GUIDELINES FOR SAFE LABORATORY PRACTICES

in the

Department of Chemistry

Yale University

EMERGENCY TELEPHONE NUMBERS

Yale Emergency (Police & Fire): 111
Yale Health Services: 2-0123
Environmental, Health & Safety (EHS): 5-3550

Have a Chemical Spill?

Call: 8:30 A.M.-5:00 P.M. Weekdays, EHS 5-3555
All Other Times, Police 111

Physical Facility Emergencies (Hoods, Floods, Electrical, etc.)
Physical Plant : 2-6888

Routine Issues:
Chemistry Business Manager (Joanne Bentley): 2-3914

Fall 2000

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I. Introduction

The wide variety of chemicals and research equipment that may present risk to researchers and staff alike requires proper training, awareness, and vigilance. This document's principal focus is upon chemical safety. However, there is something here for everyone! There is an old saying that familiarity breeds contempt. This adage is true if one adopts a cavalier attitude toward one's local work environment. On the other hand, it is important that all researchers be informed about potential dangers outside of their own laboratory. Accidents may arise when you visit a laboratory that is out of your area of expertise. Moreover, there is the outside chance that you may find yourself called upon to aid a fellow researcher in need of medical assistance. Would you be adequately prepared?

This document was compiled with the assistance of the Yale Office of Environmental Health and Safety to address issues that have immediate relevance to the Department of Chemistry. These guidelines are intended to focus attention on the aspects of laboratory safety that are the common concern of all who work in the Chemistry Department. If a particular operation or procedure is not mentioned in this document, one may not assume that the procedure or operation is safe. Its absence may simply reflect the impossibility of anticipating all conceivable and specialized laboratory situations.

This document does not replace Yale University's Chemical Hygiene Plan (CHP). The CHP was written to comply with the Occupational Safety and Health Administration's (OSHA) laboratory health standard (Occupational Exposures to Hazardous Chemicals in Laboratories (29 CFR 1910.1450)). The CHP is the most detailed and authoritative information available to you. The CHP is available online at **http://www.yale.edu/oehs/pdfforms.htm** in PDF format or from the Office of Environmental Health & Safety (5-3550). The CHP identifies how Yale University is complying with issues of chemical safety. It is your responsibility to review and to follow the procedures outlined in this plan.

- Before a researcher (staff assistant, postdoctoral, graduate student or undergraduate) begins initial work in a laboratory, he/she is to be apprised of potential hazards (chemicals, lasers, autoclaves, etc.) associated with the particular laboratory in which he/she will work. Researchers are to be instructed by their researcher advisor on personal protective equipment that should be worn. The use of Personal Protective Equipment (PPE) is discussed in the CHP, Appendix G.

- All researchers who use chemicals and fume hoods must take the on-line Chemical Safety in the Laboratory training course. **[http://info.med.yale.edu/chemsafe/]**

- All researchers who generate hazardous waste must take the on-line Hazard Waste Disposal training course **[http://info.med.yale.edu/chemhaz/]** or attend the laboratory safety training session offered twice a month at OEHS at 135 College St.

If you have questions about safe laboratory practices, see your research advisor or a member of the departmental safety committee, call the OEHS at 5-3550 or consult web resources listed in Section II.

II. Safety Links on the Internet

Important safety-related links are available at the Chemistry Department's website **[http://www.chem.yale.edu/resources.html]** and below:

Yale Office of Environmental Health and Safety	http://www.yale.edu/oehs/
Yale University Chemical Hygiene Plan	http://www.yale.edu/oehs/pdfforms.htm
Chemical Hazardous Waste Disposal Training	http://info.med.yale.edu/chemhaz/
Chemical Safety in the Laboratory Training	http://info.med.yale.edu/chemsafe/
Chemical Hazardous Waste Disposal Rules	http://www.yale.edu/oehs/hazwaste.htm
Material Safety Data Sheets (MSDS)	http://www.yale.edu/oehs/msds.htm
Laser Safety Manual 1997	http://www.yale.edu/oehs/PDF_files/laserman.pdf
Chemical,Biological & Radioactive Spills	http://www.yale.edu/oehs/emergpr.htm
Laboratory Biosafety Level Criteria	http://www.cdc.gov/od/ohs/biosfty/bmbl4/bmbl4s3.htm
Radiation Safety Procedures Manual 1997	http://www.yale.edu/oehs/PDF_files/radman5_97.pdf

The SCL Library has safety related manuals. **Prudent Practices in the Chemical Laboratory: Handling and Disposal of Chemicals** (1995) is an excellent source.

III. Cardinal Rules of Laboratory Safety

- Be sure that your fume hood works properly; use it for all chemical operations. Use a vaneometer to check hood flow rates (acceptable rate: 100 ± 20 linear feet per minute). If you call the physical plant (2-6888), be sure you also e-mail Joanne Bentley that you have done so to assure that the work is completed.

- Never work in the laboratory alone. Make sure someone is within shouting distance.

- Always wear eye protection in the laboratory. For routine work, prescription glasses with tempered lenses or plastic glasses (available in the stockroom) are acceptable. For work under conditions of special hazard (explosion, corrosive chemicals), use a face shield. EYE PROTECTION ALSO IS REQUIRED FOR ALL VISITORS IN THE LABORATORY. For the purpose of this guideline, the "laboratory" is defined as the bench area or a supporting non-isolated instrumentation room. Contact lenses should not be worn in the laboratory. They offer little protection and, if a chemical should enter your eyes, contact lenses will hinder proper first aid.

- When working with chemicals, wear gloves that are appropriate for the material being handled. Use of especially hazardous reagents (bromine, chlorosulfonic acid, etc.) may require a rubber apron also. Protective garments are not equally effective for every hazardous chemical. Check with Yale's CHP (2.3.2.2) at **http://www.yale.edu/ oehs/pdfforms.htm.**

- Keep a clean laboratory. Clutter offers the opportunity for accidents.

- Eating, drinking, and smoking are forbidden in the laboratory (See University Policy on Eating, Drinking, and Smoking in Yale's CHP, Appendix B). Food and drink containers located in the laboratory are a presumption (OSHA) of these activities having been carried out in the laboratory. In KCL, the "Fishbowl" is normally available as a lunchroom. Smoking is forbidden within the confines of both KCL and SCL.

- Follow the prescribed procedures **(http://www.yale.edu/oehs/hazwaste.htm)** for disposal of chemical waste and for the storage of chemicals. Do what you can to reduce the chemical waste generated in the course of your research.

- Never pipette by mouth.

- Keep aisles and corridors clear. Do not store chemicals on the floor, even temporarily. Access to emergency equipment (fire extinguishers, showers, etc.) should be unobstructed.

- Know what you are doing in the laboratory. If you do not know how to go about an operation, ask someone who does.

- Become familiar with the location of fire extinguishers, spill kits, and safety blankets in your area. Familiarize yourself with their use. Spill kits are available in the stockroom.

- Do not carry chemicals in glass bottles through the hallways without using a rubber bucket or cart. The stockroom has safety carriers for sale. Large flasks (e.g., Erlenmeyer) should be moved from room to room or to and from autoclaves on carts.

