University of Toronto

Department of
Materials Science & Engineering

Occupational Health and Safety Manual

Prepared by
Occupational Health and Safety Committee

2013-2014
September 3, 2013

Emergency Telephone Numbers

Campus Fire Department	82222
Campus Police Department	82222
Campus Ambulance	82222
City Emergency	(9)911
Poison Control Information	(9)598-5900
Toronto General Hospital	(9)595-3948
Mount Sinai Hospital	(9)596-4200
Office of Environmental Health and Safety	84467
Fire Prevention Office	85151
Hazardous Chemical Control	87000
Radiation Protection Office	82374
Health Services	88030
Physical Plant Maintenance	83000
Caretaking	86252

Key MSE Information

Occupational Health and Safety Committee

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Fire Wardens

Pratt Building	S. Boccia	Basement
Walberg Building	D. Grozea	Basement
Mining Building	M. Barati	2nd Floor

First Aid Personnel and First Aid Kits

S. Boccia	WB165
J. Prentice	WB140
M. Barati	MB 220C

Location of Eyewash Stations

Pratt Building	Corridors 80K, 162K, 176K, Graduate Lab. 166A
Wallberg Building	Undergraduate Labs 44, 45, 49, 50, 51, 52
Mining Building	Rms. 220, 225

Fire Extinguishers are located inside each lab close to the doorway.

Chemical Disposal is in WB 50 and is supervised by D.Grozea (WB48)

∗ Official labels must be used.

PREFACE

The vast majority of laboratory accidents do not result from ignorance of present or potential dangers. They occur as a result of a **diminished awareness** of well-known dangers i.e. a lack of respect for hazards within a very familiar environment. This is especially true when laboratory operations have proceeded smoothly for long periods without accidents and the perceived need for caution becomes increasingly remote.

The purpose of this manual is to play a part in sensitizing the reader to the importance of a constant recognition of the hazards that exist in the laboratory in an attempt at **raising consciousness** regarding safety. It also addresses, to a lesser extent, **proper responses** to certain accidents and injuries when they do occur.

This manual is certainly not intended, as an exhaustive or all-inclusive treatment of the subjects of laboratory safety or first-aid. It however does review a wide variety of laboratory dangers in order to refresh memories, focus attention and promote alertness. It is hoped that, in so doing, the ultimate result will be **PREVENTION**.

IMPORTANT NOTE: This manual outlines some general safety precautions to be taken when working in the various laboratories in the Materials Science Dept. at U of T and is based on standard laboratory practices.

Specific Health and Safety procedures related to specific laboratories in the Materials Science Dept. are the direct responsibility of the Supervisor(s) and/or principal investigator(s) of that lab, as outlined in the Occupational Health and Safety Act.

MSE SAFETY INFORMATION

Students are required to wear lab coats/coveralls and safety glasses during lab work.

These may be purchased from Chemical Engineering Stores – Rm WB16 or Medical Sciences – Materials Distribution Centre – Rm 1234 (Lab coats only).

Lab coats cannot be taken home to wash. A cleaner has been sourced via Chemistry Department – Modern Laundry, tel. 416 923 8231.

MSE OHS Committee

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Introduction

Safety in the laboratory requires the same kind of continuing attention and effort that is given to research and teaching. The use of new and/or different techniques, chemicals, and equipment requires careful preparation. Reading, instruction, and supervision may be required, possibly in consultation with other people who have special knowledge or experience. Each individual who works in a laboratory has a responsibility to learn the health and safety hazards associated with the materials to be used or produced, and with the equipment to be employed.

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 if you are to work safely in the laboratory. It is advisable that those to whom this manual is issued should study it as a whole and have a working knowledge of its contents.

1.0 General Laboratory Practices

Safe practice requires an open attitude and a knowledgeable awareness of potential hazards. Safety is a collective responsibility and requires the full co-operation of everyone in the laboratory. This co-operation means that each student and supervisor must observe safety precautions and procedures and should:

(a) Follow instructions carefully.

