IMS

Safety Manual

Prepared by the
IMS Safety Committee
January 1991
(revised 1/2009)

Institute of Materials Science
University of Connecticut

TABLE OF CONTENTS

EMERGENCY INFORMATION

DIAL 911 To report a fire, an injury, or suspicious people in your area. You will be connected to a **Public Safety Dispatcher**. Be prepared to provide the type of emergency, the location of the emergency, and any other information that will assist the emergency personnel. Wait and meet the emergency team.

Red Phone Picking up the handset on a Red Phone automatically dials **911**.

Red Pull Station Pulling down the handle on a Red Pull Station will send a fire alarm to the Fire Department Dispatch center. Meet the Firemen at the front door to tell them the location of the fire.

DIAL 6-3113 **Emergency maintenance** to report a water leak, electrical outage, non-working fume hood, etc. after normal working hours. During working hours see Deb Perko in room 121 (486-2496 **deborah.perko@uconn.edu**)

DIAL 6-3613 **Environmental Health & Safety Office** for information on how to handle and/or dispose of chemical, biological, or radioactive materials. The University's chemical hygiene officer for safety is Stefan Wawzyniecki. For up to date information visit the EH&S website at: www.ehs.uconn.edu **(please bookmark this website on your computer).**

**** For chemical waste pick-up fill out the form on the following site which, when submitted, is sent on to EH&S who will come and pick up your waste:**

http://www.ehs.uconn.edu/cwc/request.php

The IMS building safety contact is Deb Perko, 486-2496 deborah.perko@uconn.edu
Contact her to schedule the safety exam. A signed access form is also needed at that time.

The Chemical Hygiene plan is located in the IMS reading room and in each lab

or **http://www.ehs.uconn.edu/chemplan.html**

The Materials Safety Data Sheets (MSDS) are located in the IMS Reading Room

or **www.msds.com**

INTRODUCTION

Your safety is my greatest concern because nothing you learn in the classroom or discover in the laboratory can compensate you for injury resulting from unsafe laboratory practice. As you learn to use new experimental techniques or deal with a variety of chemicals and equipment it is essential that you do this properly and safely. It is your responsibility to learn what possible health or safety hazards you may encounter. It is the faculty's responsibility to direct you in the prevention of accidental injury so that you will be provided with ample instructional material to this end. As Director of IMS, I recognize my personal responsibility of providing you a safe working environment.

As a member of IMS, it is important for you to know what is expected of you and what your responsibilities are with regard to safety. In addition, there are safety practices and safety equipment with which you must be thoroughly familiar with if you are to work safely here at the Institute.

Please read this safety manual carefully and keep it for future reference. It was prepared to help you follow good laboratory practice and to insure both your personal safety and that of your colleagues in IMS.

You will be required to pass a short quiz based on the safety manual to receive your access card to the building and to your laboratory. Once you have passed the quiz, you are requested to adhere to all the safety rules and practices that you have learned or risk being excluded from your laboratory. If this seems somewhat harsh, please be assured that this policy is in your best interest and is dictated both by common sense and federal regulations.

Avoiding accidents is everybody's responsibility. Please cooperate fully in making IMS laboratories safe for yourself and for others.

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Harris L. Marcus, Director

IMS LABORATORY SAFETY REPORTING POLICY

The IMS Safety Committee, in concert with the Director of IMS, established the following IMS policy with regard to the proper reporting procedures for safety violations and safety hazards.

Any unsafe practices or problems should be reported **immediately** – if it is an individual engaging in an unsafe procedure, point out the problem to that individual. If the individual persists in the unsafe practice, bring the problem to the individual's faculty advisor's attention. If there is still no resolution of the problem, please contact any member of the IMS Safety Committee (see list in this manual or posted on the Safety Bulletin Board outside room 121 and posted on each floor) or the Chairman of the IMS Safety Committee (Deb Perko, room 121).

If you are uncomfortable with reporting to their faculty advisor a continued violation of safety procedures by a colleague, please feel free to report directly to the Chairman of the Safety Committee.

The chain of responsibility for laboratory safety in IMS begins with the **individual** experimenter (graduate student, post-doc, etc.), then the **faculty** advisor or facility supervisor and ends ultimately with the **Director** of IMS.

Remember ***Safety*** is everyone's concern.

IMS SAFETY COMMITTEE
(as of September 2009)

				Term
Ground Floor	Bryan Huey	Room 158	6-3284	
	Jyothi Suri	Room 013W	6-4665	9/1/11
	Tony Tenaglier	Room 014B	6-2784	9/1/11
1st Floor	Deb Perko(Chairperson)	Room 121	6-2496	
	Maria Mejias	Room 100	6-3742	
2nd Floor	Greg Sotzing	Room 209	6-4619	
	YoungHee Chudy	Room 201	6-3582	
	Mark Dudley	Room 214	6-2256	
	Ben Colby	Room 215	6-2290	9/1/10
	Ian Berghorn	Room 218A	6-5251	9/1/10
	A J Oyer	Room 216	6-3540	9/1/11
	Donna Mamangun	Room 218A	6-5251	9/1/11
3rd Floor	Ed Kurz	Room 305B	6-4186	
	Raji Kasi	Room 302	6-4713	
	Victoria Briand	Room 308	6-5301	9/1/11
	William Kopcha	Room 312	6-3911	9/1/11
	Keegan Soncha	Room 318B	6-0916	9/1/11
	Vincent Ustach	Room 311C	6-5730	9/1/11

FIRE SAFETY AND EMERGENCY PROCEDURES

1. If you are faced with a fire emergency, the "pre-planning" you do now will prepare you to cope with it successfully. **IN CASE OF FIRE, REMEMBER, TIME IS PRECIOUS. DO NOT PANIC.** Immediate action is necessary to avoid being trapped by gases, smoke, or heat.

2. **TO REPORT A FIRE:**
   a. DIAL 911 or pull the handle on a RED PULL STATION or lift the handset on any RED PHONE.
      (Familiarize yourself with the locations of the nearest RED PHONE or RED PULL STATION).
   b. Say, "I want to report a fire."
   c. Give your name and the location of the fire. Speak slowly and distinctly.
   d. Wait to answer any questions. Don't hang up until you are sure you have been understood.