- When you check out at the end of your studies in the the Chemistry Department, make sure your bench and desk are clean and that all waste chemicals are properly removed. BE SURE THAT THE CONTENTS OF ALL CONTAINERS ARE PROPERLY IDENTIFIED. Disposal of unknown materials costs are at least an order of magnitude greater than for normal disposal.

- Write (in indelible pen) the date on new chemicals that are brought into the laboratory. This procedure is particularly important for peroxide-forming compounds (e.g., diethyl ether and tetrahydrofuran (THF)).

The following sections are intended to give more details on some specific procedures. It must be re-emphasized, however, that no set of rules can substitute for common sense and a good professional attitude toward laboratory safety.

IV. Cardinal Rules of Laser Safety

The word "laser" is an acronym for the phrase "Light Amplification through Simulated Emission of Radiation." The laser is a source of extremely intense light having properties that are very different from the light emitted by more conventional sources. One should be aware of these unique characteristics and must observe the proper safety precautions before attempting to operate such devices. The energy level of a laser can be high enough to cause serious damage to the eye, with possible loss of vision if the beam were to impinge directly on the retina. Furthermore, uncontrolled laser light can cause serious flesh burns, ignite inflammable materials, and damage sensitive optical equipment. Since laser radiation is collimated and coherent, the energy in an emerging beam remains high and, therefore, dangerous even after propagating large distances from the source. The user is therefore advised to observe the following safety rules:

- The covers for the power supply and optical head always should be in place when the laser is energized. Built-in interlocks are designed to terminate laser emission if covers are removed. Under normal conditions, optical radiation only will be emitted through the output aperture – cover removal can lead to several addition sources of (uncontrolled) radiation output.
- Limit laser access to those individuals familiar with the equipment. Inexperienced and untrained personnel should observe strict safety precautions. In particular, do not wear highly reflective jewelry, watches, *etc.* when working in the vicinity of a laser source!
- Endeavor to keep all laser beams at heights far removed from normal eye level. In particular, when bending over (*e.g.*, to pick up a dropped pen or pad), it is advisable to turn away from the laser apparatus and/or close your eyes as your head passes through "beam level."
- Do not operate the laser in the presence of flammables, combustibles, explosives, or volatile substances. Do not allow the beam to impinge upon flammable or combustible materials (*e.g.*, wood, paper, paint, *etc.*).

- When the laser is on and the output beam is not being terminated in an experiment or optical system, the emitted light should be blocked. Use a laser power meter or some other non-reflecting, non-flammable object (*i.e.*, a specially-designed "beam dump").
- Always block the laser source when moving optical components into or out of the path traversed by a laser beam. In particular, do not allow reflective objects to be placed into the optical path as the scattered light can be just as dangerous as the primary beam.
- NEVER LOOK DIRECTLY INTO EITHER THE MAIN LASER BEAM OR ANY SECONDARY/STRAY BEAM. NEVER SIGHT DOWN A BEAM INTO ITS SOURCE.
- Do not expose skin to direct laser emission as its intensity can be sufficient to cause severe flesh wounds.
- When aligning a chain of optical components, it is advisable to reduce the output power of the laser to as low a level as possible, thereby minimizing the danger associated with (accidental) stray reflections or refractions.
- It is advisable to post warning signs and to limit access to the laser area whenever the laser is in operation. When initiating laser emission, be sure to inform any other individuals in the room.
- Whenever possible, wear the appropriate laser safety goggles. There are two hazards that exist when wearing such devices while operating lasers. First, the glasses make the laser beam itself invisible, thereby increasing the danger of inadvertent skin burns. Second, laser goggles may not afford sufficient protection if a very powerful laser beam is viewed directly.
- Most laser systems combine electricity with the rapid flow of cooling water. Although somewhat mundane compared to optical hazards, the dangers presented by such circumstances must not be ignored or overlooked. Indeed, the high voltages and high currents found in most lasers have the potential to cause fatal electrical shocks (see Section V-B-vi). Therefore, only experienced personnel should be allowed to delve into either power supplies or optical heads. In any event, extreme precautions should be taken when undertaking the diagnosis and/or repair of a faulty laser.

V. Laboratory Accidents

A. Chemical Spills [**http://www.yale.edu/oehs/emergpr.htm**]

A-i. General Information

Try to anticipate the types of spills that can occur in your laboratory and obtain the necessary equipment (spill kits, personal protective equipment, and disinfection materials if biological materials are present in the laboratory) to respond to a spill prior to it happening. You should only clean up minor spills of chemicals with whose clean up procedure you are familiar. An MSDS [**http://www.enviro-net.com/technical/msds/**] contains special spill clean up information and they should be consulted.

If the spill is too large, highly toxic or a reactive chemical, call for assistance immediately. The Office of Environmental Health & Safety is equipped to handle most spills that can occur at the University. If there is the slightest doubt regarding how to proceed, call for assistance. In the case of highly toxic spills, evacuate the room, and do not allow anyone to enter until assistance arrives.

Environmental Health & Safety, 5-3555 (8:30 A.M.-5:00 P.M., Weekdays)
University Police 111 or 2-4400 (All Other Times)

The following compounds are considered very hazardous. You should not clean them up yourself.

Aromatic amines	Hydrazine
Bromine	Hexamethylphosphoramide (HMPA)
Carbon disulfide	Organic Halides
Cyanides	Nitriles
Ethers and other IA flammable solvents	Nitro compounds

If biological materials and microorganisms known not to cause disease in healthy humans, are spilled, you should be prepared to clean them up.

A-ii. Minor Chemical Spills **[http://www.yale.edu/oehs/chemspil.htm]**

If you are cleaning up a small spill yourself, alert people in the immediate area of the spill and make sure that you are aware of the hazards associated with the material spilled. Have adequate ventilation (open windows, fume hoods on) and proper protective equipment (minimum: gloves, goggles, and lab coat). Neutralize and absorb inorganic acids and bases appropriately. For other chemicals, use a spill kit with vermiculite (Yale Spill Kit), dry sand, diatomaceous earth or paper towels. Consider all residual chemicals and cleanup materials (absorbent, gloves, etc.) a hazardous waste. Place the materials in sealed containers (plastic bags) and store them in a chemical fume hood. Contact Hazard Waste Pickup for disposal instructions and pickup (5-3551).

A-iii. Major Chemical Spills **[http://www.yale.edu/oehs/chemspil.htm]**

Attend to injured or contaminated personnel and remove them from exposure. Alert people in the laboratory to evacuate. If the spilled material is flammable, turn off ignition and heat sources. Place a plastic bag, if available, over the spill to minimize evaporation. Call the Chemical Spill Emergency Response number (5-3555). Close doors to the affected area. Have a person with knowledge of the incident available when the emergency team arrives. At night or on weekends, call the University Police at 111 (2-4400).

