gloves being used.

Understanding terms used in glove compatibility charts:

- **Breakthrough time:** Time it takes for the chemical to travel through the glove material. This is only recorded at the detectable level on the inside surface of the glove.
- **Permeation Rate:** Time it takes for the chemical to pass through the glove once breakthrough has occurred. This involves the absorption of the chemical into the glove material, migration of the chemical through the material, and then desorption once it is inside the glove.
- **Degradation rating:** This is the physical change that will happen to the glove material as it is affected by the chemical. This includes, but is not limited to swelling, shrinking, hardening, cracking, etc. of the glove material.
Compatibility charts rating systems will vary by the manufacturer’s design of their chart. Many use a color code, where red = bad, yellow = not recommended, green = good, or some variation this scheme. A letter code may be used, such as E = excellent, G = Good, P = poor, NR = Not Recommended. Any combination of these schemes may be used, so please understand the chart before making a decision on the glove to be used.
Manufacturer’s Glove Compatibility Charts

Chemguide

www.chemrest.com

www.ansellpro.com/download/

www.mapaglove.com/ChemicalSearch.cfm?id=1

www.marigoldindustrial.com/
us/search_chemical_78,390.aspx

www.vwrsp.com/programs/
safety/images/disposable_gloves.

Butyl rubber   Neoprene

www.deltagloves.com/chemchart.htm

www.mcrsafety.com/tools/permeation.shtml

www.microflex.com/
Products/~/media/Files/Literature/
Microflex Chemical Resistance Guide.ashx

www.saftgard.com/
anonymous/SolvaGard1.pdf

www.polyco.co.uk/
downloads/chemical_resistance_guide.pdf

Butyl rubber   Neoprene

www.oaktechnicalinc.com/

www.assurancechemical.com

www.sempermed.com

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Appendix E: Chemical Compatibility & Storage Considerations

**CARCINOGENS**

*Label all containers with “Cancer Suspect Agent” & appropriate organ (i.e. “Cancer Suspect Agent: Gonads”) *Store according to hazardous nature of chemical, using appropriate security when necessary.

<table>
<thead>
<tr>
<th>Compound Type</th>
<th>Chemical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimony Compounds</td>
<td>Acrylonitrile</td>
</tr>
<tr>
<td>Arsenic Compounds</td>
<td>Benzene</td>
</tr>
<tr>
<td>Benzidine</td>
<td>Chloroform</td>
</tr>
<tr>
<td>Beryllium</td>
<td>Dimethyl sulfate</td>
</tr>
<tr>
<td>Cadmium Compounds</td>
<td>Dioxane</td>
</tr>
<tr>
<td>Chromates, Salts of</td>
<td>Ethylene Dibromide</td>
</tr>
<tr>
<td>B-Naphthylamine</td>
<td>Hydrazine</td>
</tr>
<tr>
<td>Nickel Compound</td>
<td>Nickel Carbonyl</td>
</tr>
<tr>
<td>Vinyl Chloride</td>
<td></td>
</tr>
</tbody>
</table>

**TERATOGENS (cause congenital defects)**

*Label all containers Teratogens. *Storage according to hazardous nature of chemical, using appropriate security when necessary.

<table>
<thead>
<tr>
<th>Compound Type</th>
<th>Chemical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aniline</td>
<td>Mercury</td>
</tr>
<tr>
<td>Benzene</td>
<td>Nitrobenzene</td>
</tr>
<tr>
<td>Carbon disulfide</td>
<td>Phosphorus</td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>Radioactive substances</td>
</tr>
<tr>
<td>Chlorinated hydrocarbons</td>
<td>Toluene</td>
</tr>
<tr>
<td>Lead</td>
<td>Turpentine</td>
</tr>
</tbody>
</table>

**TOXIC COMPOUNDS**

*Store according to hazardous nature of chemical, using appropriate security when necessary. *Post emergency phone numbers near phone.

**WARNING**: These chemicals are dangerous or extremely dangerous to health and life when inhaled, swallowed, or absorbed by skin contact. Take proper precautionary measure to avoid exposure.

**Solids**

<table>
<thead>
<tr>
<th>Compound Type</th>
<th>Chemical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimony Compounds</td>
<td>Phenol</td>
</tr>
<tr>
<td>Arsenic Compounds</td>
<td>Phosphorus (yellow)</td>
</tr>
<tr>
<td>Barium Compounds</td>
<td>Phosphorus</td>
</tr>
<tr>
<td>Beryllium Compounds</td>
<td>Pentachloride</td>
</tr>
<tr>
<td>Cadmium Compounds</td>
<td>Phosphorus</td>
</tr>
<tr>
<td>Calcium Oxide</td>
<td>Pentasulfide</td>
</tr>
<tr>
<td>Chromates, Salts of</td>
<td>Picric Acid</td>
</tr>
<tr>
<td>Cyanides, Salts of</td>
<td>Potassium</td>
</tr>
<tr>
<td>Fluorides, Salts of</td>
<td>Selenium Compounds</td>
</tr>
<tr>
<td>Iodine</td>
<td>Silver Nitrate</td>
</tr>
<tr>
<td>Lead Compounds</td>
<td>Sodium</td>
</tr>
</tbody>
</table>
### Mercuric Compounds
- Sodium Hydroxide

