

DEPARTMENT OF PHYSICS

SAFETY AND EMERGENCY PROCEDURES MANUAL

Updated 5/5/2011

INTRODUCTION

This manual has been prepared as a guide to the personnel of the Department of Physics, University of California, Davis. Its purpose is to provide information to all faculty, staff, students, and guests of the department on matters with which they may need assistance.

Our intent is to update the booklet as needed when policies and procedures change. This manual is not intended to replace campus policies and/or guidelines that cover specific areas and procedures in detail.

CONTENTS

	Page
I. Administrative Organization	1
II. General Safety Rules	2
III. Emergency Procedures	3
3.1 General Instruction	3
3.2 Personal Injury - First Aid	3
3.3 Fire	3
3.4 Chemical Spills	4
3.5 Earthquake	5
3.6 Bomb Threat	5
IV. Building Evacuation Protocol	6
4.1 Introduction	6
4.2 Department Information	6
4.3 Emergency Evacuation Protocol	6
V. Research Facilities Safety Rules and Emergency Procedures	10
5.1 General Rules	10
5.2 Safety Rules	11
5.3 Laboratory Fume Hoods	13
5.4 Cryogenic Liquids	13
5.5 Laser Safety	13
VI. Waste Chemical Pickup & Disposal Program	14
VII. Labeling and Disposal of Radioactive Material	15
VIII. Key Policy	16

APPENDIX A

Evacuation Routes

APPENDIX B

Procedures to be Followed Concerning Telephone Bomb Threats – Bomb Threat Checklist

APPENDIX C

Safety Nets

- #5 Eye and Face Safety Protection for Laboratory Workers
- #13 Guidelines for Chemical Spill Control
- #17 Personal Computer Workstation Checklist
- #20 Electrical Safety Guidelines
- #41 What You Should Know to Protect Your Wrists from Injury
- #46 Lifting
- #54 Pregnancy and the University Workplace
- #58 Safety Precautions for Cryogenic Liquids
- #76 Safe Laser Practices

I. ADMINISTRATIVE ORGANIZATION

Department of Physics main department phone: 530 752-1500

Warren Pickett	Department Chairperson	752-5989
Lori Lubin	Vice Chairperson – Administration & Undergraduate Program	754-4418
Richard Scalettar	Vice Chairperson – Graduate Program	554-1605

Administrative Personnel

Balics, Anneke	Administrative Assistant	752-1818
Brooks, Tracey	Business Office Manager	752-6830
Cruz, Lisa (Elizabeth)	Financial Assistant	754-8719
Graham, Elizabeth	Contracts and Grants Assistant	754-7648
Lade, Tracy	Department Manager	752-4087
Lewis, Cindy	Academic Personnel Specialist	752-4086
Peterson, Laura	Graduate Program Coordinator	752-1501
Sweeney, Sara	Undergraduate Academic Advisor	752-4092
Tuck, William	Administrative Assistant	752-4088
Yan, Onelia	Financial Assistant	752-6742

Technical Personnel

Barnett, Brian	Teaching Laboratory Support and Safety	752-0679
Dubcovsky, Martin	Programmer, Cosmology Group	754-8235
Nguyen, Trung	Teaching Laboratory Assistant	752-0679
Hemer, David	Machinist	752-1796
Holbrook, Britt	Electronics Engineer	752-8286
Landry, Tiffany	Development Technician	
Smith, Matthew	Lecture Support	752-2223
Thomson, John	Machine Shop Manager	752-1796
Wang, Dar-Yih	Programmer	752-4923
Voong, Alex	Computer Support	752-4923
Neher, Christian	Development Technician, High Energy Group	

II. GENERAL SAFETY RULES

If you are having trouble evaluating the seriousness of an incident, call Peter Klavins at (530) 304-3881 or Brian Barnett at (530) 752-0679.

1. All personnel should learn the location and operation procedures of the nearest eye-wash fountain, safety shower, fire extinguisher, and fire alarm box.

First aid for acid or base in the eyes is to wash with copious amounts of water for 15 minutes, and then go immediately to the Student Health Center (students) or Employee Health Services (non-student employees and visitors) for further treatment.

First aid for acid or base on skin or clothing is to wash thoroughly with water, and then go immediately to the Student Health Center (students) or Employee Health Services (non-student employees and visitors) for further treatment. After hours, seek medical attention at Sutter Davis Hospital, Covell Blvd, Davis.

2. All accidents, injuries, explosions, or fires must be reported to the Department Manager (530 554-1047; tjlade@ucdavis.edu) as soon as possible.
3. Shoes must be worn at all times.
4. Laboratory areas where hazardous materials are used must never be used for eating or drinking.
5. Smoking is not permitted in the buildings or within 20 feet of a door or open window to the building.
6. All operations in which noxious or poisonous gases are used or produced must be carried out in a fume hood.
7. All toxic and/or flammable waste must be put into the appropriate waste container(s) provided in your laboratory. The containers must be labeled, dated, and kept covered at all times. For details for hazardous waste disposal, see Section VI. Waste may be held for a maximum of nine months; less time for some chemicals. Violations are subject to fines.

III. EMERGENCY PROCEDURES

3.1 GENERAL INSTRUCTIONS - CHEMICAL SPILL

1. Get everyone out of the laboratory immediately.
2. Close all doors and windows. Do not lock them.
3. Alert personnel in the vicinity of the spilled material and direct vacating the area if hazardous conditions exist.
4. Call the Fire Department, 911 or (530) 752-1230 (give building, room number, and request an ambulance if any injury has occurred).
5. Communicate - What the chemical is; Where it is; How much; and Likelihood of injury. Also inform the principal investigator and the Chair's office that an accident has occurred.
6. Stand guard until the Fire Department arrives. The Fire Department has protective apparatus and clothing to aid in disposing of hazardous materials.
7. Call Environmental Health and Safety (752-1493) and give the details of the accident.

3.2 PERSONAL INJURY - FIRST AID

Call **911 or (530) 752-1230** to obtain emergency medical assistance in any case of serious injury or life-threatening illness. If you are uncertain about the seriousness of an injury, call **911 or (530) 752-1230**.

Do not move a seriously injured person who is not in immediate danger from fire or other hazard, as moving an injured person can cause additional injuries.

Emergency response by ambulance and fire personnel on the Davis campus will be rapid. If an accident victim requires emergency first aid to save their life and you have received first-aid training, you should perform the procedures you believe are necessary. These life-saving procedures might include stopping profuse bleeding, Cardiopulmonary Resuscitation (CPR), or the Heimlich maneuver for a choking victim. Do not attempt to make the patient "more comfortable" or perform other unnecessary maneuvers that could result in additional injuries.

Minor injuries may be treated with your first-aid kit before sending the victim to the Cowell Student Health Center or Employee Health Services, but all injuries must be reported to your supervisor.

3.3 FIRE

1. Alert the University Fire Department by pulling the fire alarm or calling **911 or (530) 752-1230**, and calmly and clearly state:
 - ** the location of the fire
 - ** the extent of the fire
 - ** special circumstances for hazards, such as chemicals, valuable equipment, etc.

Pull boxes are located near most main building exits. An alarm may not sound in the building, but the Fire Department will be notified. All fires must be reported to the Fire Department as soon as they are discovered. The Fire Department will make the decision to evacuate the building.

2. If the fire occurs in any area where radiation, chemicals, or other hazardous substances or operations exist, advise the Fire Department personnel of the exact location and nature of the hazard. Fire Department personnel will notify EH&S or emergency clean-up contractors.

For very small fires, lab personnel should extinguish the fire using a fire extinguisher or by covering the container of flammable material, as appropriate. Good judgment is critical. If the fire cannot be controlled by laboratory staff, time lost attempting to fight it could be disastrous. It is important to consider the size of the blaze, the type of material burning, other fuels in the vicinity, and the number of people in the lab.

If you are fighting a fire and find that it is becoming larger rather than smaller, you should stop fighting it and evacuate the laboratory. You must in any case be conscious of the probability of toxic fumes, reduced oxygen supply in the room, explosion of the material burning, or of other adjacent materials. It is critical that lab personnel not overestimate their ability to fight large or growing fires.

In case of large fires or fires involving toxic or potentially explosive materials, it is imperative that others in the vicinity be warned. Knocking on doors of nearby labs may be appropriate for an initial warning. The Department Chair's office (530 752-5989) should be called to initiate a building-wide evacuation if this is determined to be necessary. The Fire Department will determine the need for larger area evacuations. Area safety liaisons have whistles to aid in emergency communication.

For all fires, notify the principal investigator and the Department Chair's office (530 752-5989) as soon as practical after calling the Fire Department.

Fire Alarm Procedures for Evacuation – See Building Evacuation Protocol, Section IV.

3.4 CHEMICAL SPILLS

For small spills (less than 1 pint), use the spill cleanup materials available in the lab to absorb and/or neutralize the spill. Wear your assigned personal protective equipment! Be sure to restock materials used and clean and put back reusable equipment.

Spills involving larger quantities or particularly hazardous materials must be reported immediately (**911 or (530) 752-1230**). If the spill presents an immediate risk to the health of the lab personnel, they must be evacuated and the room doors closed. Do not attempt to clean up spills that create hazards for which your protective equipment was not designed. Half-face respirators, for example, are not adequate for high concentrations of toxic vapors and do not protect the eyes from corrosive atmospheres.

Spills that require specialized cleanup or monitoring equipment should be performed by personnel from the UC Davis Fire Department. A common example is mercury spills. Although cleanup is fairly straightforward, it is often difficult to be certain that all the mercury has been removed without fairly expensive monitoring equipment that the lab is unlikely to own. The Fire Department has the equipment and experience to help make your cleanup easier and more effective.

In all spill cases, notify the principal investigator and the Chair's office as soon as possible. For further information on chemical spills, see **Safety Net #13 "Guidelines for Chemical Spill Control,"** in Appendix C, and on the EH&S website.

3.5 EARTHQUAKE

In a severe earthquake you will find standing or walking to be almost impossible. The best you can usually do is to crawl under a nearby desk to protect yourself from falling objects and flying glass. If you are near an open doorway, crawling under it may provide some protection in case the ceiling collapses.

Earthquake safety requires that precautions be taken before the earthquake occurs to minimize the potential for damage or injury. It is critical that chemical containers be stored in ways that will prevent them from falling to the floor during the earthquake. Bars or rods on shelves and latchable doors on cabinets will provide protection. (Swinging cabinet doors that do not have positive latches **WILL** open during an earthquake.) Large containers of hazardous liquids such as gallon-sized bottles of flammables or acids should be segregated from incompatible chemicals and stored on the lowest shelves. Less hazardous, dry chemicals in small bottles can be stored on higher shelves. If the contents of alphabetically sorted chemical containers are deposited in a mass on the laboratory floor, very dangerous chemical reactions may occur. Compressed gas cylinders should have caps on when not in use and have approved double strapping or chains at all times. An earthquake in an unprepared lab could be a very serious disaster for the occupants.

After the tremors have stopped, get out of the lab if possible. Be very aware of equipment stored or mounted overhead that could fall on you in case of an after-shock. It is unlikely that emergency personnel will be able to respond to your lab for some time after the earthquake. Initial efforts will be concentrated on saving lives rather than property, and you should be prepared to perform first aid and otherwise assist those who have been injured.

