

Lab Safety Procedures

Faber Lab

Modified on Jan. 31, 2020

Purpose

The purpose of this procedure is to support work practices for protecting laboratory personnel from potential health hazards in the laboratory.

1. Laboratory Safety Guidelines

1.1 GENERAL LABORATORY SAFETY

- Do not eat, drink, or apply cosmetics in the lab.
- Store food and drink in food-designated refrigerators only. Don't mix chemical and food storage.
- Tie back medium length and long hair when working near flames or entangling equipment.
- All accidents, no matter how minor, should be reported to the faculty/staff member supervising the laboratory.
- Know the location of all safety equipment (e.g. eyewash, fire extinguisher, safety showers, spill kit) if available.
- Keep aisles clear.
- Maintain unobstructed access to all exits, fire extinguishers, electrical panels, emergency showers, and eyewashes.
- Do not use corridors for storage or work areas.
- Do not store heavy items above 6 feet high.
- No hazardous experiments should be undertaken when working alone in the laboratory. All work with hazardous materials or operations must be approved by the Principal Investigator or lab manager, and must be conducted using the "buddy" system.
- Keep area clean and uncluttered; clean up area upon completion of task or at end of the day.

1.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

- Review standard operating procedures, safety data sheets and other hazard information to determine appropriate PPE to wear based on chemical hazards encountered.
- Remove gloves and lab coats when leaving the laboratory, so as not to contaminate doorknobs, etc.
- Wear closed toed shoes and long pants when performing lab work.

1.3 ELECTRICAL SAFETY

- Don't use permanent extension cords.
- Don't daisy chain power strips.

1.4 FUME HOODS

- Ensure the fume hood is labeled with a certification date of less than one-year prior.
- Maintain hood sash at or below the maximum height indicated by an arrow on the side of the fume hood. Close the hood sash when not working in the hood.
- Equipment used in hoods should be placed securely on blocks to allow air to flow under and around the equipment.
- Keep chemical sources and equipment at least six inches away from the face or rear of the hood.
- Don't store equipment and chemicals in the hood to avoid dead air spaces and to prevent blocking back baffles.
- Visually inspect baffles (openings at the top and rear of the hood) to be sure slots are open and unobstructed.
- All electrical devices should be connected outside the hood to avoid sparks that may ignite a flammable or explosive chemical.
- Do not use a fume hood for any function which it is not intended. Certain chemicals or reactions require special constructed hoods. Examples are perchloric acid or high pressure reactions.
- If you are not sure if there is sufficient airflow in your fumehood due to extra equipment, please contact the EHS Office and we will perform a survey for you.

1.5 CHEMICAL SAFETY

- Know the hazards of the chemicals you're working with. Consult the material safety data sheet (MSDS) or other appropriate references prior to using a chemical with which you're unfamiliar.
- Make sure all chemicals are clearly and currently labeled with the substance name.
- Use volatile and flammable compounds only in a fume hood. Procedures that produce aerosols should be performed in a hood to prevent inhalation of hazardous material. Be sure the fan is on at all times when using a fume hood. Fume hoods should not be used for storage.

- Material Safety Data Sheets (MSDS) shall be provided for all hazardous chemicals before use.
- Keep proper records of time sensitive chemicals (oxidizers, THF, and organic peroxides), and dispose of all these chemicals before their expiration date.
- Perform proper housecleaning of your lab area once a year to discard of unused chemicals and materials. General chemicals that have been around for three years or more should be discarded.
- Provide a check in procedure for incoming researchers and visiting researchers. Review safety and operational procedures with them.
- If a researcher will be leaving Caltech, please go through a check out procedure with your researcher (visiting and otherwise) that all chemicals and related materials are also properly disposed of, prior to them leaving Caltech. This helps to avoid any unknowns in your lab area, which are difficult to manage by the Institute.
- Clean up of large spills should not be attempted. Call Environmental Health and Safety Office at 6727 for clean up.

1.6 FLAMMABLE AND COMBUSTIBLE LIQUIDS

- Use fire-hazard chemicals in vented hoods and away from sources of ignition. Fire-hazard chemicals are chemicals with a flash point below 200° F (93.3° C).
- Store flammable liquids in excess of 10 gallons in approved flammable liquid storage cabinets.
- Follow proper storage procedures for flammable and combustible liquids. This includes not storing corrosives and flammables in the same cabinet.