### Oxalic Acid
- Sodium Hypochlorite

#### Liquids
- Aniline
  - Hydrochloric Acid
- Bromine
  - Hydrofluoric Acid
- Carbon Disulfide
  - Hydrogen Peroxide
- Carbon Tetrachloride
  - Mercury
- Chloroform
  - Nitric Acid
- Chromic Acid
  - Perchloric Acid
- p-Dioxane
  - Phosphorus Trichloride
- Ethylene Glycol
  - Sulfuric Acid
- Formic Acid
  - Tetrachloroethane
- Hydrazine
  - Tetrachloroethylene
- Hydrobromic Acid

#### Gases
- Carbon Monoxide
  - Hydrogen Chloride
- Chlorine
  - Hydrogen Cyanide
- Cyanogen
  - Hydrogen Sulfide
- Diborane
  - Nitrogen Dioxide
- Fluorine
  - Ozone
- Formaldehyde
  - Sulfur Dioxide
- Hydrogen Bromide

### WATER REACTIVE CHEMICALS

**Storage Precautions:**
*Store in a cool, dry place.*
*In case of fire, keep water away.*

**WARNING:** These chemicals react with water to yield flammable or toxic gases or other hazardous conditions.

#### Solids
- Aluminum Chloride
  - Maleic Anhydride
- Calcium Carbide
  - Pentachloride
- Calcium Oxide
  - Phosphorus
- Ferrous Sulfide
  - Pentasulfide
- *Lithium
  - Potassium
- Magnesium
  - Sodium

*Lithium, Potassium & Sodium must be stored under Kerosene.

#### Liquids
- Acetyl Chloride
  - Stannic Chloride
- Chlorosulfonic Acid
  - Sulfur Chloride
- Phosphorus Trichloride
  - Sulfonyl Chloride
- Silicon Tetrachloride
  - Thionyl Chloride

### OXIDIZERS

**Storage Precautions:**
*Store in a cool, dry place.
*Keep away from flammable & combustible materials (paper, wood, etc. & those listed under “Flammables”
*Keep away from reducing agents such as zinc, alkaline metals and formic acid.

**Solids**

<table>
<thead>
<tr>
<th>Ammonium Dichromate</th>
<th>Nitrates, Salts of</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonium Perchlorate</td>
<td>Periodic Acid</td>
</tr>
<tr>
<td>Ammonium Persulfate</td>
<td>Permanganic Acid</td>
</tr>
<tr>
<td>Benzoyl Peroxide</td>
<td>Peroxides, Salts of</td>
</tr>
<tr>
<td>Bromates, Salt of4</td>
<td>Potassium Dichromate</td>
</tr>
<tr>
<td>Calcium Hypochlorite</td>
<td>Potassium Ferricyanide</td>
</tr>
<tr>
<td>Ceric Sulfate</td>
<td>Potassium Ceric</td>
</tr>
<tr>
<td>Chlorates, Salts of2</td>
<td>Permanganate</td>
</tr>
<tr>
<td>Chromium Trioxide</td>
<td>Potassium Persulfate</td>
</tr>
<tr>
<td>Ferric Trioxide</td>
<td>Sodium Bismuthate</td>
</tr>
<tr>
<td>Ferric Chloride</td>
<td>Sodium Chlorite</td>
</tr>
<tr>
<td>Iodates, Salts of3</td>
<td>Sodium Dichromate</td>
</tr>
<tr>
<td>Iodine</td>
<td>Sodium Nitrate</td>
</tr>
<tr>
<td>Magnesium Perchlorate</td>
<td>Sodium Perborate</td>
</tr>
<tr>
<td>Manganese Dioxide</td>
<td>Sulfates, Salts of6</td>
</tr>
</tbody>
</table>

1Potassium bromate, sodium bromate, etc.
2Potassium chloride, etc.
3Ammonium nitrate, ferric nitrate, etc.
4Lithium peroxide, sodium peroxide, etc.
5Ferric sulfate, potassium sulfate, etc.

**Liquids**

<table>
<thead>
<tr>
<th>Bromine</th>
<th>Nitric Acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chromic Acid</td>
<td>Perchloric Acid</td>
</tr>
<tr>
<td>Hydrogen Peroxide</td>
<td>Sulfuric Acid</td>
</tr>
</tbody>
</table>

**Gases**

<table>
<thead>
<tr>
<th>Chlorine</th>
<th>Nitrogen Oxide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorine Dioxide</td>
<td>Oxygen</td>
</tr>
<tr>
<td>Fluorine</td>
<td>Ozone</td>
</tr>
<tr>
<td>Nitrogen Dioxide</td>
<td></td>
</tr>
</tbody>
</table>

**PEROXIDE-FORMING CHEMICALS**

**Storage Precautions:**
*Store in airtight containers in a dark, dry place.
*Label containers with receiving, opening & disposal dates.
*Dispose of peroxide forming chemicals before expected date of first peroxide formation in accordance with local regulations.
*Test for the presence of peroxides periodically.