Leaving a building during an earthquake can be very dangerous as there are many architectural components of the building that could fall during the shaking. If possible, find and take your lab's flashlight or other emergency light. Falling window glass can be a particularly serious hazard. Do not attempt to leave the building until you are sure that the shaking has completely stopped. Once outside, move away from building and other overhead hazards (power lines, light poles). If a building containing hazardous chemicals is burning or there is a release of toxic materials, move well away from the building by walking into the wind. If the wind direction changes, you may have to move to a new location.

3.6 BOMB THREAT

If you receive a threatening call or a bomb threat on your telephone, please follow the procedure as outlined in Appendix B.

IV. BUILDING EVACUATION PROTOCOL

4.1 INTRODUCTION

An evacuation is defined as the emptying of an occupied area and the transference of occupants to a safe location. The need to evacuate may be caused by any hazard -- natural, technological or human -- that threatens the UC Davis campus.

The Building Evacuation Protocol is the first part of a department's Emergency Action Plan. The department's Building Evacuation Protocol also links with the UC Davis Campus Emergency Operations Plan (EOP). The campus EOP coordinates the safe evacuation of students, staff, and faculty from building assembly areas to zone assembly areas and, if necessary, to a mass care facility. For more details, refer to Appendix F in the campus EOP.

The Physics Department Building Evacuation Protocol complies with the California, Code of Regulations, Title 8, Section 3220; the California Education Code, Parts 40 & 59 - Chapter C4.1, Section 66210 and Chapter 6, Section 94600; Title 19, Sections 3.09 & 3.13; and UC Davis Policy and Procedure 290-05.

4.2 DEPARTMENT INFORMATION

Department Locations: Physics Building, Roessler Hall, Earth and Physical Sciences Building

Department Safety Coordinator: Peter Klavins

Phone Number: (530) 304-3881

E-mail Address: pklavins@ucdavis.edu

Alternate Safety Coordinator: Brian Barnett

Phone Number: (530) 752-0679

E-mail Address: barnett@physics.ucdavis.edu

Department FAX Number: (530) 752-4717

Date of Annual Review of Department Action Plan: September

Date of Annual Evacuation Drill: As needed

4.3 EMERGENCY EVACUATION PROTOCOL

Warnings and Alarms

Three types of warnings are used by the campus to notify personnel to evacuate a building: (1) verbal warning, either in person or loudspeaker; (2) fire alarm, horns, and flashing lights; and/or (3) the campus radio station KDVS 90.3 FM.

Department Safety Coordinator Duties: To the extent it is possible and safe for you, check all rooms and direct everyone to evacuate.

Prior to Exiting

After hearing the alarm to evacuate, stop all work activities. If time permits, each person will gather their valuables (i.e., car keys), turn off their CPU/printer/monitor, shut down experimental equipment, lock away sensitive items, leave the lights on, and close, but do not lock the doors (locked doors can hamper rescue operations).

The person responsible for roll call will take the personnel list before leaving the building.

Evacuation Routes

Emergency evacuation routes are posted by each stairwell in the Physics Building and Roessler Hall. The map shows the primary route evacuees will take to exit the building. Walk, do not run, to the emergency exit.

Department Safety Coordinator Duties: Help direct those exiting rooms, floors, or the building by posting yourself at strategic locations along the evacuation route. Recruit volunteers to help you direct evacuees to the building assembly area.

Building Assembly Area

The safety coordinator or alternate will work closely with faculty and administration to determine if individuals are still in the building. After exiting the building, employees, students, and visitors will follow the evacuation route to the pre-arranged building assembly area (refer to the evacuation route map). The supervisor is responsible for assisting with roll call and reporting injuries to the department safety coordinator. The department safety coordinator is responsible for informing the on-scene incident commander of the status of employees. If an employee is in immediate danger, report the location of the person directly to the nearest emergency responder.

Stay within your respective group at the building assembly area. Do not leave the area.

During inclement weather, evacuees will be directed to an alternate building assembly area.

The building assembly area for employees in the Physics Department is on the lawn directly north of the Physics Building.

Department Safety Coordinator Duties: Once in the assembly area, take roll call or arrange for the responsible individuals to conduct roll call. The purpose of roll call is to help report injuries or trapped persons to the on-scene incident commander. Recruit volunteers and post them near all entrances to the building. Instruct the volunteers to advise anyone against re-entering the building. Report injuries to the on-scene incident commander.

Zone Assembly Area

The Zone Assembly area is to be determined at a later date.

Building Coordinator

The Building Coordinator will be determined at a later date.

Persons With Mobility Impairment

The following guidelines will assist differently abled employees with emergency evacuation from the Physics Department.

Visually Impaired:

1. Describe the nature of the emergency to the person.
2. Offer to guide the person and ask if he/she prefers to take your elbow.
3. Advise the person about the evacuation route.
4. Take the person to the building assembly area.

Hearing Impaired:

1. Never assume a hearing impaired person can lip read.
2. If the person did not hear the warning or alarm, write down the type of emergency and direct them to the emergency exit.
3. Offer to walk with the person to the exit.
4. Take the person to the building assembly area.

Persons using Crutches, Canes, or Walkers:

1. Describe the nature of the emergency.
2. Offer to guide the person and ask if he/she prefers to take your elbow.
3. Advise the person about the evacuation route.
4. Take the person to the building assembly area.

Persons using Wheelchairs:

1. Describe the nature of the emergency.
2. Ask the person how you can help him/her to exit the building.
3. Always follow the instructions of the wheelchair user.
4. Do not remove a person from a wheelchair unless they agree to such a procedure.
5. Some electric wheelchairs can weight 400 pounds. If needed, use a minimum of four injury-free employees with strong backs to move the chair without the battery. Follow correct lifting techniques.
6. Take extra care for wheelchair users attached to a respirator. Detach and test the portable respirator unit prior to disconnecting the battery operated respirator.

Unconscious Person in a Wheelchair:

1. Call 911 or 530 752-1230 from cell phone.
2. Give your name, department, and phone number.
3. Describe the situation and where you will meet emergency personnel.
4. If you are unable to meet emergency personnel outside, ask someone in your unit to escort emergency personnel to your location.
5. If immediate evacuation is required, do what is required to exit safely.
6. Follow all instructions from the emergency dispatcher.

Department Safety Coordinator Duties: Speak with mobility impaired persons in your department on a one-to-one basis. Ask them if they need assistance, and if yes, how do they wish to be assisted. Recruit volunteers to assist people prior to an incident.

Classrooms and Teaching Laboratories

The building evacuation notice is posted in each room. The statement will instruct students to evacuate through the nearest exit, assemble outside for roll call, and wait for further instructions.

Department Safety Coordinator Duties: Posting the building evacuation notice in general assignment classrooms is the responsibility of the Building Safety Coordinator.

Responsibilities of the Safety Coordinator

1. Know the location of all fire extinguishers, pull alarms, and first aid kits. Be sure exit signs are posted and walkways remain clear at all times.
2. When an alarm has been sounded, to the extent that it is possible and safe, systematically check all areas to assure they have been evacuated.
3. Post helpers along the evacuation route to guide others to the building assembly area.
4. Assist differently abled persons to evacuate safely.
5. Work to keep employees calm and informed.
6. If ordered by the on-scene incident commander, move to the zone assembly area.
7. If ordered by the on-scene incident commander, inform personnel when it is safe to re-enter buildings. After a major earthquake, persons may not re-enter their building until cleared by a qualified building inspector.

V. RESEARCH FACILITIES SAFETY RULES AND EMERGENCY PROCEDURES

5.1 GENERAL RULES

1. General - The following list of regulations is intended to serve as a guideline for safety in the laboratory and should be read carefully by all personnel. In case questions arise regarding any matter of safety that is not covered in this list, contact the Peter Klavins at (530) 304-3881 or the Office of Environmental Health and Safety at (530) 752-1493 for further information.
2. Accident Reports - Accident reports must be filled out and submitted to the Department Manager for any cases of fire or injury.
3. Fires - All fires, whether still burning or already extinguished, should be reported to the Fire Department (**911 or 530-752-1230**). If a fire extinguisher is used, even for a short burst, immediately report the usage to the Fire Department (752-1236) so that the extinguisher may be refilled.
4. Injuries - Employees who sustain a work-related injury or illness should immediately notify their supervisor. If medical treatment is needed or requested, the supervisor should send the employee to the Employee Health Services (510 Oak Avenue, Davis) for treatment and/or referral. Outside of Davis, the employee may be sent to any health care provider. Employees in Davis who wish to receive treatment outside the University must file a Designation of Physician form with the Physics Department (a copy is sent to Worker's Compensation). Unless a specific request for outside treatment is already on file at the time of injury or illness, an employee must be treated by University-selected physicians for the first 30 days. Additional information regarding medical treatment of work-related injuries or illness is presented in the University of California Policy and Procedures Manual, Section 370-20.
5. Safety Goggles - Safety goggles must always be worn in the machine shop and when carrying out or while watching someone else carry out any procedure which might result in eye damage if an accident occurs. Safety goggles must not be modified in any manner. If they are modified, they are no longer OSHA approved.
6. Smoking is forbidden at all times in all buildings.
7. Working Alone is not to be permitted when carrying out hazardous procedures or while working in the machine shop.
8. Bare Feet are not allowed in the laboratories or shops.
9. Eating is not allowed in areas where hazardous materials are being handled or stored.
10. Safety Equipment - Each person should know the proper location of and understand the proper operation of the fire extinguishers, safety showers, fire alarm boxes, etc., in and near his/her laboratory.
11. Waste Disposal - The improper handling of explosive, flammable, or toxic materials in a laboratory can result in hazardous conditions and fines. Proper procedures for disposal are outlined below.
 - a. Empty Glass and Metal Chemical Containers - All metal and glass containers must be emptied, rinsed out completely with water three times, have their caps removed, and be labeled "TRIPLE RINSED" before discarding in the laboratory waste cans or in the dumpster at the rear of the building. The custodians will refuse to handle any capped, unlabeled, or containers that are not empty.

- b. Chemicals and Reaction Residues – Chemical waste cannot be placed in the waste can, down the drains, or in the dumpster. If it becomes necessary to dispose of these types of materials, see the section on Waste Chemical Pick-up and Disposal Program for details.