A-iv. Spills of Specific Materials

In case of a MERCURY spill use a vacuum line with an in-line trap attached to a glass pipette to pick up droplets. *Do not use a vacuum cleaner*. Cover small droplets in inaccessible areas with powdered sulfur. Place the residue in a labeled container and call the Section on Environmental Services (5-3551) for disposal information. The Office of Environmental Health & Safety (5-3550) has a vacuum specifically designed to collect mercury. Contact them if you have a mercury spill in excess of the amount found in a standard laboratory thermometer.

To cleanup ALKALI METAL spills, smother with anhydrous sodium carbonate, calcium carbonate, powdered graphite, sand, or "Met-L-X" and call for emergency assistance (5-3555).

B. Personal Contamination and Injury

B-i. Responsibility

Should a laboratory accident occur, it is the responsibility of uninjured laboratory occupants nearby to initiate first aid treatment to the victim if trained or qualified to do so, and to arrange for notification of medical personnel. For all but the most minor injuries, the victim should be transported by the Yale Police (emergency telephone 111 or 2-4400) to Yale Health Services for professional observation and treatment. BE SURE THAT YOU TELL THE

UNIVERSITY POLICE YOUR PRECISE LOCATION. KLINE CHEMISTRY HAS BEEN CONFUSED WITH KLINE TOWER AND KLINE GEOLOGY. Victims who cannot readily walk should be transported by ambulance. Until medical help comes, DO NOT LEAVE THE VICTIM UNATTENDED. Accidents should also be reported to the departmental safety officer and the Department of Chemical Safety (5-3550).

B-ii. Essential Procedures in the Case of an Accident

- If an individual is contaminated or exposed to a hazardous material in the laboratory, do what is necessary to protect his/her life and health as well as your own. Determine the nature of the hazardous material. The MSDS will contain special first aid information. [**http://www.enviro-net.com/technical/msds/**]

- Do not move an injured person unless he/she is in further danger from inhalation or further skin exposure. Keep the victim warm and recumbent.

- Provide mouth-to-mouth resuscitation at first suspicion of difficulty in breathing.

- If the person is in contact with a live electrical circuit, DO NOT TOUCH HIM/HER. Disconnect the power first by turning off circuit breakers or by dislocating the live wire with a non-conducting object.

- In the case of severe bleeding, place a pad or cloth on the cut and apply firm pressure to control the bleeding.

- Get medical attention and assistance immediately by dialing:

University Police (ambulance)	111	(2-4400)
Yale University Health Services	2-0123	
Office of Environmental Health & Safety Emergency Response	5-3555	

B-iii. Burning Clothing and Thermal Burns

If clothes are on fire, immediately deluge the victim with water under a safety shower and wrap him/her in a blanket to extinguish the fire completely. Remove the clothing contaminated with chemicals but do not remove clothing that has burned onto the skin. Immerse the burned area in very cold or ice water until pain not only is relieved but also does not return when the burned area is removed from the water. If the burn cannot be immersed, apply ice cold compresses.

When there are extensive burns, beware of shock. Keep patient quiet (with sufficient blankets to keep him/her warm, not hot). Be careful not to contaminate the burned area. Cover the burned area with sterile gauze or a sheet. DO NOT apply ointments, lotions or cleanser to the burned area. Contact Yale Police (dial: 111) and request immediate medical attention. Do not use a fire extinguisher on a person whose clothing is burning; he/she may suffocate.

B-iv. Chemical Spills on the Body

Remove the victim from contact with the chemical as promptly as possible. If clothing has been contaminated, immediately remove all contaminated clothing while the victim is under a shower. (Do not overlook shoes!)

Affected areas of the skin should be thoroughly flushed with water (at least 15 minutes) by shower or by hose as required. Do not apply neutralizing or buffering agents. During flushing, goggles should be left on the victim until his head and face have been washed.

Contact the Yale Police (dial: 111 or 2-4400) to transfer the victim to the Yale Health Services or the Emergency Room. Call the Health Service (2-0123) and the Office of Environmental Health and Safety (5-3555) so that information on the appropriate treatment can be identified and made available to the injured person when they arrive. If you have information on appropriate treatments (chemical antidotes, etc.), relay this information. Only persons trained and qualified to administer antidotes should attempt to intervene, but your advice may be helpful and welcome.

B-v. Cuts

If blood is spurting, place a pad directly on the wound and apply firm pressure, wrap the injured in a fire blanket to avoid shock, and obtain immediate medical attention. Never use a tourniquet. In the case of a less severe but still major cut, the Yale Police should be contacted for transfer of the victim to Yale Health Services. Only in the case of trivial cuts should the wound simply be washed and a bandage applied. Report all injuries to your laboratory supervisor or principal investigator.

The most frequent cause of cuts in the laboratory is the mishandling of glassware. Insertion of glass tubing into rubber or cork stoppers should be carried out only after applying a lubricating agent (glycerol) and wrapping the glass in a towel. It is important to hold the glass tubing as close to the stopper as possible to avoid excessive strain on the tubing. Care should be exercised while inserting pipettes into rubber pro-pipettes because the top of the pipette may break under pressure. A towel should be used when breaking a glass rod.

B-vi. Electrical Shock

Do not touch the victim. Disconnect the power first by turning off circuit breakers or by moving either the live wire or the victim with a nonconducting object (i.e., wood, plastic, glass, rubber). Ensure that asphyxiation does not occur and contact medical personnel (through Yale Police). If asphyxiation is suspected, begin mouth-to-mouth resuscitation immediately.

B-vii. Eye Injuries

Loose, unattached foreign matter in the eye can often be safely removed with a wet piece of clean cotton on an applicator. However, if the particle is on the cornea or is embedded in the eye, DO NOT touch it. Contact a physician or ophthalmologist at Yale Health Services (dial: 2-0123).

Splashes of chemicals in the eye or exposure of the eye to corrosive vapors require immediate treatment. Remove contact lenses if necessary and flush the eye thoroughly with water from an eye-wash fountain. Eyelids should be forcibly held apart so that the entire surface of the eye may be washed. Flushing should be continued for at least fifteen minutes. Afterwards, transfer the victim to a physician or ophthalmologist at Yale Health Services (dial: 2-0123) and inform the physician of the chemical which caused the injury. Never apply a neutralizing solution as first aid.

B-viii. Fainting

An individual who feels faint should be made to lie down or to sit quietly with their head lowered below the level of their knees until the period of faintness passes. If loss of consciousness occurs, place the victim in a reclining position, loosen any tight clothing, maintain an open airway and treat any injury that may have been sustained in the fall. Bathe the face with cool water but do not give any liquid by mouth until consciousness returns. Contact the Yale Police (111 or 2-4400) and transfer the student to Yale Health Services for observation.

B-ix. Ingestion of Chemicals

Contact the Yale Police (111 or 2-4400) and Yale Health Services (2-0123) indicating the chemical swallowed. Cover the injured person to prevent shock. Provide the ambulance crew and physician with the chemical name and other relevant information. If possible, send the container, MSDS [**http://www.enviro-net.com/technical/msds**/], or label with the victim.