   Meet the Fire Department outside and report to the Fire Officer-in-Charge and provide the following information:
   a. Location of the incident.
   b. If anyone is trapped or injured.
   c. What happened.
   d. Chemicals involved, if known.
   e. Type of hazard: flammability, reactivity, toxicity, biological, radiological.
   f. Your recommendation on how the situation can be stabilized.

When a FIRE ALARM sounds, a FIRE ALERT situation exists.
This means a smoke/heat sensor or pull station has triggered an alarm.
All personnel must evacuate the building until such time as an all clear is given by the Fire Department.
DO NOT USE ELEVATORS.

3. **If you are conducting an experiment when an emergency evacuation occurs:**
   a. Shut down or stabilize the experiment in a safe manner.
   b. Evacuate the building.

   If the experiment cannot be shut down without creating a hazard, follow this procedure:
   a. Report to the Fire Officer-in-Charge.
   b. Describe the experiment, the location, relative hazard, and estimate the time factor before the situation becomes dangerous.
   c. If possible, you will be permitted to return to the experiment by the Fire Department.

4. Each IMS laboratory is equipped with one or more fire extinguishers of a type appropriate for the work carried on in that laboratory. If you feel a different class of extinguisher should be available for a particular reaction you are doing, call the Fire Department on their routine call number – 6-4925.

The various types of Fire Extinguishers available are as follows:

“A” – Ordinary Combustibles. Fire in paper, wood, drapes, and upholstery require an extinguisher labeled “A”.

“B” – Flammable Liquids. Fires in fuel oil, gasoline, paint, grease in a frying pan, solvents, and other flammable liquids require an extinguisher labeled “B”.

“C” – Electrical equipment. Fires started in wiring, overheated fuse boxes, conductors, and other electrical sources require an extinguishers labeled “C”.

“D” – Metals. Certain metals such as magnesium and sodium require special dry powder extinguisher labeled “D”.

Extinguishers come in dry chemical, foam, carbon dioxide, water, or halon types. Extinguishers also come in various multi-purpose combinations such as ABC to meet different types of fires.

Learn how to use your extinguisher:

a. **Pull the pin.**
b. **Aim the extinguisher nozzle** (horn or hose) at the base of the fire.
c. **Squeeze** or press the handle.
d. **Sweep from side to side** at the base of the fire. Watch for reflash. Discharge the contents of the extinguisher. Foam and water extinguishers require slightly different action. Read the instructions.

5. Certain IMS laboratories with fume hoods located near the laboratory’s exit door have been provided with fire blankets mounted at a window wall location to provide an additional margin of safety for use in exiting past a fire in such a fume hood.

FIRST AID AND EMERGENCY RESPONSE

DIAL 911 – For any medical emergency. In the event of an injury, it is most important to summon professional assistance immediately.

The following instructions are intended only as guidelines for untrained people in providing assistance to the victim during the first few minutes, until professional help arrives.

1. Effect rescue only if absolutely necessary to prevent the victim from further injury. Otherwise, **do not** move the victim or allow him/her to move until the injuries have been assessed by the Fire Department.

2. Ensure adequate breathing (give mouth-to-mouth or mouth-to-nose resuscitation if necessary).

3. Check for circulation; if absent begin Cardio-Pulmonary Resuscitation (CPR) **if you are trained to do so.**

4. Control severe bleeding by use of direct pressure.

Emergency Equipment

Know where the **eyewash station, drench safety shower,** and **laboratory first aid kit** are located in your area. Learn how to use them.

Protective Equipment

WEAR SAFETY GLASSES !! Safety glasses must be worn in every IMS laboratory at all times unless this rule is specifically waived.

1. Protective goggles fit over prescription lenses and either wrap around the face or have side panels to offer complete splash protection.
2. Face shields offer the most complete splash and impact protection of the front of the face.
3. Use a fume hood whenever vapors, gases, and dusts of toxic, flammable, corrosive, or otherwise dangerous materials are being handled.
4. Aprons, lab coats, gloves, or other protective clothing should always be available.

Emergency First Aid

Thermal Burns

1. ***Call 911***
2. Submerge the burned area in cold water (except for third-degree burns). This will significantly reduce both swelling and pain. A third-degree burn is one in which tissue damage has occurred.
3. Apply a dry sterile dressing.
4. Do not break any blisters.
5. Do not use any commercial sprays or ointments.
6. Seek medical attention.

Chemical Burns

1. ***Call 911***
2. Flush the affected area with copious amounts of water for 5 to 15 minutes.
3. If you and/or your clothing have been splashed with corrosive or toxic chemicals, use a safety shower immediately. Quickly remove all contaminated clothing. Don't be a victim of false modesty and risk severe injury.
4. Seek medical attention.

1. ***Call 911***
2. Do not handle dry ice with bare hands. Use insulated gloves.
3. Rapidly escaping gas from gas cylinders may produce rapid cooling.
4. Spilled liquid nitrogen can produce the equivalent of a third degree burn.

Chemical Eye Injury

1. ***Call 911***
2. Use the closest eye wash station and flush the eye with copious amounts of water for at least 15 minutes.
3. There is an eye wash station in the middle of the hall on every floor (e.g. outside rooms 9, 126, 216, and 316) in IMS.
4. Seek prompt medical attention.