(b) Become thoroughly aquatinted with the location and use of safety facilities such as fire extinguishers, showers, exits, and eye wash fountains.

(c) Ensure that necessary safety equipment is readily available and in usable condition. Passages between pieces of equipment should be free from obstructions and access to switches, fire extinguishers and other emergency equipment should not be impeded.

(d) Become familiar with safety procedures precautions and emergency procedures before undertaking any laboratory work.

(e) Become familiar with the experimental operations and all potential hazards involved before beginning an experiment. This includes a complete review of the potential hazards of the chemicals, including both the precautions on the labels and on the material safety data sheets. In addition, attention should be paid to potentially hazardous reactions noted by the supervisor.

Many accidents have resulted from an indifferent attitude, failure to use common-sense, or failure to follow instructions. Be aware of what your neighbours are doing because you may be a victim of their mistakes. Do not hesitate to comment to a neighbour engaging in an unsafe practice or operations. If necessary, consult your supervisor or the supervisor responsible for safety in the specific laboratory.

Unauthorized experiments and horseplay cannot be tolerated. Certain variations in experimental procedure, including changes in quantities or reagents, may be dangerous. Do not run in the laboratory. Do not push. Anticipate sudden backing up or change in direction from others. If you stumble or fall while carrying glassware or chemicals, try to project away from yourself and others. Use a carrying container, such as a regular carrier or a box, for chemicals and apparatus in transit. This will shield them from shock during any disruption of movement. Stairs must be negotiated carefully. Elevators, unless specifically indicated and so designated, should not be used for carrying chemicals.

It is advisable to remove jewelry such as rings, bracelets, and watches from wrists and hands to prevent chemical seepage underneath them, contact with electrical sources, and catching on laboratory equipment.

Regular inspections of correct laboratory practice, storage of chemicals, electrical hazards etc. will be conducted by appointees of the Safety Committee. A Laboratory Safety and Housekeeping Inspection Report (Appendix 1) will be issued for each laboratory to the supervisor responsible for safety outlining any deficiencies. All deficiencies must be corrected. A list of safety supervisors and room allocations is given in Appendix 2.

1.1. Eye Protection

It is advisable that students, instructors, and visitors wear eye protection at all times anywhere in the laboratory, even when not performing an experiment. Eye protection involving glasses, goggles, or face shields should be approved by the department before use. If glasses or goggles are stored in the laboratory, they should be put into use as promptly as possible at the beginning of the session and then cleaned, dried, and put away immediately before leaving.

The level of eye protection required depends on many circumstances. For most laboratory work, safety glasses with clear side shields are adequate provided suitable safety showers or eyewash stations are close at hand. When there is danger of chemical splashing or flying particles, goggles are mandatory. In addition, face shields of good rigidity and strength that protect the neck and approved standing shields in combination with glasses or goggles should be available and are recommended for vacuum work or where there is a potential for mild explosions. Face shields alone are not considered adequate eye protection and must be used in conjunction with other eye protection. Use of contact lenses in the laboratory is forbidden unless goggles are worn in the laboratory at all times.

Special eye protection is needed for welding, brazing and laser applications. Laser goggles should be matched to the operating wavelength of the laser. In welding applications, your skin must also be protected from radiation from the arc.

1.2 Ear Protection

Temporary exposure to high noise levels will produce a temporary hearing loss. Long term exposure to high levels produces permanent hearing loss. There appears to be no hearing hazard to noise exposure below 80 dB. Exposures above 130 dB are hazardous and should be avoided. Ear muffs offer the highest noise attenuation and are preferred for levels above 95 dB.

Ear plugs are more comfortable and are suitable for nose levels of 80-95 dB. If you suspect that a hearing hazard exists, notify the Office of Environmental Health and Safety and obtain sound level measurements.

1.3 General Practice

Laboratory jackets or coats worn to protect clothing should be flame resistant. Nonflammable, nonporous aprons are more satisfactory. Shoes must have closed toes to provide protection. Long hair and loose clothing must be confined and head coverings securely tucked into lab coats. Gloves used for experiments in the lab should not be worn in the hallways.