B-x. Inhalation of Chemicals

Remove the victim from the contaminated atmosphere and move into the fresh air as quickly as possible. Keep the victim warm and recumbent. At the first sign of breathing difficulty, begin CPR protocols if you are CPR certified. Ensure that the Yale Police (111 or 2-4400) and Yale Health Services (2-0123) have been contacted. If possible, identify the substance to which the victim was exposed. (DO NOT ENTER THE AREA IF YOU EXPECT THAT A LIFE THREATENING CONDITION STILL EXISTS - OXYGEN DEPLETION, EXPLOSIVE VAPORS OR HIGHLY TOXIC GASES. SPECIAL EQUIPMENT WILL HAVE TO BE WORN BY THE RESCUE PARTY. CALL YALE POLICE 111 AND EVACUATE PEOPLE FROM THE AREA.)

B-xi. Special Precautions for Bromine, Hydrogen Fluoride, and Alkali Metals

[http://www.yale.edu/oehs/PDF_files/hydrofluoric_acid.pdf]

Contact with bromine, hydrogen fluoride, or hydrofluoric acid will lead to excruciatingly painful burns. Thus, an apron, gloves, and a face shield should always be worn when handling these chemicals and procedures should be carried out in the hood. In the case of bromine burns, immediately flush the area with cold water, contact Yale Health Services (2-0123), and transfer the victim. Do not use any other chemicals to neutralize bromine burns on the skin. If clothing is contaminated, it must be removed.

Investigators who work with hydrofluoric acid or hydrogen fluoride should have on hand a 2.5% calcium gluconate ointment which is available **free** from the chemistry stockroom or from Environmental Health & Safety (5-3550). In the case of contact with hydrogen fluoride, immediately remove contaminated clothing under a shower and wash all areas thoroughly. Contact the Yale Police (111 or 2-4400) and Yale Health Services (2-0123) to transfer the victim immediately. Only in the event of a delay, Gently apply 2% sodium gluconate ointment to the affected area. Repeat until medical assistance arrives.

Alkali metals (e.g., lithium, sodium, and potassium) are also extremely caustic to all tissue. Any particles of metal that fall onto the skin should be rapidly removed with a cloth, paper towel or tweezers followed by flushing of the skin with water. If any metal on the skin ignites on contact with water, immediately deluge it with cold water.

C. Accidents Involving Biological Materials

[http://www.yale.edu/oehs/bio1sp.htm]

If a spill of viable biological materials occurs you should decontaminate the area. Use protective clothing and equipment which should at least include safety glasses, rubber utility gloves, and a lab coat. Decontamination can be accomplished by using a number of disinfectants, which include bleach (1:4 dilution), 70% ethyl alcohol, Lysol, and other commercially available products.

Actions to take during a spill of viable biological materials:

- Stop work and notify others in the immediate area that a spill has occurred.
- Contain the spill to prevent spread to uncontaminated areas by placing absorbent material (paper towels) around and over the spill area.
- Pour disinfectant into the spill to double the size (if possible) of the spill.
- Soak up the spill material with absorbent materials and discard the absorbent material into a red, biohazard bag.
- After removing the spill materials, decontaminate the area again with the disinfectant.
- Wash reusable (rubber utility) gloves with the disinfectant used to decontaminate the spill.
- Discard disposable gloves.
- Wash hands thoroughly with soap and water afterward.

In the event of personal contamination:

- Remove contaminated personal protective equipment.
- For needle sticks and other puncture wounds:
  - Wash the injured area with disinfectant or antiseptic soak and warm water for 15 minutes.
  - For needle sticks, squeeze around injury to encourage the flow of blood out of the wound.
- For splashes to the face (mucous membranes of eyes, nose, and mouth). Use eyewash for 15 minutes to flush exposed area. Eyelids should be forcibly held apart so that the entire surface of the eye may be washed.
- Notify your advisor.
- Call or have someone call the University Health Services (2-0123) to alert them of the incident.
- All incidents of personal contamination with the biological materials should be reported to the Section of Occupational Health and Safety at 5-3550 and the Yale Health Services Center at 2-0123.

D. Fire and Fire Related Emergencies

If you discover a fire or fire-related emergency such as abnormal heating of material, a flammable gas leak, a flammable liquid spill, smoke, or odor of burning, immediately follow these procedures:

- Notify the Fire Department by dialing:

  Dial 111 on a University phone
  Dial 911 on a SNET phone
  Dial 119 on a Yale-New Haven Hospital phone

- Activate the building alarm (fire pull station). If not available or operational, verbally notify people in the building.

- Isolate the area by closing windows and doors; evacuate the building.

- Shut down equipment in the immediate area, if possible.

- Use a portable fire extinguisher to:

  - assist oneself to evacuate
  - assist another to evacuate
  - control a small fire, if possible

Provide the fire/police teams with the details of the problem upon their arrival. Special hazard information you might know is essential for the safety of the emergency response team.

If the fire alarms are ringing in SCL/KCL/Stockroom:

- Evacuate the building and stay out until notified to return.
- Move upwind from the building; stay clear of streets, driveways, sidewalks, and other access ways to the building.
- If you are an advisor, try to account for your students, keep them together and report any missing persons to the emergency personnel at the scene.

VI. Operational Guidelines

A. Location and Use of Emergency Equipment

It is the responsibility of anyone working in a chemical laboratory to make sure that he/she is familiar with the location and use of emergency equipment. This information can be gained from orientation sessions, members of the safety committee, or qualified personnel.

Spill kits and first-aid kits should be available in each research group. It is the responsibility of the research group to keep them stocked. Spill kits are available in the chemistry stockroom. First aid kits and some replacement items are available in the Kline Tower stockroom.

When fire extinguishers are used to any extent, contact the FIRE MARSHAL'S OFFICE (2-9923) for a replacement.

Safety Procedures for Transportation, Storage, Dispensing, and Disposal of Chemicals, Solvents, and Gases

SOLVENTS IN GLASS CONTAINERS, ACIDS, AND OTHER CHEMICALS WHICH PRESENT A POTENTIAL SAFETY HAZARD SHOULD BE TRANSPORTED THROUGH THE HALLWAYS OF SCL AND KCL ONLY ON LIPPED CARTS OR IN SAFETY CARRIERS, WHICH ARE AVAILABLE IN THE STOCKROOM. Stockroom personnel will dispense such materials only in safety carriers. Individuals should avoid using elevators while carrying chemicals.

B. Hood Operation

All chemical operations should be conducted in a fume hood. Whether you work in the Sterling Chemistry Laboratory or the Kline Chemistry Laboratory, there are several common issues that each research investigator should understand completely.

The satisfactory operation of each hood in most instances depends as much upon the work habits of an individual as the physical operation of the hood. Listed below are several issues with which you should be familiar to assure an efficient hood operation.

B-i. Adequate Air Flow

Each research laboratory should have at least one "vaneometer" for the purpose of measuring the air flow across the face of the hood. It is recommended that several readings be taken across the top and bottom of the hood. An average reading of 100 ± 20 linear feet per minute is recommended. A Kimwipe or piece of tissue taped to the hood opening is a good constant reminder that the hood is functioning. Reducing the hood opening by partially closing the hood sash will increase the hood's face velocity. The Office of Environmental Health and Safety inspects hoods once a year. If the tag on your hood is dated over a year ago, call for an inspection. If you have doubts about the performance of your hood, contact the Office of Environmental Health and Safety at 5-3550.