**WARNING:** Under proper conditions, these chemicals will form explosive peroxides, which can be detonated by shock or heat.

<table>
<thead>
<tr>
<th>1Potassium</th>
<th>Tetrahydrofuran</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclohexene</td>
<td>Acetaldehyde</td>
</tr>
<tr>
<td>p-Dioxane</td>
<td>Acrylaldehyde</td>
</tr>
<tr>
<td>-----------</td>
<td>---------------</td>
</tr>
<tr>
<td>Ethyl Ether</td>
<td>Crotonaldehyde</td>
</tr>
<tr>
<td>Isopropyl Ether</td>
<td></td>
</tr>
</tbody>
</table>

*Potassium peroxide exists in the crust around a chunk of potassium. When cut with a knife the peroxide rapidly oxidizes the residual potassium resulting in an explosion.*

**LIGHT SENSITIVE CHEMICALS**

*Storage Precautions:*
*Avoid exposure to light.*
*Store in amber bottles in a cool, dry place.*

<table>
<thead>
<tr>
<th>Bromine</th>
<th>Oleic Acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethyl Ether</td>
<td>Potassium Ferrocyanide</td>
</tr>
<tr>
<td>Ferric Ammonium Citrate</td>
<td>Silver Salts$^2$</td>
</tr>
<tr>
<td>Hydrobromic Acid</td>
<td>Sodium Iodide</td>
</tr>
<tr>
<td>Mercuric Salts$^1$</td>
<td>Mercurous Nitrate</td>
</tr>
</tbody>
</table>

$^1$Mercuric Chloride, mercuric iodide, etc.
$^2$Silver Acetate, silver chloride, etc.

**PYROPHORIC SUBSTANCES**

*Storage Precautions:*
*Store in a cool, dry place.*

**WARNING:** Pyrophoric substances ignite spontaneously upon contact with air.

<table>
<thead>
<tr>
<th>Boron</th>
<th>*Iron</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Cadmium</td>
<td>*Lead</td>
</tr>
<tr>
<td>*Calcium</td>
<td>*Manganese</td>
</tr>
<tr>
<td>*Chromium</td>
<td>*Nickel</td>
</tr>
<tr>
<td>*Cobalt</td>
<td>Phosphorus, yellow$^1$</td>
</tr>
<tr>
<td>Diborane</td>
<td>*Titanium</td>
</tr>
<tr>
<td>Dichloroborane</td>
<td>*Zinc</td>
</tr>
<tr>
<td>2-Furaldehyde</td>
<td></td>
</tr>
</tbody>
</table>

$^1$Finely divided metals form a pyrophoric hazard.
$^1$Phosphorus (yellow) should be stored and cut under water.

**FLAMMABLES**

*Storage Precautions:*
*Store in approved safety cans or cabinets.*
*Segregate from oxidizing acids and oxidizers.*
*Keep away any source of ignition: flames, heat or sparks.*
*Safety cans or drums containing flammable liquids should be grounded and bonded when being used.*
*Keep fire fighting equipment readily available.*
*Have spill cleanup materials handy.*
*Store highly volatile flammable liquids in a specially equipped refrigerator.*

**Solids**

| Benzoyl Peroxide | Phosphorous, Yellow |
| Calcium Carbide | Picric Acid |
**Gases**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetylene</td>
<td>Ethylene Oxide</td>
</tr>
<tr>
<td>Ammonia</td>
<td>Formaldehyde</td>
</tr>
<tr>
<td>Butane</td>
<td>Hydrogen</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>Hydrogen Sulfide</td>
</tr>
<tr>
<td>Ethane</td>
<td>Methane</td>
</tr>
<tr>
<td>Ethyl Chloride</td>
<td>Propane</td>
</tr>
<tr>
<td>Ethylene</td>
<td>Propylene</td>
</tr>
</tbody>
</table>