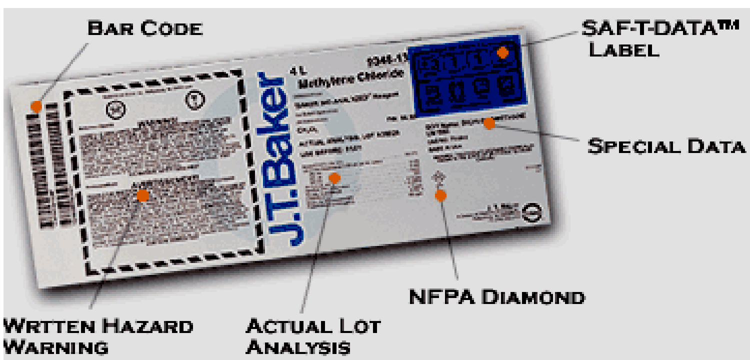
OSHA Laboratory Standard

The Occupational Safety and Health Administration expanded its regulations as of January 31, 1991 to research and academic laboratories. Unlike other OSHA chemical regulations, the lab standard is based on performance. The rules require employers to develop a "chemical hygiene plan" and to provide employee information and training. Essentially, this requires the University via the Department of Environmental Health and Safety to develop a written plan and unit safety committees (e.g. IMS Safety Committee) be established to implement the plan. The OSHA lab standard does not prescribe specific procedures that must be used to reduce exposures, but emphasized safe handling of hazardous chemicals through the practices and procedures set up by the University as described in its chemical hygiene plan. A copy of the University's Chemical Hygiene Plan can be found in the IMS Reading Room and on the EH&S web site:

www.ehs.uconn.edu/Chemical/chemplan.html

Chemical Labeling

There are two types of labels of particular importance in laboratories: the label on the commercial container and the secondary label you put on your samples, reaction products, and smaller amounts of material drawn from the commercial container. Commercial labels are usually extremely comprehensive, providing not only information on the nature, amount, and quality of the product but also a large amount of safety-related data.



However, labels placed on secondary containers by laboratory personnel are often marked only as "sample 12A". This might be sufficient if all of the material is to be used immediately, but, more often than not, it won't be. Therefore, secondary labels must meet the requirements of the Hazardous Communication Standard and **be labeled in English with the full name of the contents noting any special hazard, name of the user and the date.** All containers including squirt bottles should be labeled, even those containing harmless material like distilled water (labels are available in the IMS stockroom). The main purpose of this labeling is to protect users in the immediate area and emergency personnel in case of an accident by ensuring that the identity of the material is readily available. Additionally, superficial and uninformative labels create a major problem in the legal disposal of containers of potentially hazardous waste. This is especially a problem in the university environment where students complete their degree requirements and leave behind products and reagents of their research.

Chemical Safety Practices - General usage of chemicals

Most common chemicals used in the laboratory are "safe". However, a substance considered "safe" today might, in the future, be found to cause unsuspected long-term disorders.

1. Keep your hands and face clean. Wash thoroughly with soap and warm water <u>whenever</u> a chemical contacts your skin and also wash face, hands and arms before leaving the laboratory. It is especially important to keep chemicals from hands, face, and clothing, including shoes or other foot covering. <u>Wear shoes, not sandals</u>. If shorts are worn, they must be covered with a lab coat. Many substances are readily absorbed into your body through the skin and through inhalation. Wear appropriate gloves in the lab, (consult with permeability charts or **www.ehs.uconn.edu/Chemical/chemgloves.html**) but **not** outside the lab. Remember whatever substance is on the glove can easily be transferred to a doorknob or handrail.
2. Do not put your nose directly over a container to smell the contents; gently waft some vapors toward your nose instead.
3. Never taste a chemical. **Smoking, drinking, eating, or chewing** is forbidden in the laboratory because of the possibility of chemicals getting into the mouth or lungs through ingestion.
4. A large number of common substances are acute respiratory hazards and should not be used in a confined area in large amounts. They should be dispensed and handled only where there is adequate ventilation, preferably in a hood.
5. When bottles of chemicals are used up, they need to be vented under the hood until the odor is gone, the bottle disposed of in the bottle bin in each hallway, and the caps thrown away. Caps kept on a bottle build up pressure. Cans of chemicals are also vented under the hood, the spout is cut to eliminate anyone re-using it, and disposed of in the hallway for general trash pick up.
6. There is a definite relationship between safety performance and orderliness in the laboratory. When **housekeeping** standards fall, safety performance inevitably deteriorates. The work area should be kept clean, and chemicals and equipment should be properly labeled and stored.
   a. Spilled chemicals should be cleaned up immediately and disposed of properly.
   b. Equipment and chemicals should be stored properly; clutter should be minimized.

Chemical Reactions

Many chemical reactions involve hazards but these can be handled safely when the researcher has done some preliminary planning. Planning an experiment should include obtaining information on the reactivity, flammability, and toxicity of the chemicals <u>used in and produced by</u> the experiment. IMS maintains a **chemical properties reference library in the IMS Reading Room**. There is also an "MSDS" reference file maintained in the vertical file cabinet in the Northwest corner of the Reading Room and MSDS are also available through the website **(www.msds.com)**. Every vendor is required by law to supply a "Material Safety Data Sheet" upon request with every chemical they sell. The "MSDS" provides physical property data and toxicological information in varying degrees of depth.

Material Safety Data Sheets are designed to help you understand how to work safely with chemicals in your laboratory area. Although MSDS's may vary in appearance and length, most MSDS's will have approximately 8 to 10 sections which explain the proper ways to use, handle, and store chemicals in your work area. In addition, MSDS's provide information regarding the health hazard associated with the use of chemicals, the precautions to follow, and the emergency procedures for spills, fire and first aid. In the event of a fire occurrence, you will be asked for a copy of the MSDS by the Fire Department or EH&S. The MSDS can be a very important tool which can help you understand the dangers associated with the chemicals in your work area and, most importantly, the proper ways to protect yourself and your colleagues.

Finally, students should consult with their advisor when planning any experiment in which hazardous materials are used and/or produced.

Frequently, a laboratory procedure is carried out continuously or overnight. It is essential to plan for possible interruptions in utility services such as electricity, water, and inert gas. A frequent hazard is the failure of the cooling water supply. Be sure all hoses are securely fastened with a wire tie or clamp. In addition, commercial devices are available that monitor water flow so that its failure will automatically turn off electrical connections and the water supply. Any reaction that is left unattended for any length of time should be clearly labeled as to the nature of the reaction and its components, the possible hazards (e.g., release of poisonous vapors), the name of the experimenter, and a phone number where he/she may be reached at all times. Reactions should not be left unattended for any length of time.