B-ii. Storage of Chemicals in Hoods

The proper functioning of the laboratory fume hood is dependent upon unobstructed flow through the hood cabinet. Minimize the amount of chemicals stored in the hood. Periodic housekeeping is recommended to remove unnecessary chemicals from hoods. If chemicals require storage in a hood, a communal hood is recommended.

B-iii. Proper Work Habits

Chemical activities taking place within the hood should be conducted at least 6 inches inside the face of the hood. The hood user should remain outside the hood at all times.

Persons working in the Kline Chemistry Laboratory are urged to become familiar with the operation of the air-handling system for the building. Variations in the amount of air that is brought into the building can make an appreciable difference in the safe operation of the entire hood system. Flashing hallway lights and/or difficulty opening doors to KCL indicate an insufficient air supply to the building. In the event of a power failure in KCL, all hoods must be manually restarted by resetting the hoods at the control panel located inside the sliding doors outside your laboratory. Restarting your hood could pour your hood fumes into an adjoining laboratory if the secondary hood blowers have not been restarted. Call the Control Center 2-6888 to verify, if the secondary blowers are on, or go to the roof and check the two large, secondary blowers at the center of the roof. Check nearby hoods for positive airflow.

It is also extremely important, whether you are in KCL or SCL, that you report as quickly as possible all instances that indicate the improper functioning of your hood system. You are entirely within your rights to refuse to work in premises where the hood or other equipment is not operating correctly.

C. Solvents

C-i. Solvent Dispensing

Flammable and combustible solvents in pint, quart, and gallon containers may be purchased in the stockroom and transported to research laboratories in safety carriers or on a lipped cart. Gallon containers of flammable solvents (class I-II) must be stored in safety cabinets. Solvents in 5-gallon DOT (Department of Transportation) cans and 55-gallon drums may NOT be dispensed in laboratories. Such operations must be conducted with proper grounding in the solvent storage area in the chemistry stockroom at 350 Edwards Street. Transfers should be made into 1, 2-l/2, or 5 gallon safety cans (1 and 2-1/2 gallon sized are available in the stockroom). See section VI.-D.- i below.

C-ii. Solvent Stills

The stills that are used to dry organic solvents can be a source of explosion and fire. Stills should be kept full so that the solvent level is above the heating mantle. Allowing solvent levels to get low or the still to go dry, can cause

excessive heating and explosions. This danger is particularly high for lithium aluminum hydride ($LiAlH_4$, LAH), which decomposes at 125 ^oC, a temperature readily reached by a heating mantle in a still with a low volume or by a high boiling solvent (diglyme). AVOID $LiAlH_4$.

Calcium hydride can be used to dry pyridine, toluene, and CH_2Cl_2. Sodium or potassium benzophenone ketyl are common drying agents for ether and tetrahydrofuran. The problem with CaH_2 and the metal ketyls is the danger of cleaning the stills. Stills should be cleaned on a regular basis to avoid the accumulation of reactive drying agents. The dropwise, cautious addition of isopropyl alcohol to the still pot is recommended. This procedure is best conducted at reflux to assure that the decomposition takes place under optimum conditions. Room temperature decomposition is acceptable but often the decomposition is too slow. There is a tendency to add too much alcohol too fast, which may lead to an uncontrollable reaction. Still pot decomposition should be conducted using safety glasses, a lab coat, and a shield in a hood.

C-iii. Waste Solvents and Chemicals

The disposal of waste chemicals is to be accomplished in the following manner to comply with the Federal Resource Conservation and Recovery Act (1976) **[http://www.yale.edu/oehs/ hazwaste.htm]**. Waste is collected on an as-needed basis by calling 5-3551 when materials are ready for pick-up. This service is provided free-of-charge by the Office of Environmental Health and Safety. A waste manual is available from them that details the specifics of the University's Chemical Waste Program. This manual contains guidelines and responsibility assignments which are University policy. On each date of the pick-up research groups which regularly produce substantial volumes of wastes will be visited as a matter of course; the organic and elementary undergraduate laboratories will also be checked. Other laboratories or research groups that occasionally have items to be picked up should call Office of Environmental Health and Safety Waste Line (5-3551).

EACH RESEARCH GROUP MUST HAVE A DESIGNATED AREA (SATELLITE STORAGE AREA) FOR STORING ITS ACCUMULATION OF WASTE. Each waste container must be identified properly and labeled with the appropriate sticker, noting carcinogens or cancer suspect agents when present. The packaging of waste solvents should comply with the following guidelines:

- Material should be placed into appropriate storage containers with secure tops and labeled.
- Waste solvents may be placed in the type of container in which they were purchased (glass, plastic or metal). Metal cans should not be used for aqueous solutions and corrosive agents (alkali, acid, etc.)
- Keep a log sheet of the materials placed into a waste container. The log sheet can be used to complete the required waste tag. All containers must be labelled with the Hazardous Waste tag.
- Aqueous wastes which contain heavy metal salts (Cr, Pb, etc.) or are contaminated with organic solvents are to be placed in glass or plastic containers and labeled appropriately for collection.
- Flammables (benzene, ether, ethyl acetate, acetone, hydrocarbons, and other non-halogenated combustible liquids - solvents from a rotary evaporator) are to be placed in glass, plastic or metal containers and labeled for collection.
- Halocarbons (methylene chloride, chloroform, carbon tetrachloride, contaminated flammables (e.g., from cleaning flasks with acetone)), solids, still pots, etc. are to be placed in glass, plastic or metal containers, and labeled for collection.

Uncontaminated acids and bases may be neutralized (except chromic acid, hydrofluoric acid and ammonium hydroxide) to pH 5.5 - 9.5 and flushed down the drain with copious quantities of water. If you have question regarding the neutralization procedure, call the OEHS at 5-3550.

Further information about waste disposal, including what materials can generally be discharged to the sewer or discarded as ordinary trash, is available in the Chemical Waste Manual [see also, http://www.yale.edu/oehs].

The cost for removal of unidentified wastes from the laboratory will be charged to the researcher.