**Liquids**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetaldehyde</td>
<td>Isobutyl Alcohol</td>
</tr>
<tr>
<td>Acetone</td>
<td>Isopropyl Acetate</td>
</tr>
<tr>
<td>Acetyl Chloride</td>
<td>Isopropyl Alcohol</td>
</tr>
<tr>
<td>Allyl Alcohol</td>
<td>Isopropyl Ether</td>
</tr>
<tr>
<td>Allyl Chloride</td>
<td>Mesityl Oxide</td>
</tr>
<tr>
<td>N-Amyl Acetate</td>
<td>Methanol</td>
</tr>
<tr>
<td>N-Amyl Alcohol</td>
<td>Methyl Acetate</td>
</tr>
<tr>
<td>Benzene</td>
<td>Methyl Acrylate</td>
</tr>
<tr>
<td>N-Butyl Acetate</td>
<td>Methylal</td>
</tr>
<tr>
<td>N-Butyl Alcohol</td>
<td>Methyl Butyl Ketone</td>
</tr>
<tr>
<td>N-Butylamine</td>
<td>Methyl Ethyl Ketone</td>
</tr>
<tr>
<td>Carbon Disulfide</td>
<td>Methyl Formate</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>Methyl Isobutyl Ketone</td>
</tr>
<tr>
<td>Cyclohexane</td>
<td>Methyl Methacrylate</td>
</tr>
<tr>
<td>Diethylamine</td>
<td>Methyl Propyl Ketone</td>
</tr>
<tr>
<td>Diethyl Carbonate</td>
<td>Morpholine</td>
</tr>
<tr>
<td>p-Dioxane</td>
<td>Naptha</td>
</tr>
<tr>
<td>Ethanol</td>
<td>*Nitromethane</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
<td>Octane</td>
</tr>
<tr>
<td>Ethyl Acrylate</td>
<td>Piperidine</td>
</tr>
<tr>
<td>Ethylamine</td>
<td>Propanol</td>
</tr>
<tr>
<td>Ethyl Benzene</td>
<td>Propyl Acetate</td>
</tr>
<tr>
<td>Ethylene Dichloride</td>
<td>Propylene Oxide</td>
</tr>
<tr>
<td>Ethyl Ether</td>
<td>Styrene</td>
</tr>
<tr>
<td>Furan</td>
<td>Tetrahydrofuran</td>
</tr>
<tr>
<td>Gasoline</td>
<td>Toluene</td>
</tr>
<tr>
<td>Heptane</td>
<td>Turpentine</td>
</tr>
<tr>
<td>Hexane</td>
<td>Vinyl Acetate</td>
</tr>
<tr>
<td>Hydrazine</td>
<td>Xylene</td>
</tr>
</tbody>
</table>

*Most nitrohydrocarbons are flammable.

**ACIDS**

**Storage Precautions:**

* Store acids on low shelf or in acid cabinets.
* Segregate oxidizing acids from organic acids, flammable & combustible materials.
* Segregate acids from bases and active metals such as sodium, potassium, magnesium, etc.
*Segregate acids from chemicals which could generate toxic gases such as sodium cyanide, iron sulfide, etc.
*Use bottle carriers for transporting acid bottles.
*Have Spill Control Pillows or acid neutralizers available.

| **Acetic Acid** | *Nitric Acid* |
| **Benzoic Acid** | Nitrous Acid |
| **Chloroacetic Acid** | *Perchloric Acid* |
| *Chromic Acid* | **Phenol** |
| *Hydrobromic Acid* | Phosphoric Acid |
| Hydrobromous Acid | Phosphorous Acid |
| Hydrochloric Acid | **Propionic Acid** |
| Hydrochlorous Acid | **Sulfamic Acid** |
| Hydrofluoric Acid | **Sulfanilic Acid** |
| Hydroiodic Acid | *Sulfuric Acid* |
| *Iodic Acid* | Sulfurous Acid |

*Indicates strong oxidizing acids.
**Indicates organic acids.

**BASES**

Storage Precautions:
*Segregate bases from acids.*Store solutions of inorganic hydroxides in polyethylene containers.
*Have Spill Control Pillows or caustic neutralizers available for caustic spills.

| Ammonium Hydroxide | Calcium Hydroxide |
| Bicarbonates, Salts of¹ | Potassium Hydroxide |
| Carbonates, Salts of² | Sodium Hydroxide |

¹Potassium bicarbonate, sodium bicarbonate, etc.
²Calcium carbonate, sodium carbonate, etc.
Appendix F: Glossary