Avoid unnecessary hazards by keeping drawers and cabinets closed while working. Keep aisles free of obstructions such as chairs, boxes, and waste receptacles. Avoid slipping hazards by picking up ice, stoppers, glass beads, glass rods and other small items from the floor and by cleaning up wet spots. Use the recommended procedure for the proper disposal of chemical waste and solvents (see Section 6). Before leaving the laboratory turn off all services not in use such as water, electricity, gases, and vacuum. Lower all fume hood sashes to the lowest practical level. Turn off lights in the fume hoods and laboratory.

1.4 Overnight Operation of Equipment

Reactions that are left to run unattended overnight are prime sources for fires, floods, and explosions. Equipment such as power stirrers, hot plates, heating mantles, and water condensers should not be left on overnight without fail-safe provisions and the consent of the laboratory supervisor. Unattended reactions should be checked periodically. Always leave a “Leave on Overnight Form” (Appendix 6) plainly posted with a phone number where you can be reached in case of emergency. Any piece of apparatus that is left unattended to run overnight must be accompanied by a list of sequential instructions outlining a safe shutdown procedure indicated in the form and posted in a clearly visible location. Any valves, switches, etc. that must be activated should be clearly identified on the apparatus and annotated on the list of instructions. Remember that in the middle of the night emergency personnel are entirely dependent on your instructions and information.

1.5 Working Alone

Working alone at the laboratory bench without supervision can be extremely hazardous. Laboratory work should never be conducted unless another person is present, in the laboratory or in a nearby office or laboratory, who is aware of

your presence. Supervisors are responsible for the safety of students working under their direction.

1.6 Smoking, Eating or Drinking

In accordance with the city of Toronto smoking by-laws, the University of Toronto has adopted a smoking policy that prohibits smoking in all University buildings. Consequently, smoking **is not permitted** in any Materials Science and Engineering building. Also, when smoking outdoors, be aware of hazards outside of buildings, such as chemical storage areas, gas cylinders, and other areas where flammable materials may be stored.

To prevent accidental ingestion of hazardous chemicals, **the storage and/or consumption of food and beverages in laboratories is strictly prohibited**. Please use offices, or the undergraduate or graduate lounges for thus purpose.

Note that labs cannot be arbitrarily divided into a ‘lab area’ and an ‘office area’. If there are chemicals present within the room, the entire room must be treated as a laboratory, even if it is primarily used as an office.

2.0 Assembling Apparatus

2.1 Assembly of General Equipment

(a) Keep work space uncluttered and clear of chemicals and scraps of paper. Keep measuring equipment such as glass cylinders where they will not be easily knocked over.

(b) Set up clean, dry, approved apparatus firmly clamped and well back from the edge of the lab bench with due regard to the proximity of reagent bottles to burners and to other students and their equipment. Choose sizes that can properly accommodate the experiment to be performed, allowing 20% free space at the minimum. Larger apparatus should be placed toward the back of the lab bench.

(c) Use only equipment that is free of flaws such as cracks, chips, frayed wire, and obvious defects. Glassware can be examined in a strong light and also in polarized light for strains. Discard all defective glassware.

(d) A properly placed pan under a reaction vessel or container will confine spilled liquids in the event of glass breakage.

(e) Addition and separatory funnels should be freshly lubricated (if glass stopcocks), properly supported, and orientated so that the stopcock will not be loosened by gravity. A retaining ring should be used on the stopcock plug. Condensers should be properly supported with securely positioned clamps. The attached water hoses should be secured with a clamping device.

(f) Stirrer motors and vessels should be secured to maintain proper alignment. A magnetic stirrer is preferable, only non-sparking motors should be used. Air motors are preferable if they can be used.

(g) Apparatus attached to a ring stand should be positioned so that the center of gravity of the system is over the base and not to one side but with adequate provision for removing burners or baths quickly.

(h) Prior to adding reagents and carrying out any reactions, have the glassware assembly and auxiliary equipment thoroughly checked by the supervisor.