D. Chemical Storage

D-i. Solvent Storage

a) *Definition of solvents by flashpoints.* Classes IA-II are characterized as flammable; Class III is called

Class	Flashpoints	Boiling Point
IA	below 73°F (23°C)	below 100° F (38°C)
IB	below 73°F (23°C)	100°F (38°C) or above
IC	73°-99°F (23°-37°C)	100°F (38°C) or above
II	100°-139°F (38°-59°C)	100°F (38°C) or above
IIIA	140°-199°F (60°-93°C)	100°F (38°C) or above
IIIB	above 200°F (93°C)	100°F (38°C) or above

b) *Some examples:*

IA: ether, petroleum ether, pentane
IB: acetone, acetonitrile, methanol, propanol, ethanol, benzene, carbon disulfide, cyclohexane, dioxane, ethyl acetate, heptane hexane, pyridine, toluene
II: acetic acid, amyl acetate, formaldehyde, dimethylformamide
IIIA: aniline, benzaldehyde, bromobenzene, cyclohexanol, formic acid, nitrobenzene, octanol
IIIB: acetophenone, castor oil, dibutyl phthalate, ethylene glycol, glycerine, dimethyl sulfoxide

c) *Maximum allowed container size:*

	Class				
Container	IA	IB	IC	II	III
	----------Flammable----------			----------Combustible	
glass or plastic	1 pt	1 qt	1 gal	1 gal	1 gal
metal (other than drum)	1 gal		5 gal	5 gal	5 gal	5 gal
safety can (spring to and flame resistor)	2 gal		5 gal	5 gal	5 gal	5 gal

d) Maximum permissible limits in an individual laboratory: (OSHA)

(1) Not more than 10 gallons of flammable liquids may be stored outside of an approved storage cabinet in laboratories except in safety cans. The collective volume of waste disposal cans is

included in the 10 gallon limit. This OSHA regulation means that it is permissible to have up to 10 gallons of flammable liquids in the usual containers found in laboratories, namely glass and metal cans. Larger amounts must be accommodated in three ways: (a) use safety cans: (b) place the excess over 10 gallons in another room; (c) use an approved flammable storage cabinet.

(2) Not more than 25 gallons of Class I and Class II liquids combined and not more than a total of 60 gallons of combustible liquids (Class III) shall be stored outside of a storage room or storage cabinet. This limit applies to storage in safety cans and other containers in a single laboratory. The 25 gallons is the 10 gallons in (1) plus 15 gallons in safety cans. The excess must be stored in flammable storage cabinet.

D-ii. General Procedures For Chemical Storage

- Do not store unsegregated chemicals in alphabetical order. Do not store incompatible chemicals close to one another (See Yale's CHP section 2.4.3.2 for list of incompatible chemicals: **http://www.yale.edu/oehs/pdfforms.htm.**)

- Separate hazardous chemicals in storage as follows:

  Solids: oxidizers/flammable solids/water reactives/all others
  Liquids: acids/bases/oxidizers/flammable & combustible/perchloric acid
  Gases: toxic/oxidizers & inert/flammable

- Containers on shelves should not extend over the edge of the shelf.

- Large bottles and bottles containing corrosives and solvents should not be stored on shelves above eye level.

- Minimize the storage of chemicals on benchtops and in hoods.

- Use a tray or basin under concentrated acids and bases.

- Large glass objects (e.g., chromatography columns) should not be stored on the sink peg board.

- A good place to store volatile hazardous chemicals is in a vented cabinet or in a vented area under a hood. Chemicals of different hazard classes can be segregated by placing them in trays.

- Volatile or unstable materials may be stored in a spark-proof refrigerator only in properly sealed containers. Never store flammable solvents (ether, benzene) in the refrigerator in open containers (beakers). **Food or drink should never be stored in a laboratory refrigerator or freezer**.

- Label all refrigerated samples with the contents, owner's name, and date of preparation. Commercially obtained samples should be dated.

- Refrigerators used to store organic materials must be "spark-proof". Commercially available units meeting this requirement are available. Note that attempts to modify standard household-type refrigerators by mounting the controls on the exterior of the cabinet will not suffice, since the compressor motor,which operates intermittently, usually cannot be kept from contact with flammable heavier-than-air vapors.

- Be careful with older bottles of materials that may form peroxides (diethyl ether, tetrahydrofuran, dioxane). Opened containers of these materials should be discarded within one year of opening. All such containers should be dated upon receipt and upon opening.

- AN UNFORGIVABLE SIN: Leaving a large unlabeled bottle of "something" behind when you depart.

E. Working With Chemicals Having Specific Hazards

Some chemicals have special hazardous properties that require special laboratory procedures and precautions. These chemicals fall into several classes and can be categorized as:

- •Flammable Solvents
- •Highly Reactive Chemicals & High Energy Oxidizers
- •Compressed Gases
- •Corrosive Chemicals
- •Chemicals of High, Acute, & Chronic Toxicity

Specific procedures to be used when working with these materials are outlined in Yale's CHP, section 3.0 **[http://www.yale.edu/oehs/pdfforms.htm]**. You should familiarize yourself with these safety procedures and follow them.

F. Special Procedures For Regulated Chemicals & Particularly Hazardous Chemicals

This section establishes supplemental work procedures to control the handling of substances that are known to exhibit unusual, acute, or long-term chronic health hazards (carcinogens, reproductive toxins, and highly, acutely toxic pressurized gases). This set of procedures applies to chemical carcinogens listed and regulated by the Department of Labor, Occupational Safety and Health Administration (OSHA), and to human carcinogens listed by the International Agency for Research on Cancer (IARC) and the National Toxicology Program (NTP). Please note that a key component of these procedures is the controlled distribution of these substances. In some instances special authorization is required before purchasing and using these substances.

The pressurized hazardous gases identified below have been classified as particularly hazardous and *require prior approval of the University Chemical Safety Committee for purchasing of new materials, or handling and storage of existing material.* [See Yale's CHP, section 1.9, Research Protocol Review, for the approval procedure. **(http://www.yale.edu/oehs/pdfforms.htm)**]

Pressurized Gases Requiring Chemical Safety Committee Review & Approval

Compound	Exempt Quantity
Arsine and gaseous derivatives	None
Chloropicrin in gas mixtures	None
Cyanogen chloride	None
Cyanogen	None
Diborane	None
Germane	None
Hexaethyltetraphosphate	None
Hydrogen cyanide	None
Hydrogen selenide	None
Nitric oxide	None
Nitrogen dioxide	None
Nitrogen Tetroxide	None
Phosgene	None
Phosphine	None

The substances listed in the table below (titled "Regulated Chemicals & Chemicals with High Chronic Toxicity Requiring Special Procedures") when stored or handled in quantities exceeding the exempt quantities must be stored and handled according to the special procedures outlined below. If it is not possible to utilize these procedures the proposed alternative procedures must be reviewed and approved by the University Chemical Safety Committee prior to initiating the research. [See Yale's CHP, section 1.9 for the approval procedure **(http://www.yale.edu/oehs/pdfforms .htm)**.] If you are using any of these substances in quantities less than the exempt amount, use the procedures outlined in Yale's CHP, section 3.5, Chemicals of High Acute or Chronic Toxicity.