5.2 SAFETY RULES

1. Safety Equipment - Access to fire extinguishers, safety showers, etc., should never be obstructed by furniture or equipment. If it is suspected that any of this equipment is not in proper functioning order, contact Peter Klavins at (530) 304-3881.
2. Fume Hoods - These should be kept in good working order. The glass panels should never be removed from the hoods as this interferes greatly with their operating efficiency. If hoods are not operating correctly, let the principal investigator know immediately.
3. Labeling - All materials not stored in their original containers and all compounds prepared by any laboratory procedure should be clearly labeled. Labels should be of a type that are not easily removed or obscured in the course of normal handling. All hazardous waste must be labeled with an EH&S hazardous waste label. This label must be legible and complete.
4. Gas Cylinders - These are always to be held securely in place by a double chain with proper clamps away from any source of heat. Cylinders should always be stored and transported in an upright position. This is especially important in the case of acetylene. Also, they should never be moved without first removing the gauge and replacing the protective cap. Always check to make certain that gauges and valves are in proper working order, especially when using highly corrosive gases such as HCl. Small cylinders containing poisonous, corrosive, or highly flammable gases must be stored and used in a hood. Protective cap should always be in place when not in use.
5. Electrical Equipment - All electrical equipment, except "double insulated" electrical tools, should be equipped with three prong plugs. If three-way ground wire cords are attached in the wrong way, dangerous shock hazards may result. Safety interlocks must be installed on all high voltage equipment.
6. Refrigerators - Any material placed in refrigerators should be labeled as to the nature of the material, the **date**, and the **name of the owner** and kept in closed containers. No food or beverages should ever be placed in any laboratory refrigerator. Flammable chemicals are not to be placed in refrigerators that have not been approved for flammable storage.
7. Drying Ovens - Never place any equipment that is wet with organic solvents in drying ovens or use flammable solvent near them. They have open sparking contacts and explosions or fires could occur. Do not place plastic containers in drying ovens.
8. Vacuum and Pressure - Equipment being used under vacuum or pressure should always be handled with proper caution. Vacuum desiccators should be supplied with shields, and glass Dewar flasks must be wrapped with tape.
9. Hazardous Chemicals and Reactions - When working for the first time with chemicals or reactions whose hazards you are not acquainted with, consult with others who have used these materials before and with standard references such as "Merck Index." Always consult the material safety data sheet for each chemical. Always carry out reactions involving use of highly poisonous materials or flammable solvents in the fume hood. Also, do all reactions where there is any danger of reaction behind a safety shield.

10. Usage of Solvents - Highly flammable or toxic solvents should always be handled whenever possible in a hood or well ventilated area. Solvents in glass containers should not be kept on shelves above the level of the bench top or in places where they can be knocked over easily and broken.
11. Storage of Flammable Solvents
 - (a) You may store a total of 10 gallons of flammable solvents in each laboratory with the following limitations:
 - 1) Containers other than safety cans shall not be greater than 1 gallon.
 - 2) All containers must be properly labeled with factory label or equivalent information.
 - (b) You may store an additional 15 gallons in OSHA approved safety cans in each laboratory. Each safety-can shall be no larger than 5 gallons in size and must be properly labeled.
 - (c) If more than 25 gallons are to be stored in a single laboratory, you must use an OSHA approved storage cabinet.
 - 1) Quantities stored in OSHA approved storage cabinets may not exceed 50 gallons.
 - 2) Quantities stored in OSHA approved storage cabinets must either be in the original I.C.C. shipping containers or OSHA approved safety containers.
12. Acids and Bases - Care should be exercised when carrying large bottles of concentrated acids and bases. They should be stored in the laboratory in places where they will not be knocked over easily and broken. NOTE!! Special precautions are necessary when handling concentrated hydrofluoric and perchloric acids. Segregated secondary containment is strongly advised for liquid acids and bases.
13. Alkali Metals and Metal Hydrides - Extra precautions should always be taken when working with materials such as alkali metals, metal hydrides, aluminum alkyls, metal carbonyls, etc. Alkali metal, metal hydride and aluminum alkyl fires should be extinguished only with dry chemical extinguishers (not CO₂) or by smothering with sand or Na₂CO₃.
14. Mercury - Any mercury spillage must be cleaned up as soon as possible. For small spills, contact the department safety coordinator or EH&S. For larger spills, call 911 or (530) 752-1230. In all cases of mercury spillage, notify the office of Environmental Health and Safety who will check the area and certify that it is mercury free. Apparatus containing large quantities of mercury should be provided with secondary containment for catching the mercury in case of breakage.
15. Radioactive Materials and Ionizing Radiation - Use of radioactive materials require special storage, handling, and disposal methods. Details pertaining to these and other points may be found in the Campus Radiation Safety Manual and the California State Code Section 12. X-ray equipment must be inspected and certified by EH&S.

5.3 LABORATORY FUME HOODS

The chemical fume hoods in our laboratories are designed to protect you from toxic and noxious vapors. They are the most important item of safety equipment in your laboratory. In order to gain the full protection these hoods provide, proper operating procedures should always be observed.

1. Call Physical Plant (752-1655) if you have any reason to suspect a fume hood is not operating properly. If a hood is deficient, the other hoods on the same system will be affected also.
2. Never change the position of the dampers that control the exhaust from your hood. Hood systems are very delicately balanced and adjusting the exhaust on one hood affects every other hood on the same system.
3. Be aware that very high face velocities will not make a hood safer. Velocities much above 150 ft. per minute cause turbulence at the face of the hood causing air from within the hood to contaminate the room. (Range is 100-150 fpm.)
4. Do not block the ventilation slots at the back of the hood. This adversely affects the performance of the hood.
5. Set up your apparatus as close to the center of the hood's working surface as is practical. Try working 6 inches (15 cm) inside the hood.
6. Avoid putting your head inside the hood and stand a few inches back from the hood sashes when the experiment or reaction is in progress.
7. The horizontal sliding sashes in most of our fume hoods are intended to be used as safety shields. Do not remove sashes! This will affect the velocity drastically.

5.4 CRYOGENIC LIQUIDS

See Safety Net #58 in Appendix C and on the EH&S website.

5.5 LASER SAFETY

See abbreviated version of Safety Net #76 in Appendix C, complete version is on the EH&S website.

VI. WASTE CHEMICAL PICK-UP AND DISPOSAL PROGRAM

The Office of Environmental Health and Safety has an established, extensive waste chemical pick-up and disposal program (Policy and Procedures Manual, Section 290-65). Forms are in the red safety notebook in each lab. Hazardous waste pick-up can be requested online at the EH&S website.

DO NOT USE SINKS OR SEWER LINES FOR DISPOSAL OF ANY HAZARDOUS CHEMICAL WASTES

All waste chemicals such as organic solvents, flammable liquids, acids and other corrosive materials, highly toxic and poisonous materials, any pesticides, explosives and materials of an unknown and potentially hazardous nature are to be put in containers, capped, labeled, and dated. Please be sure to keep the flammable chemicals separate from the non-flammable chemicals. The Environmental Health and Safety Department can refuse to pick up improperly labeled waste chemicals.

REMEMBER, WASTE CHEMICALS ARE DANGEROUS, PARTICULARLY IN UNLABELED AND IMPROPERLY PACKAGED CONTAINERS.

1. DO NOT mix flammable and explosive waste materials with corrosive and poisonous wastes. Keep them stored and handled separately.
2. MAKE SURE all bottles, jars, or other containers of waste chemicals are properly sealed with caps and lids and have official EH&S hazardous waste labels stating the start date of accumulation, what the waste is, and which laboratory it came from. See Peter Klavins for information on storage time limits. Generally, it is nine months.

IF YOU HAVE ANY PROBLEMS THAT FALL INTO ANY OF THE CATEGORIES LISTED BELOW, CONTACT PETER KLAVINS AT (530) 304-3881.

1. If you need to dispose of large quantities of waste chemicals such as acids in tanks or cleaning baths, drums of waste solvents, etc.
2. If you have any questions regarding special disposal problems or wish to discuss any aspect of the waste chemical program.
3. If you need help with questions concerning research protocols and chemical protocols from the safety perspective.

CALL 911 OR (530) 752-1230 and notify Peter Klavins (530) 304-3881 to remove any materials which possess an *imminent* hazard to safety such as leaking gas cylinders, spilled mercury, peroxide forming ethers, shock sensitive compounds, etc.

VII. LABELING AND DISPOSAL OF RADIOACTIVE MATERIAL

Special areas and restrictions apply to radioactive material disposal. Solid and liquid waste must be treated differently and each radionuclide has its own special requirements. All waste must be labeled properly and packaged in accordance with EH&S regulations for the specific material.

Special Disposal Problems - Other materials such as asbestos, biological or carcinogenic material have specific guidelines. Call EH&S for further information and to obtain waste containers for these materials.

Scheduled Waste Pick-up - Containers should be placed in the laboratory near the corridor door or in a location made known to the person(s) who make the pick up. Full and partially filled containers will be picked up as scheduled and replaced with empty containers. Call EH&S at (530) 752-1493.

Special questions concerning disposal, storage, and handling of radioactive materials should be addressed to Peter Klavins (530) 304-3881.

VIII. KEY POLICY

Keys issued to department personnel are for their own personal use. We would like to keep rules to a minimum. However, the following must be observed if we are to maintain our present system.

1. Do not **loan** your key to anyone. If someone has forgotten their key, they may obtain another key from the Business Office.
2. In those hours when the use of a key is necessary to enter the building, do not leave doors ajar so that others may enter. If you notice outside doors open at these times, please close them and see that they are locked.
3. Doors to offices and laboratories should be locked from 6 p.m. to 8 a.m. and on weekends.
4. **Please remind personnel leaving the department to turn in their keys to the Business Office, room 174 Physics Building.** This is especially important for graduate students, undergraduate researchers, postdocs, and visiting scholars. Persons leaving during other than normal working hours are encouraged to leave keys with someone else in their group to be turned in. If you forgot to turn in keys, please mail them to the Physics Department.
5. Key check out to research groups and instrument rooms requires written approval from the faculty research director.

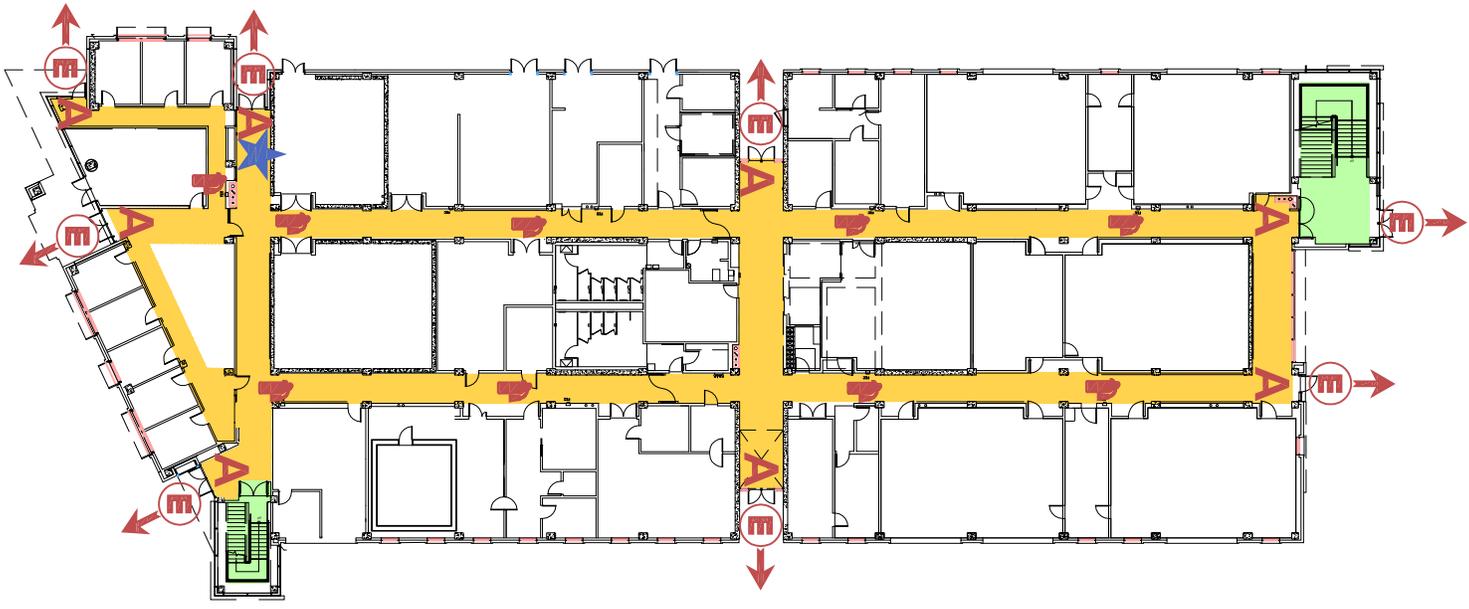
Violations of the above rules will force us to recall keys from those violating these rules.