Generally, **it is wise to avoid working alone in the laboratory**. However, if it is necessary, arrangements should be made with colleagues in other labs to cross check each other periodically after normal working hours. ***Extremely hazardous experiments should never be undertaken by a worker alone in a laboratory. The University of Connecticut's Laboratory Safety Committee recommends that the UConn Fire Department be notified if any lab is performing an experiment that is unattended after hours, or especially, if it is a highly reactive experiment.***

Laboratory Equipment

Eye Protection. Safety glasses should be worn at all times. Face shields or approved standing shields should be used for any operation having the potential for explosion. Know where your nearest eyewash station is located. If the lab has a separate eyewash bottle, be sure it is kept filled. Most labs have eyewashes at the sink. You should run water through them weekly to ensure they are clean and ready in the case of an emergency.

Safety Showers/Eyewash/First Aid kits. The safety showers/eyewash stations in IMS, located on the center of each floor, are tested three times a year to insure they will work properly when needed. First aid kits are located near the center building pillar and maintained by Deb Perko.

Refrigerators. Food and chemicals should never be stored together in any refrigerator. Domestic (household-type) refrigerators should never be used for the storage of volatile or unstable chemicals. Special explosion-proof refrigerators, where all internal electrical contacts have been eliminated, are the appropriate vehicle for chemical storage. Stored materials should be reviewed periodically, and old chemicals discarded.

Guards. All mechanical equipment should be adequately furnished with guards that prevent access to electrical connections or moving parts (such as the belts and pulleys of a vacuum pump).

Chemical Handling Equipment. Use gas cylinder carts whenever transporting gas cylinders from the loading dock to your lab or from lab to lab. Clamp securely any and all cylinders in the lab (see section on Compressed Gas & Cryogenic Safety). Use safety bottle carriers whenever carrying reagent chemicals from the Stockroom or from one laboratory to another.

Fume Hoods. The fume hood exists for one primary purpose: personal protection for you and your co-workers. With proper use of the fume hood, you can achieve maximum safety in your work, even with very hazardous chemicals and complex set-ups. IMS fume hoods are designed for face velocities in the range of 80-120 lfm (linear feet per minute) providing a laminar flow of air over the floor and sides of the hood. Higher face velocities (125 lfm or more) are likely to degrade hood performance by creating air turbulence at the hood face and within the hood. Such air turbulence can cause the vapors within the hood to spill out into the general laboratory atmosphere. The following list should provide some guidance in the proper operating procedures in using your fume hood:

1. When you are setting up your equipment, make sure that none **of it is blocking the vent at the rear of the hood.** A blocked vent can lower the face (capture) velocity you need at the front of the hood.

2. Never use electrical outlets inside the hood. Run all equipment cords to the outlets outside of the hood. That way, equipment can be unplugged in an emergency without creating a spark inside the hood.

3. To take advantage of the protection your hood offers during the preparation of your chemicals for the procedure, do as much of your weighing, handling, and dispensing as possible inside the hood.

4. During the reaction, keep the sash opening at a minimum so that the safety glass can act as a shield. This also improves the capture capability.

5. If you know the procedure you are planning will generate a very heavy emission of fumes, or vapors, check the capacity of the hood you plan to use. It may be safer to perform your procedure in a larger, higher capacity, hood.

6. **Don't use the hood for storage**. You could be creating a fire hazard. Use a vented chemical storage cabinet.

7. Look at the last date of the hood performance evaluation. Call Deb Perko (6-2496) if greater than one year.

Chemical Spills

A chemical spill is probably the most common type of laboratory accident and potentially one of the most serious if the material gives rise to hazardous vapors, interacts with the laboratory environment in a violent physical fashion, or is toxic or corrosive upon contact with a person's body. Most accidents involving chemical spills do not have such dramatic consequences, but all spills must be handled correctly.

1. Call the Fire Department (Dial 911) and describe the spill, the potential hazards, and possibly clean-up procedures. Immediately alert your fellow workers.
2. If a volatile, highly flammable, or a toxic material is spilled, warn everyone to immediately extinguish flames and to turn off spark-producing equipment such as brush-type motors.
3. Shut down all experiments and vacate the room.
4. If there is no fire hazard and the material is not particularly volatile or toxic, clean up is relatively straightforward:
    a. Spilled liquids may often be diluted with water, check with EH&S, and can be simply mopped up or eliminated by spreading an absorbent material such as vermiculite, dry sand, or clay absorbent on the spill. Commercial spill kits specific for spills of flammables, caustics, acids, mercury, and hydrofluoric acid are also available. (Mat pads, for low hazard chemical spills are located in the red pails in each hallway. Follow the directions on the lid).
    b. Spilled solids may simply be swept up into a container with which it will not react for disposal.
5. Spilled mercury, call 911 for Fire Department, as it should be carefully and immediately cleaned up using a vacuum line and trap or a mercury spill absorbent sponge or kit that converts the mercury to mercury sulfide. Any collected mercury should be labeled and disposed of as hazardous waste. The UConn Fire Department has a mercury vacuum available for large spills.
6. Lab debris should be evaluated prior to disposal. Custodians should not be expected to handle trash containers containing chemical materials. Check with EH&S (6-3613) to determine if a material may be discarded with the trash.

Chemical Storage

Storing chemicals is not simply a matter of putting them in an available space on the shelf. Safe storage requires planning during which the amount of chemicals and the location and conditions of storage need to be considered. Certain chemicals are incompatible with each other and, when mixed, could produce an extremely dangerous reaction. Researchers generally keep incompatible chemicals separate during experiment but many times fail to do so during storage, believing that the containers will keep the chemicals separate. An accident or emergency such as fire or broken or deteriorating containers, however, could result in mixing of incompatible chemicals that are stored next to each other, with disastrous consequences. The alphabetical method of storage, for instance, may result in hazardous conditions. Some simple suggestions are as follows:

1. Keep the amounts of chemicals stored in the laboratory to a minimum.
2. Chemicals should be dated when opened and checked periodically so that unused and outdated chemicals can be discarded.
3. Volatile chemicals should be stored where there is adequate ventilation to prevent the accumulation of dangerous concentrations of gases or vapors, preferably in a vented chemical storage cabinet.