1.7 CORROSIVE AND CONTACT-HAZARD MATERIALS

- Corrosive, allergenic, and sensitizer information is given in MSDS and on chemical container labels.
- Handling processes should be designed to minimize the potential for splash, splatter, or other likely scenarios for accidental contact. Handle corrosive chemicals and contact-hazard chemicals with all proper safety precautions according to the way they will be used. This may include wearing both safety goggles and face shield, gloves tested for absence of pinholes and known to be resistant to permeation or penetration, and a laboratory apron or laboratory coat. Additional protective clothing (i.e., apron, oversleeves) is appropriate where chemical contact with body and/or skin is foreseeable.

- Do not pour water into acid. Slowly add the acid to the water and stir.
- Open bottles or carboys slowly and carefully and wear protective equipment to guard hands, face, and body from splashes, vapors, gases and fumes.
- Use a mechanical aid or a pipette bulb for pipetting.
- Wipe drips from containers and bench tops. Be especially careful to wipe up visible residues of sodium hydroxide and potassium hydroxide from all surfaces. Skin contact with dry residue will result in burns.
- Acids/bases are to be handled in a fume hood. A fume hood in the Northwest corner of lab, behind the containment berm, is designated for acid/base use.
- Corrosives should never be stored above eye level.

1.8 PEROXIDE FORMING CHEMICALS

Peroxide forming chemicals (PFCs) are organic compounds that may form potentially explosive organic peroxides through exposure to air over time. Many of these chemicals are common solvents and care must be taken in managing these chemicals to prevent the formation of peroxides.

- All solvents should be checked to see if they belong to peroxide forming chemicals. Common peroxide forming materials include ethers, amides, alkynes and 1, 4-dioxane. Please see the attached tables for examples of peroxide forming materials.
- In this lab, we have only used 1, 4-dioxane (class-2 peroxide-forming chemicals). The following guidelines are for class 2. If other classes of PFCs are used, please contact the safety officer.
- All peroxide forming chemicals **must** be marked with the **receiving date** and **opening date**.
- Class-2 PFCs should be disposed of within 12 months of opening, and tested monthly for peroxides starting 3 months from opening if uninhibited by stabilizers (e.g. hydroquinone and BHT).
- Use in a well-ventilated area or in a fume hood.
- Proper PPE (gloves, lab coat, eyewear, long pants and closed-toed shoes) should be used when handling PFCs. Wash hands thoroughly after handling PFCs.
- Keep containers closed when not in use.
- Peroxide forming chemicals should be stored in airtight containers in a dark, cool, and dry place.
- Most PFCs are flammable organic liquids so the precautions for handling flammables applies to PFCs as well.

- If old containers of peroxide formers are found in the lab (greater than 2 years old, or if the date is unknown) do not handle the container. If there is any sign of peroxide formation, such as discoloration, cloudiness, crystal formation anywhere in or on the bottle, do not handle the container and contact EH&S immediately at x6727. Please see the Chemical Hygiene Plan for spill and accident procedures.

Class 1 PFCs		
Isopropyl ether	Potassium amide	Vinylidene chloride
Divinyl acetylene	Potassium metal	
Divinyl ether	Sodium amide	
Class 2 PFCs		
Acetaldehyde	Diethyl ether	4-Methyl-2-pentanone
Cumene	1,4-Dioxane	Tetrahydrofuran
Cyclohexene	Dimethoxyethane (glyme)	Tetrahydronaphthalene
Cyclopentene	Furan	Vinyl ethers
Diacetylene	Propyne	
Dicyclopentadiene	Methylcyclopentane	
Class 3 PFCs		
Acrylic acid	Chlorotrifluoroethylene	Vinyl acetate
Acrylonitrile	Methyl methacrylate	Vinylacetylene
Butadiene	Styrene	2-Vinylpyridine
Chlorobutadiene	Tetrafluoroethylene	
Vinyl chloride (chloroethene)	1,1-Dichloroethene	

1.9 MERCURY POROSIMETER

Mercury and mercury vapor are harmful materials – use of the porosimeter requires hands-on training for material testing, cleanup procedures, and waste disposal. Such training will occur on an individual, as-needed basis – the following list of precautions is important for all lab users but does not substitute for user familiarization with equipment and safe handling procedures

- The porosimeter, porosimeter computer, and adjacent fume hood should be treated as mercury-containing areas and avoided for all non-porosimeter related work.
- The lab phone next to the porosimeter computer is designed for emergency calls only.
- Proper PPE (gloves, lab coat, eyewear) should be used when interacting with the porosimeter, computer, or fume hood.