APPENDIX A

APPENDIX B

APPENDIX C

**IN CASE OF FIRE
USE STAIRWAY
FOR EXIT, DO NOT
USE ELEVATORS.**

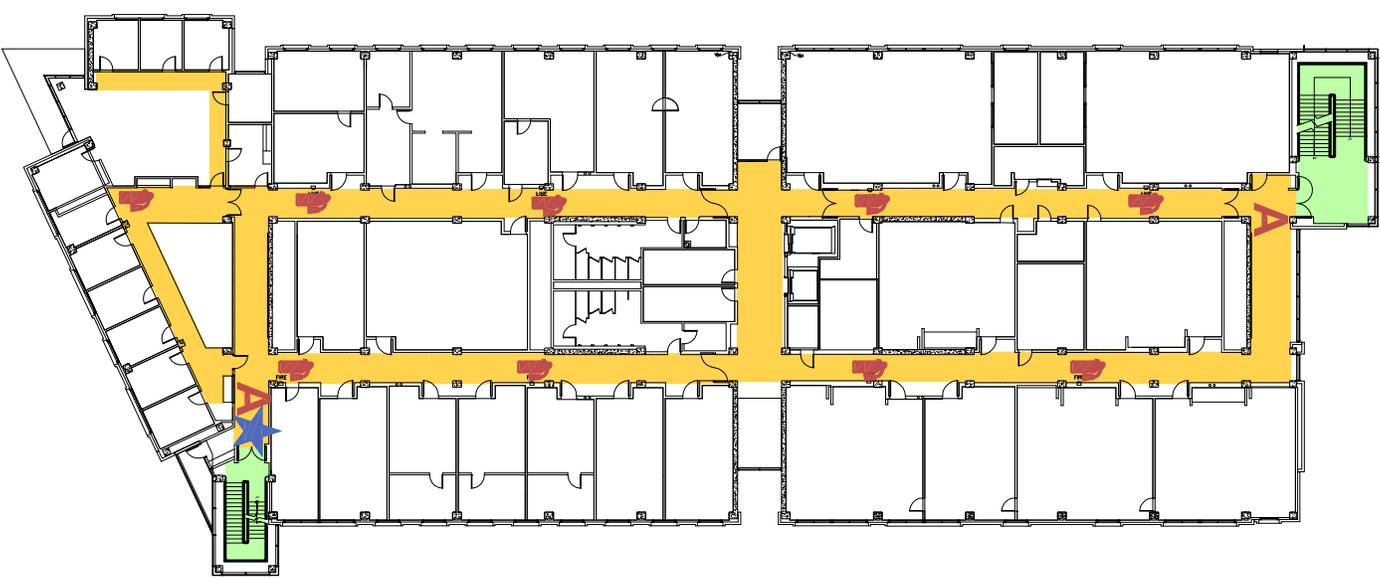


- Fire Extinguisher
- Fire Alarm Box
- Exit
- You Are Here
- Exit Path
- Exit Stairs

**Emergency Phone
Number: 911**

**Physical Sciences Building
First Floor**

**IN CASE OF FIRE
USE STAIRWAY
FOR EXIT, DO NOT
USE ELEVATORS.**

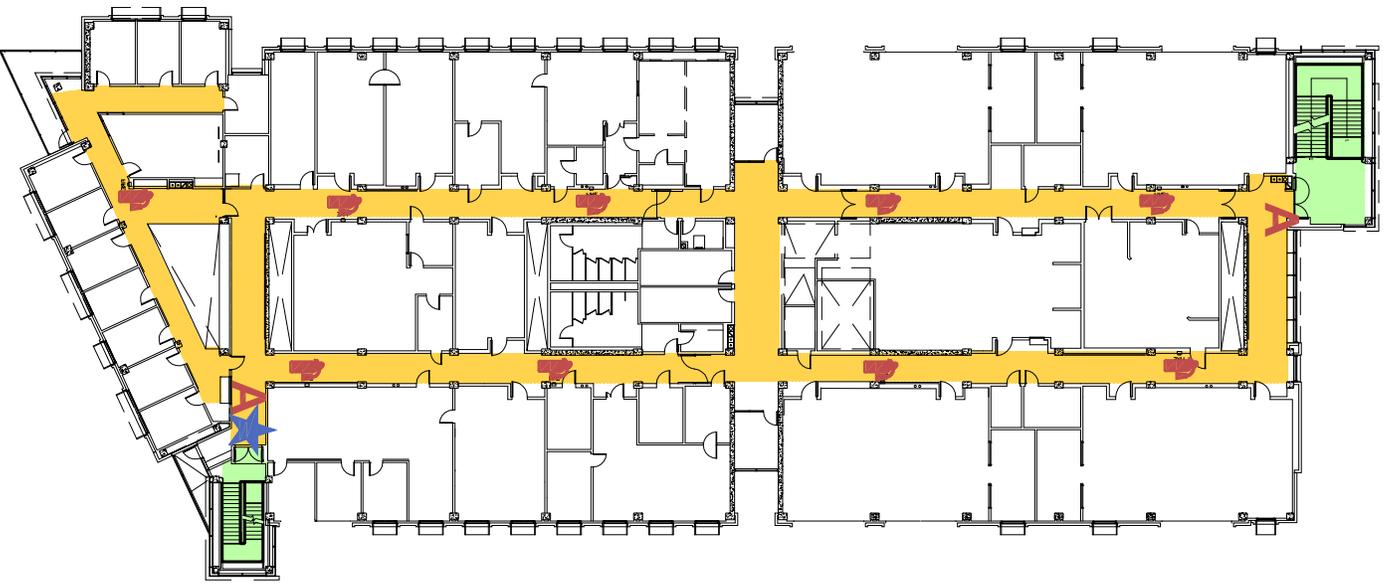


-  Fire Extinguisher
-  Fire Alarm Box
-  Exit
-  You Are Here
-  Exit Path
-  Exit Stairs

**Emergency Phone
Number: 911**

**Physical Sciences Building
Second Floor**

**IN CASE OF FIRE
USE STAIRWAY
FOR EXIT, DO NOT
USE ELEVATORS.**



-  Fire Extinguisher
-  Fire Alarm Box
-  Exit
-  You Are Here
-  Exit Path
-  Exit Stairs

**Emergency Phone
Number: 911**

**Physical Sciences Building
Third Floor**

Telephone Bomb Threats

Procedures to be Followed

It is important to carefully follow certain procedures in the case of a telephone bomb threat. This form along with the "Bomb Threat Checklist" is a useful response guide in a threatful a situation to help ensure the safety of those involved. These forms may be copied and utilized by departments.

With Your Checklist in Hand...

1. When a bomb threat is received by the telephone, the person taking the message should keep the caller talking as long as possible and make written notes of the following:
 - The time and date of the call
 - The assumed age and sex of the caller
 - Any distinguishing speech characteristics
 - What was said by the caller, as precisely and completely as possible
 - Any background noise that may help identify the source of the call
 - The phone number of the caller (if your phone is equipped with this function).
2. Notify the University Police immediately by calling the emergency number, **9-1-1**. Also inform your immediate supervisor or department head. Always be sure to give the name of the building, room number, your name and telephone extension number.
3. The University Police will assign personnel to investigate the call and take whatever police action may be deemed necessary and reasonable for the safety of the campus community.
4. The Police will conduct a search of the building, or of specific locations in or around the building. When it is judged prudent and feasible to do so, the search will be conducted with the assistance and cooperation of the department head and/or building manager.
5. After an evaluation/assessment of the content of the bomb threat, the decision to evacuate or close a building shall be made jointly, whenever possible, by the Police and the department head and/or building manager.
6. If the decision is made to evacuate, the Police will, when indicated, inform the designated person in the affected departments, asking that they, in turn, notify their people to clear the offices, rest rooms, and work areas in their sections of the building. The University Police will make every effort to be certain that all occupants of the building have been informed of the threat and evacuated from the building. Occupants should be directed to take personal belongings such as briefcases, purses, etc. with them. (If necessary, the Police Department may activate the building's audible fire alarm system to aid in the evacuation.)
7. Any unusual or suspicious object should be reported immediately to the University Police or to any immediate supervisor or administrative officer. Suspected objects or materials should **NOT** be touched or disturbed.
8. Every bomb threat or incident of a suspected explosive device should be considered valid until all reasonable precautions for public safety have been taken or until the danger to life and property is terminated.

UC Davis Police Department
Crime Prevention Unit
530-752-6589



Crimes in Progress: **9-1-1**

Non-Emergency & Cell Phone: UCD: 530-752-1230
UCDMC: 916-734-2555

Bomb Threat Checklist

QUESTIONS TO ASK THE CALLER:

1. When is the bomb going to explode?
2. Where is it right now?
3. What does it look like?
4. Did you place the bomb?
5. Why?
6. What is your address?
7. What is your name?