Common Terms used in Material Safety Data Sheets

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSORPTION</td>
<td>To take in and make a part of an existing whole, for example, a sponge absorbs water.</td>
</tr>
<tr>
<td>ACID</td>
<td>Any chemical which undergoes dissociation in water with the formation of hydrogen ions. Acids have a sour taste and may cause severe skin burns. They turn litmus paper red and have pH values of 0 to 6.</td>
</tr>
<tr>
<td>ACUTE EFFECT</td>
<td>An adverse effect on a human or animal body, that takes place soon after exposure. Examples include dizziness, nausea, skin rashes, inflammation, tearing of the eyes, unconsciousness, and even death.</td>
</tr>
<tr>
<td>AEROSOL</td>
<td>A fine aerial suspension of particles sufficiently small in size to confer some degree of stability from sedimentation, for example, a smoke or fog.</td>
</tr>
<tr>
<td>ALKALI</td>
<td>Any chemical substance which forms soluble soaps with fatty acids. Alkalies are also referred to as bases. They may cause severe burns to skin. Alkalies turn litmus paper blue and have pH values from 8 to 14. Also known as caustic.</td>
</tr>
<tr>
<td>ANESTHETIC</td>
<td>A chemical that causes a total or partial loss of sensation. Overexposure to anesthetics can cause impaired judgment, dizziness, drowsiness, headache, unconsciousness, and even death. Examples include alcohol, paint remover, and degreasers.</td>
</tr>
<tr>
<td>ASPHYXIANT</td>
<td>A vapor of gas which can cause unconsciousness or death by suffocation (lack of oxygen). Most simple asphyxiants are harmful to the body only when they become so concentrated that they reduce oxygen in the air (normally about 21%) to dangerous levels (16% or lower). Asphyxiation is one of the principal potential hazards of working in confined spaces. In addition, some chemicals like carbon monoxide function as chemical asphyxiants by reducing the blood’s ability to carry oxygen.</td>
</tr>
<tr>
<td>AUTO-IGNITION</td>
<td>The temperature to which a closed, or nearly closed container must be heated in order that the flammable liquid, when introduced into the container, will ignite spontaneously or burn.</td>
</tr>
<tr>
<td>TEMPERATURE</td>
<td></td>
</tr>
<tr>
<td>BOILING POINT</td>
<td>The temperature at which a liquid changes to a vapor state, at a given pressure; usually expressed in degrees Fahrenheit at sea level pressure (760 mmHg, or one atmosphere). For mixtures, the initial boiling point or the boiling range may be given. Flammable materials with low boiling points generally present special fire hazards.</td>
</tr>
<tr>
<td>CARCINOGEN</td>
<td>A substance or agent that can cause a growth of abnormal tissue or tumors in humans or animals. A material identified as an animal carcinogen does not necessarily cause cancer in human. Examples of human carcinogens include coal tar, which can cause skin cancer, and vinyl chloride, which can cause liver cancer.</td>
</tr>
<tr>
<td>CAS</td>
<td>Chemical Abstracts Service. A Columbus, Ohio organization which indexes information published in Chemical Abstracts by the American Chemical Society and provides index guides by which information about particular substances may be located in the Abstracts when needed. CAS numbers identify specific chemicals.</td>
</tr>
<tr>
<td>CAUSTIC</td>
<td>See Alkali</td>
</tr>
</tbody>
</table>

72
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFR</td>
<td>Code of Federal Regulations. A collection of the regulation that have been promulgated under U.S. law.</td>
</tr>
<tr>
<td>CEILING LIMIT</td>
<td>The maximum amount of a toxic substance allowed to be in workroom air at any time during the day.</td>
</tr>
<tr>
<td>CHEMICAL NAME</td>
<td>The scientific designation of a chemical in accordance with the nomenclature system as developed by the International Union of Pure and Applied Chemistry (IUPAC) or the Chemical Abstracts Services (CAS) rules of nomenclature.</td>
</tr>
<tr>
<td>CHRONIC EFFECT</td>
<td>An adverse effect on a human or animal body, that can take months or years to develop after exposure. Examples include cancer and irreversible damage to certain organs.</td>
</tr>
<tr>
<td>CHRONIC EXPOSURE</td>
<td>Long-term contact with a substance</td>
</tr>
<tr>
<td>COMBUSTIBLE</td>
<td>Able to catch on fire and burn.</td>
</tr>
<tr>
<td>COMBUSTIBLE LIQUID</td>
<td>Any liquid having a flash point at or above 100 degrees Fahrenheit (37.8 °C), but below 200 degrees Fahrenheit (93.3 °C) or higher, the total volume of which make up ninety-nine (99%) or more of the total volume of the mixture.</td>
</tr>
<tr>
<td>COMMON NAME</td>
<td>Any designation or identification such as code name, code number, trade name, brand name, or generic name used to identify a chemical other than by its chemical name.</td>
</tr>
<tr>
<td>COMPRESSED GAS</td>
<td>(1) Any gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 degrees Fahrenheit (21.2 degrees C); or (2) a gas or mixture of gases having in a container, an absolute pressure exceeding 104 psi at 130 degrees Fahrenheit (54.4 degrees C); or (3) a liquid having a vapor pressure exceeding 40 psi at 100 degrees Fahrenheit (37.8 degrees C) as determined by ASTM D-323-72.</td>
</tr>
<tr>
<td>CONCENTRATION</td>
<td>The relative amount of a substance when combined or mixed with other substances. Examples: 2ppm hydrogen sulfide in air. or a 50 per cent caustic solution.</td>
</tr>
<tr>
<td>CONFINED SPACE</td>
<td>Any area which has limited openings for entry and exit that would make escape difficult in an emergency, has a lack of ventilation, contains known and potential hazards, and is not intended nor designated for continuous human occupancy.</td>
</tr>
<tr>
<td>CORROSIVE</td>
<td>As defined by DOT, a corrosive material is a liquid or solid that causes visible destruction or irreversible alterations in human skin tissue at the site of contact that has a sever corrosion rate on steel. Two common examples are caustic soda and sulfuric acid.</td>
</tr>
<tr>
<td>DECOMPOSITION</td>
<td>Breakdown of a material or substance (by heat, chemical reaction, electrolysis, decay, or other processes) into parts or elements or simpler compounds. Examples of materials that can cause decomposition of tissue are caustic soda (NaOH, sodium hydroxide) and sulfuric acid.</td>
</tr>
<tr>
<td>DERMAL</td>
<td>By or through the skin.</td>
</tr>
<tr>
<td>DERMATITIS</td>
<td>Inflammation of the skin.</td>
</tr>
<tr>
<td>DIKE</td>
<td>A barrier constructed to control or confine hazardous substances and prevent them from entering sewers, ditches, streams or other flowing waters.</td>
</tr>
<tr>
<td>DOT HAZARD CLASS</td>
<td>DOT requires that hazardous materials offered for shipment be labeled with the proper DOT hazard class. These classes include corrosive, flammable liquid, organic peroxide, ORM-E, poison B, etc. The DOT hazard class may not adequately describe all the hazard properties of the material.</td>
</tr>
</tbody>
</table>
EVAPORATION RATE
The rate at which a particular material will vaporize (evaporate) when compared to the rate of vaporization of a known material. The evaporation rate can be used in evaluation the health and fire hazards of a material. The known material is usually ethyl either with a vaporization rate designated as 1.0. Vaporization rates of other solvents or materials are then classified as:

- FAST evaporating if greater than 3.0
- MEDIUM evaporating if 0.8 to 3.0
- SLOW evaporating if less than 0.8

EXPLOSIVE
A chemical that causes a sudden almost instantaneous release of pressure, gas, and heat when subject to sudden shock, pressure, or high temperature.

EXPOSURE
Being actually subjected to a hazardous chemical in the course of employment through any route of entry (inhalation, ingestion, skin contact, or absorption, etc.). The federal Hazard Communication Standard also includes both accidental and possible exposures in this definition of exposure.

EXTINGUISHING MEDIA
The fire fighting substance to be used to control a material in the event of a fire. It is usually named by its generic name, such as fog, foam, water, etc

FLAMMABILITY LIMITS
The range of gas or vapor concentration in the air that may ignite or explode if an ignition source is present.

FLAMMABLE
(1) A gas that, at ambient temperature and pressure forms a flammable mixture with air at a concentration of thirteen percent (13%) by volume or less;
(2) A gas that at ambient temperature and pressure, forms a range of flammable mixtures with air, wider than twelve percent (12%) by volume, regardless of the lower limit.

FLAMMABLE LIQUID
Any liquid having a flash point below 100 degrees Fahrenheit (37.8 C), except any mixture having components with flash points of 100 F (37.8 C) or higher, the total of which make up ninety-nine percent (99%) or more of the total volume of the mixture.

FLAMMABLE SOLID
A solid, other than a blasting agent or explosive, as defined in 29 CFR 1910.109 (a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard.

FLASH POINT
The temperature at which a liquid will give off enough flammable vapor to ignite if an ignition source is present. There are several flash point test methods and flash points may vary for the same material depending on the method used, so the test method is indicated when the flash point is given (150 PMCC, 200 TCC, etc.).

HAZARDOUS MATERIAL
Any chemical which is a physical hazard or a health hazard.

HAZARDOUS POLYMERIZATION
Polymerization is a chemical reaction in which one or more small molecules combine to form larger molecules. A hazardous polymerization is such a reaction which takes place at a rate which releases large amounts of energy. If hazardous polymerization can occur with a given material, the MSDS usually will list conditions which could start the reaction; and since the material usually contains a polymerization inhibitor, the expected time period before the inhibitor is used up.
### HEALTH HAZARD
A chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system and agents which damage the lungs, skin, eyes, or mucous membranes.

### HAZARDOUS INGREDIENTS
The hazardous substances that make up a mixture.

### IGNITABLE
Capable of being set afire.

### IMPERVIOUS
A material that does not allow another substance to pass through or penetrate it.

### INCOMPATIBLE
Materials which could cause dangerous reactions from direct contact with another are described as incompatible.

### INGESTION
The taking in of a substance through the mouth.

### INHALATION
The breathing in of a substance in the form of a gas, vapor, fume, mist, or dust.

### IRRITANT
A substance which, by contact in sufficient concentration for a sufficient period of time, will cause an inflammatory response or reaction of the eye, skin, or respiratory system. The contact may be a single exposure or multiple exposures. Some primary irritants: chromic acid, nitric acid, sodium hydroxide, calcium chloride, amines, metallic salts, chlorinated hydrocarbons, ketones, alcohols.