Several shelf storage patterns are shown below. For more information refer to EH&S website: **www.ehs.uconn.edu/Chemical/chemplan.html#introduction**.

Inorganic Chemicals		Organic Chemicals	
Sulfur, Phosphorous Arsenic Phosphorous Pentoxide	Arsenates, Cynates Cyanates (store away from any water)	Alcohols, Glycols, Amines Amides, Imines, Imides (store flammables in a dedicated cabinet)	Phenols Cresols
Halides, Sulfates, Sulfites, Thiosulfates, Phosphates, Halogens, Acetates	Sulfides, Selenides Phosphides, Carbides Nitrides	Hydrocarbons, Esthers Aldehydes (Store flammables in a dedicated cabinet)	Peroxides, Azides Hydroperoxides
Amides, Nitrates(not Ammonium Nitrate), Nitrites, Azides (store away ammonium nitrate away from all other substances—ISOLATE IT!)	Borates, Chromates, Manganates, Permanganates	Ethers, Ketones, Halogenated Hydrocarbons Ethylene Oxide	Acids, Anhydrides (store certain organic acids in an acid cabinet)
Metals & Hydrides (store away from any water) (store flammable solids in a flammable cabinet)	Chloraes, Perchlorates, Chlorites, Perchloric Acid Peroxides, Hypochlorites, Hydrogen Peroxide	Epoxy Compounds Isocyanates	Miscellaneous
Hydroxides, Oxides, Silicates, Carbonates, Carbon	Miscellaneous	Sulfides, Polysulfides, etc.	Miscellaneous

Avoid using the Floor

Acids, except Nitric
(Acids are best stored in a dedicated cabinet)

Store Nitric Acid away from other acids unless your acid cabinet provides a separate compartment for Nitric Acid.

Avoid using the Floor

Alcohols, Glycols, Hydrocarbons, Esthers, Ketones, etc.
(store flammables in a dedicated cabinet)

store severe poisons in a poisons cabinet.

Hazardous Waste Disposal

In 1980, federal regulations on Hazardous Waste Management went into effect under the authority of the Resource Conservation and Recovery Act (RCRA). These regulations are designed to establish a "cradle to the grave" system for the management of hazardous wastes from all sources. All chemical laboratory work eventually produces chemical waste, and those who generate such waste have **the moral and legal obligation** to insure that the waste is handled and disposed of in ways that pose minimum potential harm, both short term and long term, to health and environment.

Waste chemicals can be handled in several ways:

1. The first method of disposal available is the collection of toxic, environmentally damaging, hazardous waste for pick-up and disposal by the Environmental Health & Safety Department. All liquid and solid wastes must be collected in labeled bottles and cans. The IMS Stockroom has 5 gallon and 10 liter high-density polyethylene cans for collection of waste materials at no cost for IMS labs.

   Liquids should be segregated into several classes, such as –

   a. Waste oils (pump oils, heating bath oils, etc.)
   b. Hydrocarbons (non-halogenated) (itemize chemicals individually by full name)
   c. Halogenated (itemize chemicals individually by full name)

2. Neutralize chemicals for which there are known neutralization methods, then dispose of them after being cleared by EH&S. Remember only modest quantities.

3. **Chemicals should not be disposed of down the drain.**

   Every container of liquid waste must have attached a "Hazardous Chemical Disposal" tag complete with generator's name, location, phone number, and the major components listed (complete chemical name- no abbreviations) with a good estimate of percentages which total to 100%. A sample tag is shown on the next page. Lab clean outs that generate a number of smaller containers of solid and liquid wastes need to use the "Laboratory Clean Out Form" listing the materials to be disposed of as hazardous waste. This form is located on the safety table in front of room 121 along with all the necessary tags and labels. For chemical waste pick-up fill out the form on the following site which, when submitted, is sent on to EH&S who will come and pick up your waste:

   www.ehs.uconn.edu/Chemical/Chemwaste%20pickup.htm

If you feel you have an extremely hazardous or toxic chemical you want picked up immediately, or if you have any questions on hazardous waste disposal, please call EH&S at 6-3613.

Disposal of Sharps and Glass Syringes

Disposable sharps (needles, scalpels, razor blades, etc.) are to be collected in approved sharps containers. These are available at no cost in the IMS Stockroom, for IMS labs. For larger containers, visit the EH&S Biological website. When full, fill out the Biological Waste pick-up form for EH&S who will pickup and dispose of your sharps. The form is located at:

http://www.ehs.uconn.edu/bwc/request.php

Do Not Date Until Pick Up Has Been Arranged

Refer to instructions on Reverse

HAZARDOUS WASTE

Federal Law Prohibits Improper Disposal

CONTENTS

– Use Full Chemical Names
– No Formulas or Abbreviations

1. Toluene % 20
2. Acetone % 40
3. methanol % 10
4. benzene % 10
5. Xylene % 20

Total Volume/Mass 100

Building E. V. Gant Rm. 121

Date 2/25/03 Phone 6-2496

Dept. Institute of materials Science

Name (Print) Deb Perko

Signature Deb Perko

Hazards:
- [x] Ignitable
- [ ] Reactive
- [ ] Toxic
- [ ] Corrosive
- [x] Other benzene = carcinogen skin irritant

ID No. 47251

Special Access IMS Laboratories

Foundry

The IMS Casting Facility, room 15, exists for the fabrication of alloys (arc melting, vacuum induction melting, and casting), welding and heat treatment. Certain precautions are necessary when making use of the above facilities and access is gained via the facility supervisor – Hal Brody.

X-Ray Laboratories

IMS has a state-of-the-art x-ray facility used mainly for x-ray diffraction research. Because of the potential radiation hazard from the primary beam, x-ray scattering, or leakage, access to these laboratories are permitted only after discussion and testing with the facility supervisor – Dr. Jack Gromek.

RADIATION AND LASER SAFETY

Ionizing radiation from radioactive materials or devices and light radiation from lasers can be potentially hazardous unless used with strict adherence to safety rules and procedures. The safety rules which govern all uses of ionizing radiation are concerned with minimizing exposure to levels far below those which might cause any adverse somatic or genetic effects. The regulations regarding users are primarily set to preventing inadvertent eye exposure to the laser beams.