BACKGROUND / SOUNDS

Office machines	Radio
Street noises	Children
Dishes	Factory Machines
Voices	Animals
PA system	Static
Music	Phone booth
Household	No noises
Other:	_____

THREAT LANGUAGE

Educated	Incoherent
Foul/Obscene	Read Message
Irrational	Taped
Other:	_____

CALLER'S VOICE

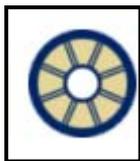
Male	Distinct
Female	Slurred
Normal	Bass
Soft	Tenor
Loud	Nasal
Fast	Lisp
Slow	Raspy
Calm	Deep
Excited	High
Angry	Cracking
Laughing	Stutter
Crying	Ragged
Deep Breathing	
Accent (type?):	_____
Familiar (who?):	_____

EXACT WORDING OF THREAT:

REPORT BOMB THREATS IMMEDIATELY TO THE POLICE DEPARTMENT

Emergencies: Fire, Police, Medical
From all telephones with the exception of cellular phones, dial:

9-1-1



Safety Services

SafetyNet #13 - Guidelines for Chemical Spill Control

safety net

UC DAVIS ENVIRONMENTAL HEALTH AND SAFETY • 2-1493

General Steps To Follow

1. When 1 pint or more of a hazardous material or any amount of an extremely toxic substance is spilled or when in doubt, call UC Davis Fire Department (911). Evacuate the room, close the door, and wait for emergency personnel.
2. If the substance spilled is flammable, turn off all ignition sources before securing the room.
3. In case of chemical contact with skin or eyes, flood the affected area immediately with water; continue for at least 15 minutes. Seek medical assistance at Employee Health Services or Cowell Student Health Center for skin irritation, contact with an extremely toxic substance, any eye injury, or any adverse reaction.
4. All contaminated clothing must be removed immediately. Clothes must be laundered before reuse or disposed of as hazardous waste.
5. When incidental to one's duties, small spills (1 pint or less) may be cleaned up by laboratory personnel. It is good laboratory practice to keep spill absorbents on hand. A good, general purpose spill absorbent is available from the Storehouse (Fisher Scientific, Cat. No.: NC9571649, DRIZORB Absorbent). Spill cleanup kits for solvents, acids, bases (caustics), mercury, hydrofluoric acid, and others are commercially available from sources such as J.T. Baker and Lab Safety Supply.
 - a. Most strong acids may be absorbed and then neutralized with aqueous solutions of sodium bicarbonate, calcium hydroxide (slaked lime), or sodium carbonate (soda ash). (Note: DO NOT attempt to absorb hydrofluoric acid (HF). Skip this step and neutralize immediately only if you are familiar with proper neutralization procedures for HF; otherwise, return to step one.)
 - b. Caustic solutions and flammable liquids may be absorbed with an inert absorbent.
 - c. DO NOT attempt to blot cryogenic liquid spills with unprotected hands. Evacuate the space and allow the liquid to evaporate. If the cryogenic fluid evaporates to a flammable, toxic or asphyxiating gas, follow procedures (1) and (2) for large

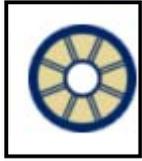
spills.

- d. Formaldehyde spills may be absorbed with an inert absorbent.
 - e. For mercury spills, see [SafetyNet #16](#), "Guidelines for Mercury Spill Control", for more information.
 - f. Solid spills are not usually emergencies. If the material spilled is toxic, use dampened cloths or paper towels to transfer it to plastic bags. Brushing dry material may cause dust to become airborne.
6. All absorbed spill material must be collected in double plastic bags or plastic containers with secure lids and disposed of as hazardous waste. See [SafetyNet #8](#), "Guidelines for Disposal of Chemical Waste" for more information. If the absorbent has been used for a flammable or volatile compound, it must be stored in a well-ventilated area away from sources of ignition while awaiting pickup. A fume hood is a good temporary storage area.

For additional information, contact your [EH&S Safety Advisor](#), EH&S at 530-752-1493 or ehsdesk@ucdavis.edu.

Reviewed/Revised. 8/2009

AWM



Safety Services

SafetyNet #17 - Personal Computer Workstation Checklist

safety net

UC DAVIS ENVIRONMENTAL HEALTH AND SAFETY • 2-1493



- Use this checklist to assess your own computer workstation
- Refer to diagram for an example of proper positioning at the computer.
- If you answer "NO" to any items, it may indicate a need for workstation modifications.
- To check on videos, or classes about ergonomics, go to the [EH&S website](#).
- If you have questions or need further information, contact Environmental Health & Safety at 530-752-1493.

Chair Adjustment

- Is your chair height adjustable?
- Does your chair support your lower back?
- Is there room between the front edge of the chair seat and the back of your knees?

- Can you easily reach your work without interference from the arms of your chair?
- When using the keyboard or mouse, are you able to keep your arms in a comfortable position with elbows in at your sides?
- Do your feet rest flat on the floor or footrest?
- Are your knees bent at approximately 90-110 degree angles?

Sitting with your feet flat on the floor (or supported by a footrest) will help support your spine. Having your thighs parallel to the seat with knees bent at approximately a 90-110 degree angle, and having adequate clearance behind your knees, will keep the chair from interfering with the blood circulation to your legs.

If the back of your chair is adjustable, raise or lower it so that the contour of the chair provides maximum lumbar (lower back) support. If possible, adjust the tilt of the backrest to support your body in an upright position. A slight angle, either forward or back, is also acceptable. Adjust the chair according to what is most comfortable for you.

If your chair has arms, they should allow you to get close to your work without getting in the way. If you are typing, they should be at a height where they barely contact your elbows when your arms are resting comfortably at your side. Chair arms should not force you to elevate your shoulders or wing your arms to the side.

Work surface/Keyboard Adjustment

- With your chair adjusted properly, is your keyboard at approximately elbow level?
- Are your arms in at your sides rather than stretched out in front of you?
- Are your shoulders relaxed and not elevated when you work at your work surface?
- When using the computer, is there approximately a 90-110 degree angle between your forearms and upper arms?
- When using the computer, are your wrists in line with your forearms and not bent upwards, downwards, or to one side or the other?
- Is there at least 2 inches of clearance between the bottom of your work surface and the top of your thighs?

Ideally, with your arms resting comfortably at your sides, the bottom of your elbow should be at the same height as the surface supporting your keyboard. To easily check this, turn sideways to your keyboard. If your work surface is too high and cannot be adjusted, raise the chair to bring your elbows level with the keyboard and support your feet with a footrest if necessary. If your work surface is adjustable, start by adjusting your chair as described in the first section. Once the chair is adjusted, then adjust the work surface.

Monitor Adjustment

- Is your monitor aligned in front of your keyboard rather than off to the side?
- Is the viewing distance to your computer monitor at least 18-30 inches (at arm's length)?
- Is the top of the computer screen at or just below eye level?
- Is your computer monitor protected from excess glare?
- If you wear bifocals or trifocals, are you able to look at the monitor without tilting your head?

Position your monitor so it is aligned in front or nearly in front of your keyboard to allow your neck to remain straight when viewing the monitor. Raise or lower your computer monitor so that the top of the screen is at or just below eye level. You may need to unstack the monitor from the CPU to lower the monitor to the correct height or place a book between the monitor and CPU to raise it to the correct height. People who wear bifocals or trifocals often end up tilting their heads back to read through the lower portion of their glasses. Lowering the computer monitor by placing it directly on the desk surface typically helps. Bifocal users may want to discuss with their eye doctor the possibility of obtaining glasses specifically designed for computer use.

Workstation Accessory Adjustments

- Are your input devices (mouse, trackball, digitizing tablet) at the same level and next to your keyboard?
- Are your primary work materials located in front of you?
- Are your most frequently accessed items (phone, manuals, etc.) easy to reach?
- Do you have a document or copyholder to hold reference material?
- Are you able to keep your arms from resting on any sharp, square edges of your work surface?
- If a large percentage of your time involves using a phone, do you use a phone headset?

Computer input devices such as a mouse or trackball should be located at the same level and next to the keyboard to avoid reaching. This can sometimes be a problem if using a keyboard tray that is not wide enough to accommodate the keyboard and mouse. Modification or replacement of the keyboard tray may be necessary.

As you change tasks, remember to move primary materials in front of you. If you must frequently look at reference materials as you type, you should consider a document holder to allow your head to remain in a more upright position. Position the document holder at the same height and distance as your monitor. If doing a lot of reading or writing on the desk, inclining the material by placing it on a 3-ring binder notebook helps reduce the need to bend the neck forward.

The wrists should remain straight when typing. If you have poor wrist habits, a padded wrist rest can help support your wrists in a straight position. Height of the wrist rest should not exceed the height of the space bar on the keyboard. Avoid wrist rests that are wider than 3 inches since this results in the need to reach further for the keyboard.

When talking on the phone, it is not good for the neck to cradle the phone between your ear and shoulder. For jobs with a high volume of phone calls, headsets are recommended since they allow you to maintain the head in an upright position when talking on the phone.

Work Habits

- When using the computer, do you have a light touch on the keys?
- When using the keyboard or mouse, do your fingers, forearms and shoulders remain relaxed?
- When using the mouse, do you move your arm from your shoulder instead of reaching excessively with your wrist or fingers?
- Do you take short and frequent micro breaks throughout the day to reduce fatigue?
- Do you frequently change body positions while working?
- Do you provide your eyes with vision breaks every hour?

- Do you work fairly regular hours without a lot of overtime?
- Are you able to meet deadlines without excessive stress?
- Are you comfortable and free of pain while working?

When typing, it is important to use a light touch on the computer keys. Sometimes, slowing your typing speed just 5-10% helps you use a lighter touch and reduces tension in the fingers, forearms, and shoulders. During mouse use, hold the mouse lightly. Movement of the mouse should occur from the shoulder instead of only at the wrist. When not actively using the mouse, ease your grip on the mouse to let your hand relax.

Periodic breaks help alleviate fatigue and strain to your eyes and upper body. Taking a break does not mean that you have to stop working. Rather, it allows you to integrate other activities such as making phone calls, making copies or talking with a co-worker. Changing positions periodically helps maintain circulation and prevents putting pressure on any one area of the body for an extended period of time.

Working overtime, or working under stress to meet deadlines can add to tension or discomfort. In addition to taking breaks and frequently changing positions, you should pay attention to how your body responds to discomfort. Discomfort, which goes away overnight, can be a sign of fatigue. Discomfort that is continuous may build to a more serious problem. If you experience lasting discomfort, please discuss this with your supervisor or contact Employee Health Services, 530-752-2330 for medical advice. Aches and pains that are addressed early, typically resolve quickly. Ignoring pain prolongs and may worsen the problem.

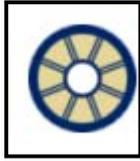
Finally, develop good habits away from work. While you may not be able to adjust all of the work surfaces at home, you may be able to make minor adjustments that are significant to your body. Good posture and good work habits are just as important away from work, whether you are using your home computer, doing chores around the house or are involved in special projects or hobbies.

For further information refer to the [workbook](#), "Easy Ergonomics For Desktop Computer Users", and the [video](#), "Ergonomics: Setting Up Your Computer Workstation."

For additional information, contact your [EH&S Safety Advisor](#), EH&S at 530-752-1493 or ehsdesk@ucdavis.edu.

Reviewed/Revised. 01/2007

CC



Safety Services

SafetyNet #20 - Electrical Safety Guidelines

safety net

UC DAVIS ENVIRONMENTAL HEALTH AND SAFETY • 2-1493

Accidents involving electricity pose a high risk of serious injury or death. Following these guidelines will help university staff and students to safely use common electrical equipment.

- **Do not use 2-prong ungrounded electrical devices.** All department-purchased electrical equipment must be 3-prong grounded with very limited exceptions (e.g. clocks, radios, small fans).
- **Do not use extension cords or power strips as a substitute for permanent wiring.** Extension cords and temporary power strips may be used for experimental or developmental purposes for no longer than three months, or for portable tools or appliances that must be moved frequently. UL listed surge-protected power strips used with data processing equipment and voltage regulators, timers, and similar controllers are exceptions. All other electrical equipment, such as freezers, incubators, refrigerators, and other appliances must be plugged directly into a permanent receptacle.
- **Do not use equipment having worn or damaged electrical cords, plugs, switches, receptacles, or cracked casings.** These characteristics dramatically increase the likelihood of a live conductor coming in contact with metal objects or water and thus possibly electrocuting a person. Running electrical cords under doors or rugs, through windows, or through holes in walls is a common cause of frayed or damaged cords and plugs. Call the Operations and Maintenance Work Order Desk at 530-752-1655 for assistance in repairing university-owned electrical equipment.
- **Do not attempt "free lance" repairs unless you are a qualified electrical technician assigned to perform electrical work by your supervisor (applies to work with electricity of 120 volts or higher).** Electrical work is covered by UC Davis Policy & Procedure #290-85. Call EH&S for assistance in determining qualifications to perform electrical work. Fixed wiring may only be repaired or modified by Operations and Maintenance personnel.
- **Do not use 2-prong to 3-prong adapters, cube taps, 2-prong (ungrounded) extension cords, or similar grounding bypass devices.** All electrical devices fabricated for experimental purposes must meet state and university construction and

grounding requirements. Extension cords and other purchased equipment must be UL listed. See [UC Davis Policy & Procedure #290-85](#) for more details.