### LC<sub>50</sub>
Lethal Concentration 50%. The concentration of a material in air which, on the basis of laboratory test, is expected to kill 50% of a group of test animals when administered as a single exposure (usually 1 or 4 hours). The LC<sub>50</sub> is expressed as parts of material per million parts of air, by volume (ppm) for gases and vapors, or as micrograms of material per liter of air (mg/L) or milligrams of materials per cubic meter of air (mg/m<sup>3</sup>) for dusts and mists, as well as for gases and vapors.

### LD
Lethal Dose. A concentration of a substance being tested which will kill a test animal.

### LD_<sub>50</sub>
Lethal Dose 50%. A single dose of a material which on the basis of laboratory tests is expected to kill 50% of a group of test animals. The LD<sub>50</sub> dose is usually expressed as milligrams or grams of material per kilogram of animal body weight (mg/kg or g/kg). If a material has a low LD<sub>50</sub>, then only a very small amount is needed to cause an adverse effect and that substance would be considered highly toxic. Generally, substances with low LD<sub>50</sub>'s have high toxicity and vice versa.

### LEL
Lower Explosive limit or lower flammable limit of a vapor or gas. The lowest concentration (lowest percentage of the substance in air) that will produce a flash of fire when an ignition source (heat, arc, or flame) is present. At concentrations lower than the LEL, the mixture is too "lean" to burn. Also see UEL.

### LFL
Lower Flammable Limit. See LEL.

### LOCAL EFFECT
When toxic effects occur directly at the point of contact, the material is said to have a local effect.

### MELTING POINT
The temperature at which a solid substance melts or becomes liquid. Ice melts at zero degrees C.
mg/kg  A way of expressing dose: milligrams (mg) of a substance per kilogram (kg) of body weight. Example: a 100 kg person given 10,000 mg of a substance would be getting a dose of 100 mg/kg (10,000 mg/100 kg).

mg/m³  A way of expressing the concentration of a substance in air: milligrams (mg) of substance per cubic meter (m³) of air.

MSDS  Material Safety Data Sheet. Contains specific health and safety information required by the Federal Hazard Communication Standard for any hazardous substance. There is no standard format for a MSDS. They will vary in length, format, and appearance, depending on the manufacturer of supplier, who must provide a MSDS for each hazardous chemical they produce.

MUTAGEN  A material that alters a cell’s genetic information and may lead to undesirable inherited conditions.

NFPA  National Fire Protection Association. An international voluntary membership organization to promote/improve fire protection and prevention and establish safeguards against loss of life and property by fire. Best known on the industrial scene for the National fire Codes - 16 volumes of codes, standards, recommended practices, and manual developed (and periodically updated) by NFPA technical committees. Among these is NFPA 704M, the code for showing hazards of materials using the familiar diamond-shaped label or placard with appropriate number of symbols.

NIOSH  National Institute for Occupational Safety and Health of the Public Health Service, U.S. Department of Health and Human Services (DHHS). Federal agency which recommends occupational exposure limits for various substances and assists OSHA and MSHA in occupational safety and health investigations and research.

NONFLAMMABLE  Not easily ignited, or if ignited, not burning rapidly.

OSHA  Occupational Safety and Health Administration of the U.S. Department of Labor. Federal agency with safety and health regulatory and enforcement authorities for most U.S. industry and business.

OXIDIZER  A chemical other than a blasting agent or explosive as defined in 29 CFR 1910.109 (a) that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases. Chlorate (ClO₃), permanganate (MnO₄), and nitrate (NO₃) compounds are examples of oxidizers; note that all contain oxygen (O).

ORGANIC PEROXIDE  An organic compound that contains the bivalent -O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical. Some organic peroxides are highly unstable, and may decompose with explosive force.

PEL  Permissible Exposure Limit. The legally enforced exposure limit for a substance established by OSHA regulatory authority. The PEL indicates the permissible concentration of air contaminants to which nearly all workers may be repeatedly exposed eight (8) hours a day, forty (40) hours a week, over a working lifetime (30 years) without adverse health effects.

pH  The symbol relating the hydrogen ion (h) concentration to that of a given standard solution. A pH of 7 is neutral. Numbers increasing from 7 to 14 indicate greater acidity.

PHYSICAL HAZARD  A chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive.
POISON CLASS A  A D.O.T. hazard class for extremely dangerous poisons; that is, poisonous gases or liquids of such nature that a very small amount of the gas, or vapor of the liquid, mixed with air is dangerous to life. Some examples: phosgene, cyanogen, hydrocyanic acid, nitrogen peroxide.

POISON CLASS B  A D.O.T. hazard class for liquid, solid paste, or semisolid substances (other than Class A poisons or irritating materials) which are known (or presumed on the basis of animal tests) to be so toxic to man as to afford a hazard to health during transportation. Some examples: arsenic, beryllium chloride, cyanide, mercuric oxide.

PYROPHORIC  A chemical that will ignite spontaneously in air at a temperature of 130 degrees Fahrenheit (54.5 degrees C) or below.

PPM  Part per million. Generally used to express small concentrations of one substance in a mixture.