Environmental Health & Safety Department – Radiation Safety Office

The Radiation Safety office requires a usage permit for any use of radioactive materials, radiation devices or class 3A and 4 lasers. Before ordering any radiation producing materials or using any ionizing radiation producing devices, you should contact the University's Radiation Safety Office at 6-3613. Laser users should also contact the Radiation Safety Office prior to the installation of a laser.

Individual User Responsibility

Each individual who is a user of radioactive materials, or radiation producing equipment, is responsible for:

1. Following the safety protocols and procedures for the particular use.
2. Keeping his/her exposure to radiation as low as possible, and below the maximum permissible exposure levels.
3. Wearing the prescribed monitoring equipment such as film badges, wrist badges, and pocket dosimeters in radiation areas.
4. Performing appropriate radiation surveys during and after working with a radiation source.
5. Keeping radiation exposures as low as reasonably achievable by:

    a. Utilizing time, distance, and shielding protection factors for all sources.
    b. Following established protocols and safety procedures.
    c. Using appropriate protective clothing
    d. Labeling radiation sources and areas where sources are used.
    e. Reporting radiation incidents such as uncontrolled contamination or injury involving radioactive materials to the Principle Investigator and the Radiation Safety Officer.
    f. Properly securing radiation sources when not in use.

Radioactive Waste

Every person is responsible for the safe handling and disposal of his/her radioactive waste products.

There are several types of radioactive waste so individuals should contact the Radiation Safety Office 6-3613 to determine proper disposal method for each.

Radiation Generating Equipment

IMS has several laboratories using ionizing radiation generating equipment, e.g. the X-ray facilities, and the electron microscopy laboratories. These laboratories all have a technical supervisor who will instruct a new user in the correct safety procedures to be followed. With the exception of electron microscopy, each user of such equipment must complete appropriate radiation safety training as prescribed by the Radiation Safety Office.

In addition, IMS has a number of laboratories that are conducting research using lasers (**l**ight **a**mplification by **s**timulated **e**mission of **r**adiation). These laboratories are generally not under the control of a technician and, therefore, it is extremely important for individuals to acquaint themselves with the hazards associated with the particular laser they will be using.

They key points to laser safety involve the optical hazards of laser beams. The power coming out of a laser is measured in watts, but it is the watts per unit area that are important. This can be illustrated by the fact that on a sunny day the watts that hit the palm of your hand may feel very nice, but use a magnifying glass to focus the same amount of watts on your palm and you will understand the difference between watts and watts per square centimeter. Laser beams have very small divergence angles, which means that the intensity is confined in a very narrow cone. You can quickly walk into a beam that you don't know is there until it hits you in the eye. The actual damage to your eye depends on what the wavelength of the light is. There are lasers that operate all the way from the far infrared into the ultraviolet. Far infrared light, (light between 1.4 and a thousand microns) is absorbed by the cornea of your eye. It doesn't actually penetrate through the eye and hit your retina. You will have some damage to the cornea. Also short ultraviolet with wavelengths between 100 and 350 nanometers, which is the visible, and in the near infrared out to 1.4 microns, passes through the lens and is focused on the back of the retina. This is the most dangerous case of all because you get high intensity on the back of your eye.

LASER SAFETY

Laser Safety

The University of Connecticut has in place a Laser Safety Program necessitating various training, medical (eye examinations), and operational requirements intended to ensure the safe use and operation of Class III and IV lasers. The laser information included in this safety guide is not intended to supplant the requirements of the University Laser Safety Program but to provide a brief overview of lasers and their associated potential harmful effects. **It is required for research personnel to contact the Environmental Health & Safety Department 6-3613 prior to the acquisition and/or initial use of Class III and IV lasers at the University of Connecticut**.

Laser Classifications

In order to assess the risks from any particular laser, a set of laser classifications has been established by the Bureau of Radiological Health. There are four different classes of lasers and the higher the class, the more dangerous the laser.

Class I Laser – A Class I laser is incapable of admitting any kind of hazardous laser radiation for any viewing or normal operating conditions. Such a laser typically would be a continuous wave (CW) laser in the visible range putting out 0.5 microwatts.

Class II Laser – A Class II laser has sufficient power to produce retinal injury after extended exposure periods, but not enough to cause accidental injury. An example of a Class II laser is a CW visible laser with an output of less than a milliwatt. A 0.5 milliwatt helium-neon laser will fall into this category. If you stare at it for a long time, you can damage your retina.

Class III Laser – Class III lasers have two categories. A IIIA laser can cause retinal damage if you stare at it long enough; you will not receive damage to your eye from short-term accidental exposure. A class IIIB laser is more dangerous. You can have some redness and temporary soreness in your eye. Any helium neon laser with an output over 1 milliwatt is a Class IIIB laser.

Class IV Laser – Class IV lasers produce hazardous direct, diffuse, or specularly reflected beams. Not only are they dangerous when the beam is reflected off of a shiny piece of metal or mirror, but also when a beam is diffusely scattered. These lasers also have potential fire and skin burn hazards. Five watt and above CW argon, krypton, and dye lasers are examples of Class IV lasers. You can receive accidental retinal damage from this type of laser.

Laser Safety Protection Measures

The primary means of protection is to physically prevent exposure. **Baffles** may be used to physically intercept or terminate the primary beam and any reflected or secondary beams. Entrance to a laser facility by unauthorized personnel or unexpected entry should be prevented by **safety interlocks** while the laser is in operation. A warning light should be placed at the entrance. Protective **eyewear** appropriate to the laser system in use should be worn if there is any eye hazard. The filters in the protective goggles should be matched to the wavelength of the laser's emissions. Since some lasers emit radiation at more than one wavelength, it may be necessary to have filters covering each range of frequencies. It would be desirable to have the filters in the protective eyewear attenuate only narrow wavelength regions spanning those emitted by the laser while allowing adequate visible light through so that normal vision is not impaired.