- **Use portable GFCIs whenever powering devices pumping liquids or devices in the vicinity of tanks and water sources.**

For additional information, contact your [EH&S Safety Advisor](#), EH&S at 530-752-1493 or ehsdesk@ucdavis.edu, or the UC Davis Fire Department at 530-752-1236.

Reviewed/Revised. 01/2007

SDB

WHAT YOU SHOULD KNOW TO PROTECT YOUR WRISTS AND HANDS FROM REPETITIVE MOTION INJURY

SafetyNet #41

The Potential for Injury

Any combination of the following factors can lead to the over use of some part of your body. Repetitive tasks, awkward or fixed postures and excess stress without adequate recovery time can lead to repetitive motion injury.

Structures of the Wrist

- **Bony Structure:** Eight small bones called carpal bones make up the bony structure of the wrist (Figure 1). The bones are aligned in two rows and form the bottom and sides of the carpal tunnel (Figure 2).

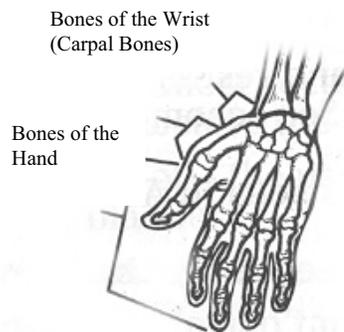


Figure 1

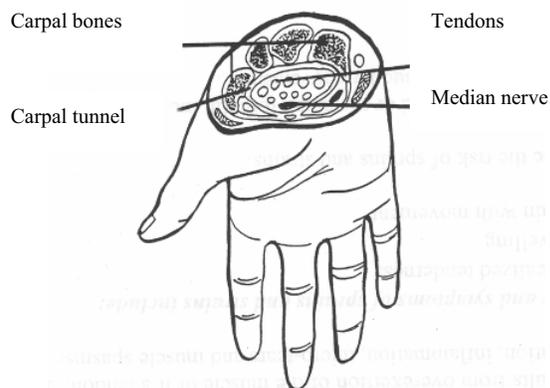


Figure 2

- **Ligament:** A thin, but very strong band of connective tissue called a ligament covers the top of the carpal tunnel (Figure 2, 3). A complex network of smaller ligaments holds each carpal bone to the next.
- **Carpal Tunnel:** A narrow passage between the forearm and hand at the base of the palm through which nerves and tendons pass is called the carpal tunnel.
- **Nerve and Blood Supply:** Part of the nerve and blood supply to the hand also passes through the carpal tunnel (Figure 2).
- **Muscles/Tendons:** Nine tendons also run through the tunnel connecting the muscles of the forearm to the bones of the wrist and hand (Figure 3). These tendons bend your fingers and thumb.

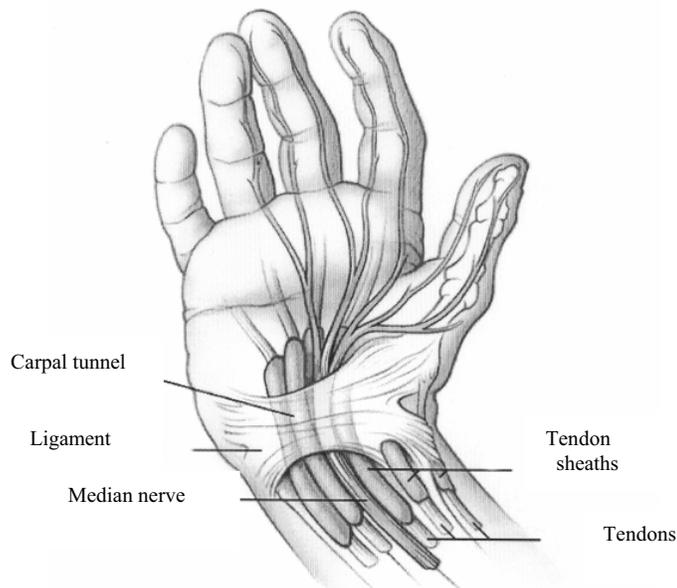


Figure 3

- Lubricating membrane: The tendons are covered with a lubricating membrane called synovium which may enlarge and swell under some circumstances.

Wrist Position

Studies have shown that pressure within the carpal tunnel depends on wrist position (Figure 4). Pressure is relatively minimal when the wrist is straight or in neutral position. Pressure dramatically increases with positions of wrist flexion (bent forward) and extension (bent backwards). Positions of wrist flexion and extension also cause increased stress to the joints between the carpal bones and increased tension to the tendons crossing the wrist.



Figure 4

The Body's Reaction to Stress

Stress is needed to maintain tissue strength (Figure 5). When the body is stressed, tissue damage occurs as a natural process. If adequate recovery time is allowed before the tissues are again stressed, the body tissues rebuild themselves to a stronger level. However, if recovery time is inadequate, symptoms can result. Adequate recovery time will then be needed to again enter the cycle. Any increase in stress to the tissues above the level to which the tissues are accustomed, will begin the cycle. New activities or an increase in the intensity of an activity, to which the body is accustomed, would each result in an increase in stress to the tissues.

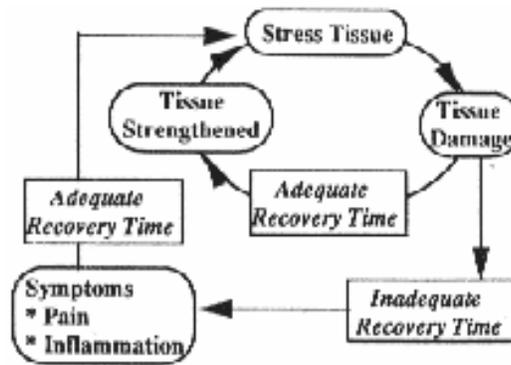


Figure 5

Types of Injury and Methods of Prevention

- Wrist Joint Sprain:

The wrist joints can be sprained if relatively large forces are applied to the wrist when the wrist is in an awkward position, typically when it is extended. Examples include: 1) lifting a heavy binder with one hand during which the wrist is forced into extension to balance the weight of the book; 2) placing full body weight on the hand with the wrist extended when stapling; 3) pushing against an object with the wrist extended.

Prevention:

Avoid large forces to the wrist, especially when the wrist is extended. Whenever possible, try to keep the wrists straight during activity. Use two hands to lift relatively heavy objects such as full binders. Use of two hands helps distribute the load and results in increased control of wrist position.

- Tendonitis/Tenosynovitis:

Tendonitis is inflammation of a tendon. Tenosynovitis is inflammation of a tendon sheath. Both can occur if the tendon is used excessively, especially when the wrist is in an awkward position. Initially, irritation of a tendon occurs over a localized area. If the irritation continues, inflammation of the tendon can spread along the tendon sheaths, resulting in symptoms into the forearm and/or hand.

Prevention:

Avoid excessive wrist flexion or extension during activity. Avoid rapid changes in workload or activity. Remember that the body will adapt to a given workload if it is given adequate time to adapt. When beginning a new activity, limit the amount of new activity for a given session. Try to vary activities as much as possible to alter the type of stresses. Realize that the body can become de-conditioned during an extended leave of absence such as a long vacation, sick leave, or maternity leave. Upon return, increase activity gradually.

- Carpal Tunnel Syndrome:

Carpal Tunnel Syndrome is diagnosed when compression within the carpal tunnel is sufficient to cause damage to the median nerve. Typical symptoms of Carpal Tunnel Syndrome include pain in the front of the wrist and hand, tingling and numbness in the thumb and first two fingers, and/or loss of strength and coordination of the hand. It is possible to have symptoms that mimic Carpal Tunnel Syndrome if inflammation within the carpal tunnel is sufficient to compromise the space within the carpal tunnel. Typically, carpal tunnel-type symptoms resulting from injury to the wrist (e.g. wrist sprain or tendonitis) resolve with treatment of the injury and do not result in Carpal Tunnel Syndrome.

Prevention:

Take frequent, regular wrist breaks. Avoid resting your wrist on the work surface or wrist when mousing or keying. Reduce the repetition and force of gripping and pinching activities. Resolve wrist sprains, tendonitis or tenosynovitis quickly through proper care. Smoking has been identified as a risk factor for Carpal Tunnel Syndrome. Assess your wrist position and posture during activity. Avoid excessive wrist flexion or extension during activity and avoid wrist flexion at night.

Steps to Take if Symptoms Arise

If symptoms are severe, seek medical advice immediately. Often symptoms come on gradually but even minor symptoms should not be ignored. Early recognition of a problem and following steps 1-6 below can prevent symptoms from getting worse and will dramatically shorten treatment time.

1. Assess your activity level and make adjustments as needed. Have you increased your activity too quickly? Have you added a new activity? Back off on activities that aggravate the symptoms.
2. Assess your wrist position during activity and make adjustments as needed. Look at activities at work and at home since it is important to consider the overall stress to the body.
3. During the initial phase of symptoms, you can apply ice and take an anti-inflammatory such as Motrin or Ibuprofen to control inflammation.
4. If symptoms last more than 3-4 days, inform your supervisor and seek medical attention. Employee Health Services will provide evaluation for work related problems.
5. If you have specific questions regarding your workstation, contact EH&S at 530-752-1493.
6. For problems due to keyboard use, consult SafetyNet #17, "Personal Computer Workstation Checklist", and SafetyNet #96 "Keyboard and Mouse Use" or the workbook "Easy Ergonomics for Desktop Computer Users". For problems due to pipetting, consult SafetyNet #27, "Controlling Laboratory Ergonomic Risk Factors". The SafetyNets and workbook are available on line at <http://ehs.ucdavis.edu/ergo/index.cfm>.

For additional information, contact your EH&S Safety Advisor, EH&S at 530-752-1493 or ehsdesk@ucdavis.edu.



LIFTING SafetyNet #46

This document identifies factors that affect your back when lifting and lowering. By controlling the factors, you can reduce stress to your back when lifting and lowering to help prevent injury both at work and at home.

Object Weight

The heavier the weight of the object, the greater the stress will be to your back when lifting. If possible, reduce the weight of heavy loads prior to moving them. This can often be accomplished by splitting the load in half. Sometimes the weight of the load cannot be reduced. If the load is too heavy for you, either get help or use a mechanical lifting device.