- A buddy is required in lab when transitioning a sample from low to high pressure chambers and when removing a sample from the high pressure chamber for disposal
- Mercury waste containers should be sealed when not in use
- Any mercury spilled on the counter tray should be wiped into the drain hole in the tray, from which it will fall into a collector and be covered by a layer of oil.
- The instrument must be unplugged before any panel is removed to avoid the hazards of high voltages which are present.
- When performing a low-pressure operation, make sure all retaining knobs are securely tightened. It is recommended that capacitance detectors be installed on all ports, used and unused. This is to prevent the possibility of the penetrometer being expelled when the system pressure is raised to as high as 50 psi.
- Should a penetrometer be broken and mercury spilled in the high pressure chamber, the glass and mercury should be removed immediately.
- The mercury supply reservoir located adjacent to the high pressure chamber is sealed by a stopper cap. The cap must always be securely in place during a test.

1.10 1600°C TUBE FURNACE & 1700°C BOX FURNACE

- To avoid electrical shock, this furnace must:
 - Be installed by a competent, qualified electrician who insures compatibility among furnace specifications, electrical source and grounding code requirements.
 - Always be disconnected from the electrical supply prior to maintenance and servicing.
- To avoid personal injury:
 - Do not stand directly in front of the open, heated chamber without wearing a heat resistant face shield, gloves, and apron. If quenching a sample is necessary, consult faculty or lab manager, use appropriate equipment such as tongs and insulation, and wear necessary PPE. Work with a buddy.
 - Do not use in the presence of flammable or combustible materials; fire or explosion may result. This device contains components which may ignite such materials.
 - Refer servicing to qualified personnel.
 - CAUTION: Hot Surface. Avoid Contact.

- To AVOID EYE DAMAGE in servicing or cleaning furnace, proper eye protection must be worn.
- To AVOID BURNS, do not stand directly in front of the chamber without wearing a heat resistant faceshield, gloves and apron.
- To AVOID FIRE, do not place combustible materials where exposed to heat from open door.

1.11 JULABO CHILLER

- Avoid skin contact to chill plate or plumbing when chiller system is active. The system is capable of reaching temperatures as low as -50°C ; skin contact can result in injuries or burns.
- Polydimethylsiloxane, PDMS, a silicone oil, is used for circulation – care should be taken to avoid leaks or spills as impacted surfaces can become slippery. Address leaks and clean spills as soon as they are detected.

1.12 COMPRESSED GAS CYLINDERS

- **For all lab personnel:**
 - Should be familiar with the gas container content and the potential hazards. They should have access to the appropriate Material Safety Data Sheet.
 - Secure cylinders at the top and bottom. Keep the cylinder capped when not in use.
 - All gas cylinders, including lecture and empty bottles, should be in an upright manner and chained.
- **For lab personnel responsible for changing out compressed gas cylinders:**
 - Wear safety glasses when handling compressed gases.
 - Do not lubricate, modify, force, or tamper with cylinder valves.
 - Always make sure that the regulator appears sound before attaching it to a cylinder.
 - Make sure that the correct regulator and CGA connector is being used. Table 1: CGA Connection Chart. If the connections do not fit together readily, the wrong regulator or a defective regulator is probably being used.
 - Use only the correct fittings and connections to ensure compatibility. Make sure that the threads on the cylinder and the connection mate, and are of a type intended for gas service.