REACTIVITY  A description of the tendency of a substance to undergo chemical reaction with other materials or other conditions in use or in storage.

ROUTES OF ENTRY  The means by which material may gain access to the body, for example, inhalation, ingestion, and skin contact.

SCBA  Self-contained Breathing Apparatus. A respiratory protection device that consists of a supply or a means of respirable air, oxygen, or oxygen generating material, carried by the wearer.

SENSITIZER  A substance which, on first exposure, causes little or no reaction in man or test animals but which, on repeated exposure, may cause a marked response not necessarily limited to the contact site. Skin sensitization is the most common form of sensitization in the industrial setting, although respiratory sensitization to a few chemicals is also known to occur. Examples of sensitizes include poison ivy, pollen, and some isocyanates and epoxy resin hardeners.

SKIN ABSORPTION  Ability of some hazardous chemicals to pass directly through the skin and enter the bloodstream.

SOLUBILITY  The amount of a substance that can be dissolved in a solvent, usually water.

SPECIAL FIRE FIGHTING PROCEDURES  Special procedures and/or personal protective equipment that are necessary when a particular substance is involve in a fire.

SPILL OR LEAK PROCEDURES  The methods, equipment, and precautions that should be used to control or clean up a leak or spill.

SPLASH PROOF GOGGLES  Eye protection made of a non-corrosive material that fits snugly against the face, and has indirect ventilation ports.

STABILITY  An expression of the ability of a material to remain unchanged. For MSDS purposes, a material is stable if it remains in the same form under expected and reasonable conditions of storage or use. Conditions which may cause instability (dangerous change) are stated - examples, temperatures above 150 degrees Fahrenheit, shock from dropping.

SUPPLIED AIR RESPIRATORS  Air line respirators or self-contained breathing apparatus.

SYSTEMIC TOXICITY  When a toxic effect occurs at a body part some distance from the point of contact, the substance is said to have a systemic effect. Systemic toxicity is also known as remote effect.
VISCOSITY

A relative measure of how slowly a substance pours or flows. Very viscous substances, like molasses, pour very slowly. Slightly viscous substances, like water, pour and splash easily.

TERATOGEN

A substance or agent to which exposure of a pregnant female can result in malformations in the fetus. An example is thalidomide.

THERMAL

Involving heat.

TLV

Threshold Limit Value. A term used by ACGIH to express the airborne concentration of a material to which nearly all persons can be exposed day after day, without adverse effects. ACGIH expresses TLVs in three ways:

1) TLV-TWA: The allowable time-weighted average concentration for a normal 8-hour work-day or 40-hour work week.

2) TLV-STEL: The short-term exposure limit or maximum concentration for a continuous 15-minute exposure period (maximum of four such periods per day, with at least 60 minutes between exposure periods and provided that the daily TLV-TWA is not exceeded).

3) TLV-C" The ceiling limit - the concentration that should not be exceeded even instantaneously.

TOXIC SUBSTANCE

Any substance which can cause acute or chronic injury to the human body, or which is suspected of being able to cause diseases or injury under some conditions.

TRADE SECRET

Any confidential formula pattern, process, device, information or compilation of information that is used in an employer's business, and that gives the employer an opportunity to obtain an advantage over competitors who do not know or use it.

TWA

Time-weighted Average Exposure. ACGIH terminology. See TLV.

UEL

Upper Explosive limit or upper flammable limit of a vapor or gas. The highest concentration (highest percentage of the substance in air) that will produce a flash of fire when an ignition source (heat, arc, or flame) is present. At higher concentrations, the mixture is too "rich" to burn. Also see LEL.

UN NUMBER

A registry number assigned to dangerous commonly carried goods by the United Nations Committee of Experts on the Transport of Dangerous Goods. This UN number is required in shipping documentation and on packaging as part of the DOT regulations for shipping hazardous materials.

UNSTABLE

A chemical which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shock, pressure, or temperature. These chemicals are also referred to as reactive.

VAPOR

The gas given off by a solid or liquid substance at ordinary temperatures.

VAPOR DENSITY

The density of the gas given off by a substance. It is usually compared with air, which has a vapor density set at 1. If the vapor is more dense than air (greater than 1), it will sink to the ground; if it is less dense than air (less than 1), it will rise.

VENTILATION

Circulating fresh air to replace toxic air.

VIScosity

A relative measure of how slowly a substance pours or flow. Very viscous substances, like molasses, pour very slowly. Slightly viscous substances, like water, pour and splash easily.
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<td>VOLATILITY</td>
<td>A measure of how quickly a substance forms vapor at ordinary temperatures.</td>
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<td>WASTE DISPOSAL</td>
<td>Proper disposal methods for contaminated material, recovered liquids or solids and their containers.</td>
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<td>WATER REACTIVE</td>
<td>A chemical that reacts with water to release a gas that is either flammable or presents a health hazard. Also denoted dangerous when wet.</td>
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