Distance

The further the object is from your body, the greater the stress will be to your back when lifting. Position the object as close as possible to your body before you begin the lift. This may require bringing the object to the edge of the shelf or pallet in preparation for the lift. Do not reach over other objects! If other objects are in the way, either move them out of the way or move to a position where you are able to get close to the object you are lifting. Try to store objects that are moved frequently in positions that allow you to get close to the objects when lifting.

Height

Lifting the object from the ground is more stressful than lifting the same object from several inches off the ground. When possible, store objects on platforms (i.e., shelves or pallets) that raise objects off the ground. Starting positions that are at a level between the knee and waist are the least stressful to the back.

Acceleration

The faster you accelerate an object when lifting, the greater the stress will be to your back. Always lift with controlled speed to reduce stress to your back. If the object is so heavy that you have to jerk the object to lift it, it is too heavy and you should either get help or use a mechanical lifting device. Also, the faster you decelerate an object immediately before setting it down, the greater the stress will be to your back. Always lower objects with controlled speed.

Stance

A stance where the feet are too close together can increase stress to the back if something unexpected happens (i.e., the load shifts, someone bumps into you, your foot slips). Your initial reaction to the unexpected is either to prevent dropping the object you are lifting or to prevent yourself from falling. In recovering your balance, you may twist your back or overexert your muscles. This can be prevented by being prepared for the unexpected through use of a wide stable stance. Your feet should be about shoulder width apart to give you side-to-side stability and staggered to give you forward and backward

stability. Also, with this stance, you will be less tempted to twist during the lift.

Torso Stability

The more torso motion you allow during the lift, the greater the stress to your back when lifting. Try to keep your torso a stable unit during the lift. This is accomplished through contraction of your abdominal muscles. The lift should be initiated with your legs. Keep your torso rigid as you come to an upright position using your leg and buttock muscles. Your thigh and buttock muscles are far stronger than your back muscles!

Twisting

Twisting during a lift increases the stress to your back during lifting. Instead of twisting, come to an upright position, then pivot, using your feet. Your feet should face where you lift object from and where you set an object down.

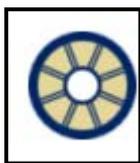
Steps for Manual Lifting

1. **Assess the lifting environment.** This is a mental process that takes just seconds before you begin the lift. Look at the surrounding area to become aware of possible hazards. Is the floor or ground level and dry? If not, you will need to take extra precautions during the lift. Do you know where you will place the object you are about to lift? If not, you may need to clear a place for the object before the lift. Is the pathway needed to perform the lift and/or carry the object clear? If not, you need to either take extra precautions or clear the pathway.
2. **Assess the weight and size of the object.** Nudge the object to assess the approximate weight of the object. This will help you determine whether you can lift the object yourself or whether you need additional help from another person or a mechanical lifting device. Also, assess the size of the object. Often, bulky items are not heavy, but require additional help to maintain proper body mechanics during lifting, carrying, and lowering. Know your limitations and get additional help when necessary.
3. **Get close to the object to be lifted.** Move other objects out of the way or move yourself to a position where you can be close to the object you are about to lift.
4. **Assume a stable stance.** Your feet should be approximately shoulder width apart with feet staggered slightly.
5. **Bend your knees.** Bend your knees as far as you can and still be able to come to an upright position using your thigh muscles. If you have weak thighs, you may only be able to bend your knees slightly.
6. **Grip the object firmly.**
7. **Keep your back a straight, stable unit.**
8. **Initiate the lift with your leg and buttock muscles.**
9. **Lift with controlled speed.**
10. **Continue to keep your back a straight, stable unit.**

11. **Come to an upright position using your leg and buttock muscles.**
12. **Pivot, using your feet; do not twist.**
13. **To lower, use the same precautions noted above.**

For additional information, contact your EH&S Safety Advisor, EH&S at 530-752-1493 or ehsdesk@ucdavis.edu.

Rev. 1/2007
BAC



Safety Services

SafetyNet #5 - Eye and Face Safety Protection for Laboratory Workers



Everyone working in laboratories on the UC Davis Campus is required to wear appropriate personal protective equipment. Collectively known as PPE, these items are intended to minimize exposure or injury to laboratory students, visitors and employees.

Variable Working Situations

In locations where there is a risk of injury to the face or eye, face/eye protective devices must be worn. Due to the variability in laboratory work, procedure specific hazard analysis should be performed to identify PPE needed by laboratory workers. Job specific PPE requirements should be maintained in the laboratory's Chemical Hygiene Plan for ready access by laboratory students, visitors and employees.

Effective eye and face protection device requirements can differ between, or within a laboratory. When laboratory procedures require the use of eye or face protection everyone in the laboratory, including those wearing contact lenses or other corrective eyewear, must wear the required protective devices. If laboratory procedures call for a face shield, safety glasses or goggles must also be worn (ANSI 287.1)(OSHA Title 8, Section 3382). For example, when working with a corrosive everyone in the laboratory should wear goggles and/or a face shield.

Eye and Face Protection

Please refer to [SafetyNet #73](#), "Laser Protective Eyewear" and [SafetyNet #106](#), "Hazards of Ultraviolet Radiation" to select protective eyewear when working with lasers or UV light.

Special Considerations for Eyeglass and Contact Lens Users

Employees wearing corrective eyeglasses or sunglasses, and those wearing contact lenses should follow these recommendations:

- Do not handle or store contact lenses in laboratories in areas where chemical, biohazard, or radiological materials are used or stored.
- Do not insert contacts in areas where chemical, biohazard, or radiological materials are used or stored.
- Certain chemicals should not be used when wearing contact lenses. If you need medical advice about wearing contact lenses in areas where chemicals are stored and/or used, contact Occupational Health Services at 530-752-2330 (campus) or 916-734-3572 (UCDHS) for recommendations on appropriate eye protection.
- Contact lens wearers should inform their supervisor and co-workers that they wear contact lenses

The UC Davis Policy and Procedure 290-50 further describes campus policies relating to protective clothing and equipment for the workplace. For additional information, contact your EH&S Safety Advisor, EH&S at (530) 752-1493 or ehsdesk@ucdavis.edu.

Reviewed/Revised. 8/2008

GW



PREGNANCY AND THE UNIVERSITY WORKPLACE: GUIDELINES FOR SUPERVISORS

SafetyNet #54

The guidelines given below will assist supervisors in their discussions with employees about reproductive hazards and provide guidance to supervisors in compliance with state and federal nondiscrimination law relevant to such issues.

A supervisor should ensure that any potential workplace reproductive hazards are explained to the employee and that the employee's concerns about the effects of his or her work on reproductive ability are explained. Information relating to potential reproductive hazards that might be found in the workplace can be requested from EH&S.

Legal Issues

Often problems arise when supervisors decide to transfer, terminate, or otherwise alter the employment conditions of a pregnant woman or women with childbearing potential. In the majority of cases, courts have found that decisions of this type constituted unlawful discrimination. In a few instances, courts have determined that the risk of harm to a fetus was significant enough to justify barring women of childbearing age from jobs. EH&S and Employee and Labor Relations can supply you with more recent or detailed legal information. In general, the following rules apply:

- It may be a violation of federal and state anti-discrimination statutes to terminate, lay off, or reassign a pregnant employee or woman of childbearing age, or to place such a person on unpaid leave of absence on the grounds that the workplace or job is too dangerous for a developing fetus. Such action may be appropriate, however, when the employee herself requests reassignment or unpaid leave. If such a request is made, the supervisor should discuss the matter with his or her department chair and Employee and Labor Relations to determine if this action can be accomplished as a reasonable accommodation to the employee's request.
- If a decision is made to accommodate the employee's request, the action should be documented in writing. A statement that the employee has requested reassignment or leave and that the supervisor has agreed to the request should be included in the documentation. If the employee is covered by a collective bargaining agreement, consult Employee and Labor Relations before arranging leave or reassignment. These agreements should always be part of the written record discussed below.
- Employees who work with radioactive materials or radiation-producing machines should consider the hazards associated with radiation risk to the embryo/fetus. It is a woman's right to implement lower dose limits for the embryo/fetus by declaring her pregnancy, in writing, with the estimated date of conception. She also has the right to un-declare her pregnancy.
- You may not, with very narrow exceptions, include statements in a job description or vacancy listing requiring that an employee or applicant cannot be pregnant, of childbearing age, or of a particular sex. You may not refuse to hire someone because she is pregnant, and you may not terminate an employee for this reason. Supervisors who feel that the work environment in their area may qualify for the narrow exception that would allow for the exclusion of pregnant women

or women of childbearing age should contact EH&S and Employee Health and Labor Relations to discuss the issue before taking any action.

- University policy requires that if an employee is disabled by her pregnancy and later returns to work, you must return her to the same or a similar job.

All Supervisors Should

- Recognize that materials used in the workplace may affect both male and female employees and that such materials may create potential reproductive hazards by affecting the male reproductive system, the female reproductive system, or the fetus. Required health and safety programs (Injury Illness Prevention Program, Laboratory Safety Standard, Bloodborne Pathogen Standard, etc.) should be in place and updated annually to assure priority for a safe and healthful work environment for all employees.
- Ensure that employees are informed of the hazardous properties of materials they must use in their work. For information on employee health and safety training consult SafetyNet #33, "Hazardous Material Information and Training" and SafetyNet #39, "Safety Training Tips."
- Review Material Safety Data Sheets on substances used in the workplace to determine if substances used in the supervisor's area of responsibility create a *known* risk of reproductive hazard. Supervisors should discuss the properties of these materials with all employees and establish standards for handling such substances and protective measures appropriate for the type of work being performed.
- Encourage employees to tell supervisors as soon as possible when they become pregnant. However, supervisors should be aware that employees cannot be required to inform their employer about their reproductive status. Supervisors should ensure that employees do not feel they are being coerced to reveal personal information.

When A Supervisor Learns That An Employee Is Pregnant, He or She Should

- Contact EH&S to discuss any concerns the supervisor has about the employee's work and its potential effect on the health of the mother or fetus. Specific regulatory limits for radiation exposure apply to declared pregnant women. Call EH&S for more information about radiation regulations.
- Meet with the employee to discuss any concerns about the employee's health or the health of the fetus. Contact Employee and Labor Relations before making a commitment to any accommodation that changes a working condition.
- Encourage pregnant employees to discuss their work environment and duties with their personal physicians. The supervisor should obtain copies of documentation from an employee's physician to support any accommodations or changes in duties requested by the employee.
- Establish reasonable work practices, including procurement of protective equipment that will reduce any risks perceived by the employee or the supervisor. (For example, if the employee must use small quantities of solvents outside a fume hood, provision of an air-purifying respirator would help.) EH&S and the Occupational Physician may be able to assist in resolving health and safety concerns. Employee and Labor Relations may also be of assistance.
- Consult the collective bargaining agreement, if any, that governs the working conditions for the affected employee. Contact the appropriate labor relations representative for advice as needed. Note that state and federal regulations may require the University to adopt different, and in some situations, stricter health and safety standards than those set forth in the contracts.