COMPRESSED GAS & CRYOGENIC SAFETY

Compressed Gas Cylinders

Compressed gasses have a multitude of uses in research laboratories. Understanding the properties of the gas as well as the proper handling of the equipment is important in creating a safe laboratory environment. Nearly all accidents involving compressed gases are a result of not following established methods for safe handling and proper use of these products. A standard cylinder is approximately 152 cm (60 in) tall, 23 cm (9 in) in diameter, and can be as much as 80 kg (175 lbs.), and the cylinders can contain up to 2200 psi of pressure. Should the valve connection on top of the cylinder be broken off, the cylinder would correspond to a rocket capable of punching a hole through most laboratory walls and would represent a major danger to all occupants in an area where such an incident occurred. The contents of cylinders also frequently represent inherent hazards. These pressure-independent hazards associated with the contents include flammability, toxicity, corrosiveness, excessive reactivity, and potential asphyxiation if the volume of air displaced by the contents of a cylinder is sufficient. Obviously, measures need to be taken to insure that the integrity of the cylinder is totally maintained. Compressed gas cylinders can be used safely if due care is taken with them and the accessories and systems with which they may be combined. Some simple gas cylinders safety rules are:

1. Cylinder caps should always be on a cylinder while in storage and at any time it is being moved.

2. When moving gas cylinders, they should be strapped to a properly designed wheeled cart to insure stability.

3. Compressed gas cylinders of all sizes must be supported by straps, chains, or a suitable stand to prevent them from falling over at all times. Never store or leave cylinders near a source of heat. Cylinders should be stored in an upright position (i.e. with the valve stem up), keep flammable and oxidizers separate.

4. Never attempt to repair, alter, or change cylinder valves. Wrenches should not be used on valves equipped with a hand wheel. Damaged valves should be immediately reported to Nancy Kellerann in purchasing (room 120) for a replacement cylinder.

5. Storage of cylinders in a laboratory at a given time should be restricted to those in actual use or attached to a system ready for use. If this is not feasible, the actual number of cylinders present should be maintained at an absolute minimum.

6. Promptly remove the regulator from empty cylinders and replace the protective cap at once; mark the cylinder "MT" in large letters (on the tag) and remove to the loading dock. This will avoid demurrage (storage) costs and storage hazards.

7. Be sure to use the appropriate regulator on each cylinder. Adaptors or home-made modifications are prohibited.

8. Always use a trap to prevent back-siphonage of chemicals into the cylinder.

9. Never bleed a cylinder completely. Maintain a slight pressure to keep contaminants out.

Cryogenic Safety

Cryogenic materials are characterized by extreme low temperatures, such as dry ice (solidified carbon dioxide-boiling point- 78.5 degrees C) and liquid nitrogen (boiling point- 192.8 degrees C). Cryogenic materials such as these are commonly used as cooling baths for apparatus and experimental samples thus special safety precautions should be observed.

1. Avoid contact with the skin as these cryogenics will cause severe burns and possible frost bite.

2. Use gloves and eye protection when handling cryogenics.

3. When cooling a warm object, pour the liquid or immerse the warm object into the liquid slowly to avoid splashing caused by vigorous boiling.

4. Use only approved metal/glass dewars to transport cryogenics. Note: glass dewars should have a secondary containment jacket to safeguard them in the event of implosion.

5. Dewars should be equipped with a loosely fitted cap to prevent spillage during transports and prevent pressure build up. Note: If liquid nitrogen ever has a blue tint then the liquid should be replaced immediately. The blue tint indicates liquid oxygen and it is potentially explosive, it should be treated as a hazard.

ELECTRICAL SAFETY

The hazards associated with the use of electricity include electrical shock, electrical are flash/blast as well as fires caused by shorts and overloaded circuits or wiring. In addition, sparks from electrical equipment can serve as an ignition source for flammable or explosive vapors or combustible materials. Most incidents are a result of unsafe work practices, improper equipment use, and faulty equipment. Adherence to the following rules and procedures can significantly reduce the electrical hazards one might encounter in the laboratory and ensure compliance with OSHA regulations:

1. Know the location of electrical panels and disconnect switches in or near the laboratory so that power can be quickly shut down in the event of a fire or electrical accident. To enhance safety, post the location of the electrical panel on the equipment it services.

2. Never obstruct electrical panels and disconnect switches. These should be clearly labeled to indicate what equipment or power source they control. **The National Electric code requires a minimum 3-foot clearance must be maintained around electrical panels at all times to permit ready and safe operation and maintenance of such equipment.**

3. **Do not overload circuits or wiring.** Overloading can lead to overheated wires and arcing, which can cause fires and electrical injuries.

4. Inspect all electrical equipment (hot plates, heaters, stirrers, ovens, extension cords, etc.) before you use them to ensure that cords and plugs are in good condition – not worn, twisted, frayed, abraded, corroded, or with exposed wires or missing ground pins. Live parts must be effectively insulated or physically guarded. Equipment with damaged or defective cords or plugs should be taken out of service immediately and repaired by qualified personnel.

5. Ensure that all electrical outlets have a grounding connection requiring a three-pronged plug. All electrical equipment should have three-pronged, grounded plugs or be double insulated.

6. Electrical outlets, wiring, and other electrical equipment integral to the building may only be serviced and repaired by Facilities Operations, qualified trades personnel, or other qualified electricians. See Deb Perko (room 121) for assistance.

7. Work on electrical equipment must be done only after the power has been disconnected. On cord and plug connected equipment, the power cord must be unplugged and under the exclusive control of the person performing the work so that the equipment cannot be accidentally turned on by someone else. On hard-wired equipment, the main disconnect device or circuit breaker must be shut off and locked and tagged with a special padlock and tag. **Service and/or repair work on hard-wired equipment may only be carried out by authorized individuals who have received Lockout/Tagout training** (available through the University Department of Environmental Health and Safety).

8. Limit the use of extension cords – they are for **temporary, short-term use only**. In all other cases, request the installation of a new electrical outlet. Do not use extension cords as a substitution for fixed receptacle outlets. **Long-term use of extension cords is a violation of OSHA regulations.** The long-term use of multi-outlet power strips is also illegal, except for use with computer equipment. Do not use more than one multiplex outlet plugged into a single wall outlet.