Regulated Chemicals & Chemicals With High Chronic Toxicity Requiring Special Procedures

Compound	Exempt Quantity (See Note 1 Below)	OSHA Regulated Substance
N-Acetoxy-2-acetylaminofluorene	2	
2-Acetylaminofluorene	2	Y
Acrylonitrile	1	Y
Aflatoxins	2	
o-Aminoazotoluene	2	
4-Aminodiphenyl	3	Y
2-Aminofluorene	2	
Asbestos	1	Y
Arsenic and arsenic compounds	2	Y
Azathiopurine	2	
Benz[a]anthracene	2	
Benzene	1	Y
Benzidine	3	Y
Benzo[a]pyrene	2	
Bromoethyl methanesulfonate	2	
1,4-Butanediol dimethanesulfonate (myleran)	2	
Carbon tetrachloride	1	
Chlorambucil	2	
Chloroform	1	
N,N-bis(2-chloroethyl)-2-naphthylamine	2	
bis-Chloromethyl ether	3	Y
1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea	2	
Cycasin	2	
Cyclophosphamide	2	
Diazomethane	2	
Dibenz[a,h]anthracene	2	
1,2-Dibromo-3-chloropropane	1	Y
3,3'-Dichlorobenzidine (& its salts)	3	Y

Diepoxybutane	2	
4-Dimethylaminoazobenzene	2	Y
7,12-Dimethylbenz[a]anthracene	2	
3,3'-Dimethylbenzidine	2	
1,1-Dimethylethylenimine	1	
1,1-Dimethylhydrazine	2	
1,2-Dimethylhydrazine	2	
1,4-Dinitrosopiperazine	2	
p-Dioxane	1	
Ethylene dibromide	1	
Ethyleneimine	2	Y
Ethyl methanesulfonate	2	
Ethylene oxide	1	Y
Ethionine	1	
Ethylenimine	2	
2-Ethoxyethanol	2	
2-Ethoxyethylacetate	2	
Formaldehyde	1	Y
Formamide	1	
Hexavalent chromium and chromium compounds	1	
Hydrazine	2	
N-Hydroxy-2-acetylaminofluorene	2	
Lead and lead compounds	1	Y
2-Methoxyethanol	2	
2-Methoxyethylacetate	2	
3'-Methyl-4-aminoazobenzene	1	
Methyl chloromethyl ether	3	
3-Methylcholanthrene	2	
4,4'-Methylene bis(2-chloroaniline)	2	
Methylhydrazine	2	
Alkyl mercury compounds	3	
Methyl methanesulfonate	2	
1-Methyl-3-nitro-1-nitrosoguanidine	2	
alpha-Naphthylamine	2	Y
beta-Naphthylamine	3	Y
4-Nitrobiphenyl	3	Y
N-[4-(5-nitro-2-furyl)-2-thiazoyl]-formamide	2	
4-Nitroquinoline-1-oxide	2	
N-Nitrosodiethylamine	2	
N-Nitrosodimethylamine	2	Y
N-Nitrosodi-n-butylamine	2	

N-Nitrosodi-n-propylamine	2	
N-Nitroso-N-ethylurea	2	
N-Nitroso-N-ethylurethane	2	
N-Nitroso-N-methylurea	2	
N-Nitroso-N-methylurethane	2	
N-Nitrosopiperidine	2	
Polychlorinated biphenyls	2	
Procarbazine	2	
1,3-Propane sulfone	2	
beta-Propiolactone	2	Y
Propylenimine	1	
Thorium dioxide	2	
m-Toluenediamine	2	
Uracil mustard	2	
Urethane	1	
Vinyl chloride	2	Y

Note 1 - The exempt quantities are defined as:

Exempt Quantities

Number	For Laboratory Storage	For Laboratory Use
1	< 1 liter or 1000 grams	< 50 milliliters or 50 grams
2	< 0.1 liter or 100 grams	< 5 milliliters or 5 grams
3	none	none

Special Handling Procedures

Use these chemicals only in a chemical fume hood or other appropriate containment device (glove box). If a chemical fume hood is used, it should have a face velocity of at least 100 ± 20 linear feet per minute with the sash at the operating height.

Volatile chemicals should be stored in a vented storage area in an unbreakable, primary or secondary container or placed in a chemically resistant tray (to contain spills). Nonvolatile chemicals should be stored in cabinets. *Do not store these chemicals on open shelves or counters.* Access to all of these chemicals should be restricted.

Volatile chemicals should be transported between laboratories in durable rubber containers.

All procedures with these chemicals should be performed in designated areas. Other employees working in the area should be informed of the particular hazards associated with these substances and the appropriate precautions that are necessary for preventing exposures. All designated areas should be posted with a sign which reads:

WARNING
DESIGNATED AREA FOR HANDLING THE FOLLOWING
SUBSTANCES WITH HIGH, ACUTE, OR CHRONIC TOXICITY:

[list of substances - identify acute or chronic hazard]
[Example: Benzene - carcinogen]

AUTHORIZED PERSONNEL ONLY

Vacuum pumps used in procedures should be protected from contamination with scrubbers or filters. The pump exhaust should be equipped with an oil mist filter and the pump exhaust discharged to a fume hood or other dedicated exhaust line.

Analytical instruments or other laboratory equipment generating vapors and/or aerosols during their operation should be exhausted locally or vented in a chemical fume hood.

Skin surfaces that might be exposed to these substances during routine operations or foreseeable accidents should be covered with appropriate protective clothing. Gloves should be worn whenever transferring or handling these substances. When wearing washable garments (such as a laboratory coat), evaluate the potential for exposing non-laboratory personnel (and placing them at risk) during the laundering process. Wear disposable garments if others may be placed at risk during the laundering process. Consider using full body protection (disposable coveralls) if the potential for extensive personal contamination exists.

All protective equipment should be removed when leaving the designated area and decontaminated (washed) or, if disposable, placed in a plastic bag and secured.

Work surfaces on which these substances will be handled should be covered with an easily decontaminated surface (such as stainless steel) or protected from contamination with plastic trays or plastic backed paper. Materials that will be discarded should be placed in plastic bags and secured.

Chemical wastes from procedures using these substances should be placed in containers, tagged and discarded through the University's hazardous chemical waste program. The wastes should be stored in the designated area (defined above) until picked up. If it is possible to safely chemically decontaminate all toxic substances to nontoxic materials during or at the end of the procedure this should be done.

Normal laboratory work should not be conducted in a designated area until it has been decontaminated or determined to be acceptable by the principal investigator, laboratory supervisor or OEHS.

If one or more of these substances are used in large quantities, on a regular basis (three or more separate handling sessions per week), or for long periods of time (4-6 hours) a qualitative and potentially quantitative exposure assessment should be performed. Contact the Office of Evironmental Health and Safety to perform this assessment. They and the Employee Health Physician will determine if it is appropriate to establish an ongoing medical surveillance program.

Lab personnel of childbearing age should be informed of any known reproductive toxins used in the laboratory. An employee who is pregnant, or planning to become pregnant, and who is working with potential reproductive toxins that might affect the fetus, should contact the OEHS to evaluate their exposure and inform the Employee Health Physician and her personal physician of the particular substance being used as necessary. The OEHS can assess potential exposures and work with the principal investigator or laboratory supervisor, if necessary, to adjust work practices to minimize the potential risk.