- Attach the regulator securely with the secondary valve closed and preferably with the regulator flow backed off (counterclockwise) before opening the cylinder valve wide.
- When cylinders are no longer in use, shut the valves, relieve the pressure in the gas regulators, remove the regulators and cap the cylinders.
- Before returning empty gas containers, a check should be carried out to ensure that the container valve is closed (and not leaking) and that the valve outlet plug (or cap nut) has been securely refitted.
- Leave a small amount of contents in the cylinder to avoid contamination.
- Segregate gas cylinder storage from chemical storage.
- Keep incompatible classes of gases stored separately. Keep flammables from reactives which include oxidizers and corrosives. For example, keep cylinders containing oxygen or oxidizing gases away from flammable solvents, combustible materials, unprotected electrical connections, gas flames or other sources of ignition.
- Always label cylinders so you know their contents; do not depend on the manufacturers color code. Gas cabinets should have a clear label on the outside.
- Note the name and phone number of the supplier of the cylinder. Cylinders are generally “loaned” when they are distributed, and the empty cylinders are to be returned to the supplier once you are finished with the gas.
- If a cylinder of material has been here for more than three years, please contact the EHS Office and mark it for return to the supplier.

1.13 HAZARDOUS WASTE MANAGEMENT

- Hazardous waste containers must be completely labeled and dated when the first drop of hazardous waste goes in Use only authorized Institute Hazardous Waste Identification Tags for container labeling. See the Environment, Health, & Safety website for more information: www.safety.caltech.edu
- Waste containers must be kept closed except when adding hazardous waste
- Do not fill a waste container completely to the top. Provide room for air space
- Do not place incompatible chemicals in a waste container
- EHS must receive all hazardous waste containers within 9 months from the date of initial accumulation
- Dispose of your waste at the completion of a project. Do not abandon the waste, so that someone else must deal with it
- Call EH&S for waste pick-up

1.14 OLD, DAMAGED, OR NO LONGER USEFUL EQUIPMENT

- Review the equipment asset list for your lab at least once a year to see if you have old, damaged, or outdated equipment that require disposal.
- For proper disposal, notify the Safety Office if you believe that the equipment has been used for radiological, biological, or chemical work. The types of equipment should be decontaminated and certified prior to disposal, and the Safety Office is able to assist you with this process.
- Contact your Building Administrator if you have a large amount of e-waste for disposal, as they work with you to get this matter taken care of, or you may take it over to the Recycling Center on the first Wednesday of each month between 9:00am and 12:00pm for proper disposal.
- Try not to leave old equipment in the hallways, as these are potential fire hazards.

1.15 DRILL PRESS

- Everything must be clamped. Always remove key from the chuck before turning on the press. Let press stop on its own after turning power off; don't attempt to stop it with your hand.
- Before starting a machine, always check it for correct setup.
- Wear proper clothing while working on the press:
 - No loose clothing
 - No open-toed shoes must not be worn in machine/maintenance shops. c)
 - No jewelry must not be worn.
 - Tie back long hair.
 - Wear goggles
- Do not work in the shop if tired, in hurry, or any medication which might cause drowsiness.
- Report any damage to machine or hand tools immediately to safety officer.
- While the drill is running, keep your head and hands away from spinning bit.
- Machines must be shut off when cleaning, repairing, or oiling.
- Clean up your machine after use.
- Keep the floor around machines clean, dry, and free from trip hazards. Do not allow chips to accumulate.

1.16 EMERGENCY RESPONSE PROCEDURES

Emergencies on campus (ex: police, fire, paramedics, chemical, etc.) **CALL 5000.**

1.16.1 Fire

- Remain calm
- Alert others
- Close doors
- Evacuate to EAP (Indicate EAP here)

1.16.2 Earthquake

- Remain calm
- Drop, cover, and hold
- Evacuate when shaking stops if building damage present

1.16.3 Shelter in Place when

- A chemical or biological spill
- Severe weather
- Or an armed individual on campus

1.16.4 Biological, Chemical, and Radiological Incidents

- Attend to injured persons
- Confine the area
- Get help-notify Safety or Security
- Evacuate if necessary

1.16.5 Personal Injury

- Check the area for additional hazards
- Call **5000** and notify the supervisor
- Care:
 - Remove the injured/exposed individual from the area, unless it is unsafe to do so because of the medical condition of the victim or the potential hazard to rescuers.
 - Report the exposure to EH&S.
 - Flush contamination from eyes/skin using the nearest emergency eyewash/shower for a minimum of 15 minutes. Remove any contaminated clothing.
 - Bring to the hospital copies of MSDSs for all chemicals the victim was exposed to.