9. Ensure that all extension cords used are carefully placed, visible, and not subject to damage. Cords must not run through doors, walls or partitions, under rugs, or above dropped ceilings. They must not be tied in knots, draped overhead, or attached to walls.

10. **Ensure that the wire size of an extension cord is adequate for the current to be carried**. Failure to do so can lead to electrical fires. Cords used for 110-120 volt service should be UL listed with a polarized three prong plug. Extension cords must never be linked together – use the proper length extension cord needed for the application.

11. Keep corrosive chemicals and organic solvents away from electrical cords – these can easily erode the insulation on wires.

12. Keep flammable materials away from electrical equipment.

13. Keep electrical equipment away from wet or damp locations or potential water spillage, unless specifically rated for use under such conditions.

14. Never handle electrical equipment when hands, feet or body are wet or perspiring or when standing on a wet floor.

15. **In the event of an electrical fire, leave the area, call 911, and pull the nearest fire alarm.** Do not use water on an electrical fire. The appropriate fire extinguisher is labeled "C" or "ABC". If safe, and possible, shut down the main power source.

16. In an electrical emergency, if a person received an electrical shock, do not touch the equipment, cord or person. **Call 911 so that the Fire Department can treat the injured person and evaluate the situation.** If safe, and possible, shut down the main power source.

For more information go to the UConn EH&S Electrical Safety Policy:

www.ehs.uconn.edu/occupational/?P=PPP

LABORATORY SAFETY INSPECTIONS

An important part of the IMS safety program is the monthly laboratory inspection conducted by members of the IMS Safety Committee. The purpose of these inspections is not to find fault but to point out possible hazards being overlooked in a laboratory and maintain a high degree of safety awareness. A copy of a typical laboratory safety inspection is shown below:

IMS LABORATORY INSPECTION SHEET

Floor: ______ **Room** _____ **1st P.I.**_________________ **2nd P.I. or Lab Manager:** ____________________

Y	N	N/A	Rate 1 - 5 (low to high)	Rate
			Assigned waste disposal area?	
			Sharps container available?	
			Safety glasses available?	
			Heating/AC units clear of debris above and below?	
			Floors dry and bench tops (including hoods) reasonably organized and clean?	
			Containers, including non-hazardous chemicals and wastes, legibly labeled with the full chemical name.	
			Chemical and waste containers closed except during use (no funnels)	
			Fume hood sashes closed as far as possible to contain spills while still maintaining adequate ventilation rates? (note below if hood not operating)	
			Gas cylinders secured and stored away from heat sources?	
			Area around electrical panel clear?	
			Extension cords and power strips not daisy chained?	
			Current chemical inventory and MSDS sheets available for lab use?	
			Exits cleared of obstructions and accessible?	
			Emergency contact numbers *in the window facing hallway* current? (narrow card)	
			Emergency contact information *on the back of the door* current? (rectangular card)	

Notes: ______________________________

Faculty response: ______________________________

____
(Faculty/Manager Signature and Date)

______________________ (Inspector's initials & Date)

______________________ Deb Perko, IMS Safety Chairperson

______________________ (Overall Lab Grade)

CHAPTER OF THE IMS SAFETY COMMITTEE

1. There shall be a Safety Committee composed of IMS faculty, staff, and students.

2. The Committee shall assist the IMS staff in establishing safe laboratory practices and will conduct periodic inspections of the various IMS facilities for the purpose of uncovering unsafe practices and increasing general awareness of the importance of laboratory safety.

3. In the course of regular laboratory inspections the Committee shall issue reports of said inspections to the facility supervisors and to the Director's office. Within two weeks of the issuance of such a report the facility supervisor or other responsible person shall respond to the Committee concerning each unsafe practice by:
    a. Indicating in writing that the practice has been corrected, or
    b. Meeting with one or more Committee members to discuss the offending practice and to arrive at a mutually acceptable course of action. Record will be made of such agreement.

   When feasible, the Committee itself may initiate corrective action.

4. In addition to regular inspections the Committee may make spot inspections by random selection or at the request of concerned persons. Such inspections may be subject to report.

5. In the event that a facility supervisor fails to respond appropriately to findings by the Committee of unsafe practices, the matter shall be brought specifically to the Director's attention. Noteworthy positive actions will also be brought to the Director's attention. To ensure the safety of IMS staff and other persons frequenting the IMS facility, the Director can –
    a. Close an unsafe facility until the offending situation is corrected, or
    b. Bar specific individuals from the use of IMS facilities.

6. In the course of identifying safe as well as unsafe practices, the Committee will assemble a Manual of Laboratory Safety identifying both general and specific practices. This Manual will be updated from time to time, and will be a required furnishing of each laboratory. All IMS faculty, staff and students will be expected to be familiar with its contents.

7. It is recognized that the Committee is not expert in all manners of laboratory practice. For this reason it shall endeavor to be guided in its judgment by what seems to be prudent practice. Clearly, the Committee cannot define a precise midpoint separating safe from unsafe. Thus, a judgment that an unsafe condition exists may be qualititative in nature; however, in the absence of an irrefutable rebuttal such judgment will constitute IMS policy.

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Submitted and edited by: Deb Perko, Executive Assistant, IMS Safety Chairperson

INSTITUTE OF MATERIALS SCIENCE

The Institute of Materials Science (IMS) was established at the University of Connecticut in 1966 in order to promote academic research programs in materials science. To provide requisite research laboratories and equipment, the State of Connecticut has provided $6,000,000, which has been augmented by over $7,500,000 in federal grants. To operate the Institute, the State Legislature appropriates over $1,200,000 annually for faculty and staff salaries, supplies and commodities, and supporting facilities such as an electronics shop, instrument shop, a reading room, etc. This core funding has enabled IMS to attract over $5,500,000 annually in direct grants from federal agencies and industrial sponsors.

IMS fosters interdisciplinary research programs in various areas of materials science with special emphasis on adhesion, composites, corrosion, electrical insulation, interfaces, liquid crystals, metals, and polymers. These programs are directed toward training graduate students while advancing the frontiers of knowledge and meeting current and long-range needs of our state and our nation.