G. Working with Biological Materials

[**http://www.cdc.gov/od/ohs/biosfty/bmbl4/bmbl4s3.htm**]

Biosafety Level 1 (BL1) is suitable for work involving well-characterized agents not known to cause disease consistently in healthy adult humans, and of minimal potential hazard to laboratory personnel and the environment. The laboratory is not necessarily separated from the general traffic patterns in the building. Work is generally conducted on open bench tops using standard microbiological practices. Special containment equipment or facility design is neither required nor generally used. Laboratory personnel have specific training in the procedures conducted in the laboratory and are supervised by a scientist with general training in microbiology or a related

science. The following standard and special practices, safety equipment and facilities apply to agents assigned to Biosafety Level 1:

G-i. Standard Microbiological Practices

a. Access to the laboratory is limited or restricted at the discretion of the laboratory director when experiments or work with cultures and specimens are in progress.

b. Persons wash their hands after they handle viable materials, after removing gloves, and before leaving the laboratory.

c. Eating, drinking, smoking, handling contact lenses, applying cosmetics, and storing food for human use are not permitted in the work areas. Persons who wear contact lenses in laboratories should also wear goggles or a face shield. Food is stored outside the work area in cabinets or refrigerators designated and used for this purpose only.

d. Mouth pipetting is prohibited; mechanical pipetting devices are used.

e. Policies for the safe handling of sharps are instituted.

f. All procedures are performed carefully to minimize the creation of splashes or aerosols.

g. Work surfaces are decontaminated at least once a day and after any spill of viable material.

h. All cultures, stocks, and other regulated wastes are decontaminated before disposal by an approved decontamination method such as autoclaving. Materials to be decontaminated outside of the immediate laboratory are to be placed in a durable, leakproof container and closed for transport from the laboratory. Materials to be decontaminated outside of the immediate laboratory are packaged in accordance with applicable local, state, and federal regulations before removal from the facility.

i. A biohazard sign can be posted at the entrance to the laboratory whenever infectious agents are present. The sign may include the name of the agent(s) in use and the name and phone number of the investigator.

j. An insect and rodent control program is in effect.

G-ii. Special Practices: None

G-iii. Safety Equipment (Primary Barriers)

a. Special containment devices or equipment such as a biological safety cabinet are generally not required for manipulations of agents assigned to Biosafety Level 1.

b. The wearing of laboratory coats, gowns, or uniforms is recommended to prevent contamination or soiling of street clothes.

c. Gloves should be worn if the skin on the hands is broken or if a rash is present. Alternatives to powdered latex gloves should be available.

d. Protective eyewear should be worn for conduct of procedures in which splashes of microorganisms or other hazardous materials is anticipated.

G-iv. Laboratory Facilities (Secondary Barriers)

a. Laboratories should have doors for access control.

b. Each laboratory contains a sink for handwashing.

c. The laboratory is designed so that it can be cleaned easily. Carpets and rugs in laboratories are not appropriate.

d. Bench tops are to be impervious to water and are resistant to moderate heat and the organic solvents, acids, alkalis, and chemicals used to decontaminate the work surface and equipment.

e. Laboratory furniture is capable of supporting anticipated loading and uses. Spaces between benches, cabinets, and equipment are accessible for cleaning.

f. If the laboratory has windows that open to the exterior, they are fitted with screens.

H. Use of Rotary Evaporators

All rotary evaporators employing aspirators must be cooled with circulating ice water to prevent solvents from entering the water and waste systems. Under no circumstances are organic substances or the volatile toxic materials to be flushed down drains.

Macalaster-Bicknell sells an immersible Little Giant Pump (#34726) or a more elaborate non-immersible unit (#35228), either of which will fulfill this need.

All aspirators are to be used only on faucets containing backflow preventers. These devices prohibit contamination of the city water supply.

I. Broken Glass

Broken glass must <u>not</u> be discarded in the wastebaskets or trash cans; neither the housekeeping staff nor the trash facilities are equipped to handle it. Serious accidents have occurred due to broken glassware being placed in ordinary waste paper receptacles. Dispose of glassware in cardboard boxes provided for this purpose. When the box is full, seal it with tape, and label it WASTE GLASS. Place it in the hall for removal.

VII. Safety Check List

Although the OEHS conducts periodic safety inspections of the laboratory facilities, you are strongly encouraged to perform regular-self assessments of your laboratory. The following list and check-off form are a good place to start:

1) Compressed gases securely strapped
2) Safety shower and eyewash inspection up-to-date
3) Eyewash stations flushed
4) Unobstructed access to safety showers and eyewash stations
5) Unused cup sinks stoppered or filled with mineral oil/glycerol
6) Proper use of wire or hose clamps on all water and gas connections
7) Fume hood inspection up-to-date
8) Sufficient fume hood air velocity
9) Electrical wires properly grounded and connected; no frayed wires
10) No wires on the floor
11) Belt guards on all vacuum pumps
12) Flammable solvents stored in appropriate storage cabinets
13) All chemicals properly labeled
14) All chemical waste containers capped and properly labeled
15) No food stored in chemical refrigerators
16) Unobstructed access to all fire extinguishers
17) Up-to-date fire extinguisher fire extinguisher weight and inspection tag
18) Up-to-date emergency phone numbers posted on all laboratory doors
19) Proper hazard warnings (Laser, etc.) posted on all laboratory doors
20) Copy of Chemistry Safety Manual available in laboratory
21) Occupants wearing safety equipment in labs: glasses, gloves, lab coat, etc.

VIII. Monthly Laboratory Safety Inspection List

Year:	Jan	Feb	Mar	Apr	May	Jun	Jul
1) Compressed gases securely strapped							
2) Safety shower and eyewash inspection up to date							
3) Eyewash stations flushed							
4) Unobstructed access to safety showers and eyewash stations							
5) Unused cup sinks stoppered or filled with mineral oil/glycerol							
6) Proper use of wire or hose clamps on all water and gas connections							
7) Fume hood inspection up-to-date							
8) Sufficient fume hood air veolocity							
9) Electrical wires properly grounded and connected; no frayed wires							
10) No wires on the floor							
11) Belt guards on all vacuum pumps							
12) Flammable solvents stored in appropriate storage cabinets							
13) All chemicals properly labeled							
14) All chemical waste containers capped and properly labeled							
15) No food stored in chemical refrigerators							
16) Unobstructed access to all fire extinguishers							
17) Up-to-date fire extinguisher inspection tag							
18) Up-to-date emergency phone numbers posted on all laboratory doors							
19) Proper hazard warnings (Laser, etc.) posted on all laboratory doors							
20) Copy of Chemistry Safety Manual available in laboratory							
21) Occupants wearing safety equipment in labs: glasses, gloves, etc.							

Important Phone Numbers:

Yale Emergency-- Fire and Police		111
Yale Health Services		2-0123
Environmental Health and Safety		5-3550
Physical Plant		2-6888
Chemical Spills	8:30 AM - 5:00 PM, M-F	5-3555
	All Other Times	111 (Police)

IX. Laboratory Door Emergency Sticker

The sticker below must be posted on the door of every laboratory. It should be updated once a year or more frequently as needed.

In Case of Emergency, contact:

Date _____

Room: _____

PI: _____ (office)

_____ (work phone)

_____ (home phone)

Room Occupants: (Phone only)

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

Yale Emergency-- Fire and Police	111
Yale Health Services	2-0123
Environmental Health and Safety	2-3550
Physical Plant	2-6888
Chemical Spills	
8:30 AM - 5:00 PM, M-F	5-3555
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