- Document discussions between the employee and the supervisor. This documentation should include a summary of concerns expressed by the employee, concerns expressed by the supervisor, steps taken by the supervisor to address the employee's concerns, and an explanation of the supervisor's rationale for not accommodating requests made by the employee, if applicable. This documentation should also indicate any modifications in work practices, as well as the provision of protective equipment, if any, that will be employed. Consult EH&S before making adjustments to working conditions (other than straightforward alterations in hours of work) or recommending protective equipment. Changes in working conditions, including hours or work, must be approved by the Office of Employee and Labor Relations. The documentation should be signed by the supervisor, the employee, and by any other University representatives who have participated in its preparation. Each of the signatories should keep a copy.
- Recommend that the employee provide a copy of the documentation discussed above to her physician. Reasonably attempt to accommodate the physician's suggestions or request for changes.

Additional Resources

Personnel in the following offices can assist you with more specific information.

Campus:

Environmental Health and Safety	530-752-1493
Occupational Physician	530-752-2330
Employee and Labor Relations	530-752-6660
Benefits	530-752-1774
Campus Counsel	530-754-6295

UDCMC:

Health Physics	916-734-3355
Occupational Safety	916-734-2740
Employee Health	916-734-3572
Employee and Labor Relations	916-734-3362
Benefits	916-734-8099

For additional information, contact your EH&S Safety Advisor, EH&S at 530-752-1493 or ehsdesk@ucdavis.edu or UCDHS Health Physics at 916-734-3355.



SAFETY PRECAUTIONS FOR CRYOGENIC LIQUIDS

SafetyNet #58

General Information

- Cryogenic liquids such as liquid nitrogen, helium, and oxygen are, by definition, extremely cold. Contact between cryogenic liquids and exposed skin can produce a painful burn. A splash of cryogenic liquid to the eye can cause loss of vision. Always wear proper personal protective equipment including a buttoned lab coat and pants or a long skirt, heavy gloves, and a face shield, or at least safety goggles, whenever handling cryogenic liquids.

Other Hazards Associated With Cryogenic Liquids

- **Pressure buildup.** Boiling of liquefied gases within a closed system increases pressure. Users must make certain that cryogenic liquids are never contained in a closed system. Cold fingers and similar devices have exploded when either an ice dam is formed within the apparatus or when users create a closed system by shutting off all valves. Users should also tape exposed glass parts to minimize the hazard of flying glass shards in the event of an explosion.
- **Oxygen enrichment.** Liquid nitrogen and liquid helium may fractionally distill air, causing liquid oxygen to collect in the cryogenic container. Liquid oxygen increases the combustibility of many materials, creating potentially explosive conditions. Make sure to provide adequate venting when working with cryogenic liquids in a closed system or enclosed space.
- **Asphyxiation.** If vented into a closed space, a cryogenic liquid will vaporize, displacing oxygen and possibly causing asphyxia. For this reason, never store a container of cryogenic liquid in a closed space.
- **Embrittlement.** Do not dispose of cryogenic liquids down the drain! Ordinary materials such as metal or polyvinylchloride (PVC) piping in laboratory sinks may not be able to withstand cryogenic temperatures. Allow cryogenic liquids to evaporate in a fume hood or other well-ventilated area. Materials exposed to cryogenic temperatures for long periods or materials that have undergone periodic warming and freezing must be examined regularly for cracks and warping.
- **Cryotube Explosions.** Cryotubes used to contain samples stored under liquid nitrogen may explode without warning. Tube explosions are caused by liquid nitrogen entering the tube through minute cracks and then expanding rapidly as the tube thaws. In addition to wearing proper safety equipment, when thawing cryotubes place the cryotube in a heavy-walled container (e.g., a desiccator) or behind a safety shield to protect yourself in the event that the tube shatters.

For additional information, contact your EH&S Safety Advisor, EH&S at 530-752-1493 or ehsdesk@ucdavis.edu.



SAFE LASER PRACTICES

SafetyNet #76

The Principal Investigator is responsible for ensuring that lasers under his/her control are used safely. The following control measures are recommended as a guide to safe laser use. Some of the measures may be required (see attachments 1 and 2, Engineering and Administrative and Procedural Controls), particularly in the case of high powered lasers or lasers that emit invisible non-ionizing radiation.

Recommended Work Area Controls

- Access by non-laser users to the laser work area should be limited. Doors should be closed and secured.
- An active laser should never be left unattended unless it is a part of a controlled environment.
- The illumination in the area should be as bright as practical so that the pupils of the user's eye will be constricted.
- The laser should be set up so that the beam path is not at normal eye level (i.e., below 4.5 feet or above 6.5 feet).
- Where practical, the laser system or beam should be enclosed with polyvinyl chloride (PVC) tube or a similar material to prevent accidental exposure to the beam.
- The potential for inadvertent reflections should be minimized by shields and by removal of unnecessary shiny surfaces. Krylon flat black spray paint is inexpensive and handy.
- Practice good housekeeping to ensure that no device, tool, or other reflective material is left in the beam path.
- Windows in the laser work area should be provided with adequate shades or covers (class 3b and 4).
- The main beams and reflected beams should be terminated or stopped by a protective device such as a beam block. **NOTE:** This is required for any accessible laser that may exceed the maximum permissible exposure. Contact EH&S (530-752-1493) if you have any questions or are unsure if this situation exists.
- Lasers with beams operating at wavelengths outside the visible spectrum should be equipped with audible or visual warning devices informing users of the presence of invisible beams.

General Laser Use Controls

- **Class 1 Controls**
 - No user safety rules are necessary. However, general laser safety training should be provided to all users.

- **Class 2 Controls**

- Never permit a person to continuously stare into the laser source.
- Never point the laser at an individual's eye unless a useful, approved purpose exists.

- **Class 3 Controls**

- Never aim the laser at an individual's eye as permanent eye damage may result.
- Permit only authorized personnel to operate the laser.
- Enclose as much of the beam as possible. Even a transparent enclosure will prevent individuals from placing their head or reflecting objects within the beam path. Terminations (beam stops) should be used at the end of the useful paths of the primary and any secondary beams.
- Shutters, polarizers, and optical fibers should be placed at the laser exit port to reduce the beam power to the minimal required level.
- A warning light or buzzer should indicate laser operation. All invisible beams (i.e., infrared lasers) must have a warning device.
- Do not permit laser tracking of non-target vehicles or aircraft.
- Operate the laser only in a restricted area (e.g. closed laboratory without windows and an appropriate warning sign on the door).
- The laser beam path must be well below or above the eye level of any sitting or standing observers (below 4.5 feet or above 6.5 feet). The laser should be mounted firmly to ensure that the beam travels only along its intended path.
- Proper laser eye protection for the direct beam or an inadvertent reflection must be provided and worn if a potential eye hazard exists.
- A key switch should be installed to prevent activation by unauthorized personnel.
- The beam or any inadvertent reflections should never be directly viewed with optical instruments such as telescopes or binoculars.
- Remove all mirror-like surfaces from within the vicinity of the laser beam path to avoid inadvertent reflections.

- **Class 4 Controls**

- Strictly control access to laser area or localized enclosure to necessary personnel.
- Indoor laser operations should be in a light-tight room with interlocked entrances to ensure that the laser cannot operate while the door is open.
- Eye protection is needed for all individuals working in the controlled area. If laser beam irradiance is sufficient to be a serious skin or fire hazard, suitable shielding or protective clothing must be present between the laser beam and any personnel or combustible material.
- Operating the laser or laser system with remote controls and video monitoring or other remote (safe) viewing techniques should be done whenever feasible.
- Beam shutters, beam polarizers, and beam filters should always be used to limit exposure. The flash lamps in optical pump systems should be shielded to eliminate any direct viewing.
- Backstops should be diffusely reflecting and fire-resistant target materials. Safety enclosures should be used around micro welding and micro drilling work pieces to contain hazardous reflections from the work area. Microscopic viewing systems used to study the work piece should prevent hazardous levels of reflected laser irradiation back through the optics.

Previously stated laser controls and work area controls are to be used as guidelines while preparing laser work areas and safety protocols. Attachments 1 and 2 contain engineering, administrative and procedural controls that are required for each class of laser.

For additional information, contact your EH&S Safety Advisor, EH&S at 530-752-1493 or

Attachment 1
Engineering
Control Measures for the Four Laser Classes

Control Measures	Laser Classification				
	1	2	3M	3B	4
Engineering Controls	1	2	3M	3B	4
Protective Housing	X	X	X	X	X
Without Protective Housing	LSO shall establish Alternative Controls				
Interlocks on Protective Housing	V	V	V	X	X
Service Access Panel	V	V	V	X	X
Key Control	-	-	-	•	X
Viewing Portals	-	MPE	MPE	MPE	MPE
Collecting Optics	MPE	MPE	MPE	MPE	MPE
Totally Open Beam Path	-	-	-	X NHZ	X NHZ
Limited Open Beam Path	-	-	-	X NHZ	X NHZ
Remote Interlock Connector	-	-	-	•	X
Beam Stop or Attenuator	-	-	-	•	X
Activation Warning Systems	-	-	-	•	X
Emission Delay	-	-	-	-	X
Indoor Laser Controlled Area	-	-	-	X NHZ	X NHZ
Class 3b Indoor Laser Controlled Area	-	-	-	X	-
Class 4 Laser Controlled Area	-	-	-	-	X
Laser Outdoor Controls	-	-	-	X NHZ	X NHZ
Laser in Navigable Airspace	-	-	•	•	•
Temporary Laser Controlled Area	V MPE	V MPE	V MPE	-	-
Remote Firing and Monitoring	-	-	-	-	•
Labels	X	X	X	X	X
Area Posting	-	-	•	X NHZ	X NHZ

LEGEND X - Shall
 • - Should

– No Requirement

V - Shall if enclosed Class 3b or 4

MPE - Shall if maximum permissible exposure (MPE) limits are exceeded

NHZ – Nominal Hazard Zone analysis required

Attachment 2

Administrative and Procedural Control Measures for the Four Laser Classes

Control Measures	Laser Classification				
	1	2	3R	3B	4
Administrative and Procedural Controls	1	2	3R	3B	4
Standard Operating Procedures	–	–	–	•	X
Output Emission Limitations	–	–	LSO Determination		
Education and Training	–	•	•	X	X
Authorized Personnel	–	–	–	X	X
Alignment Procedures	–	X	X	X	X
Protective Equipment	–	–	–	•	X
Spectator	–	–	–	•	X
Service Personnel	V MPE	V MPE	V MPE	X	X
Demonstration with General Public	MPE [†]	X	X	X	X
Laser Optical Fiber Systems	MPE	MPE	MPE	X	X
Laser Robotic Installations	–	–	–	X NHZ	X NHZ
Eye Protection	–	–	–	• MPE	X MPE
Protective Windows	–	–	–	X NHZ	X NHZ
Protective Barriers and Curtains	–	–	–	•	•
Skin Protection	–	–	–	X MPE	X MPE
Other Protective Equipment	Use may be required				
Warning Signs and Labels (Design Requirements)	–	•	•	X NHZ	X NHZ
Service and Repairs	LSO Determination				
Modifications and Laser Systems	LSO Determination				

- LEGEND
- X - Shall
 - - Should
 - No Requirement
 - V - Shall if enclosed Class 3b or 4
 - MPE – Shall if MPE is exceeded
 - NHZ – Nominal Hazard Zone analysis required
 - [†] - Applicable only to UV and IR Lasers