(i) Provide a vent for chemicals that are to be heated. Prior to heating a liquid, place boiling stones in unstirred vessels (other than test tubes). If a burner is to be used, distribute the heat with ceramic-centered wire gauze. Use a thermometer in a boiling liquid if there is the possibility of dangerous exothermic decomposition as in some distillations. This will provide a warming and may allow you time to remove the heat and apply external cooling. Setup should allow for fast removal of heat.

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

(k) When ever hazardous gases are likely to be involved, the experiment should be confined to a fume hood. When working with flammable gases, do not use burners, hot plates, or sparking motors in the vicinity. Use appropriate traps, condensers, or scrubbers to minimize release of material to the environment.

(l) When conducting a reaction that could result in a mild explosion or when using a vacuum system (which may implode), use a face shield that is sufficiently large and strong to protect your neck or use a standing shield as directed by your supervisor. The standing shield must be used if an explosion is possible. Shields that can be knocked over by an explosion must be stabilized with weights or fasteners. Standing shields are preferably secured near the top. Some protection can be offered by a fume hood with the sash closed. Eye and face protection must be worn even when using the shields or hood.

(m) Whenever possible, use controlled electrical heaters in place of gas burners.

(n) No apparatus or equipment should be placed on the floor of a working area in the laboratory.

(o) Thin walled rubber or plastic tubing must not be used for water lines on the pressurized side of an apparatus. In order to prevent water damage, reinforced rubber or reinforced tygon tubing should be used on the pressurized side.

2.2 Glassware

(a) Borosilicate glassware is recommended for all laboratory glassware except for special experiments that use UV or other light sources.

(b) The only soft glass provided in the laboratory should be reagent bottles, measuring equipment, stirring rods, and tubing. Any sizable nonspherical glass equipment to be evacuated, such as suction flasks, should be specially designed with heavy walls. Dewar flasks and large vacuum vessels should be taped or otherwise screened or contained in a metal jacket to prevent flying glass from an implosion. Thermos bottles with thin walls are not adequate substitutes for Dewar flasks. Bottles, jars, and other containers of acids, alkalies, flammable or

combustible substances, or corrosive chemicals should be transported in carriers to protect them from breakage, as well as to limit the spread in case of leaks. It should be noted that even plastic containers can cause similar problems because plastic can be punctured or fail under pressure or heat.

(c) Rubber or plastic tubing should be clamped to glass or metal tubing, as changes in fluid pressure may otherwise cause the joint to come apart.

2.2.1 Cutting of Glass Tubing

(a) Hold the tubing against a firm support and make one quick firm stroke with a sharp file, rocking the file to extend the nick one-third around the circumference.

(b) Wet the nick with water or a soap solution.

(c) Cover the tubing with a cloth and hold the tubing in both hands one inch away from the nick with the nick facing outward.

(d) Hold the tube away from your body and push outward with your thumbs.

(e) Fire polish the cut end to prevent the laceration of the skin and to ease insertion into rubber hoses and stoppers.

2.2.2 Insertion of Glass Tubing or Rods Into Rubber Hoses

(a) Fire polish or file smooth the end of the glass to be inserted.

(b) Lubricate the glass. Water may be sufficient; glycerol is a good lubricant.

(c) Wrap a cloth around the glass. Protect your hand holding the hose with a cloth or glove.

(d) Hold the wrapped glass not more than 5 cm from the end nearest the hose.

(e) Insert the glass into the hose with a slight twisting motion, avoiding too much pressure and torque.

(f) Stuck tubing may be removed by slitting the hose with a sharp knife.

2.3 Compressed Gases

Always use the minimum-sized compressed gas cylinder adequate to perform an experiment. When ordering hazardous gases, consider factors such as handling and storage, eye and skin absorption, proper gas regulators, and chemical

properties. The publications of the Compressed Gas Association and of major suppliers should be consulted before using compressed gases. The following rules for use of compressed gases apply:

(a) Handle cylinders of compressed gases as high-energy sources and therefore as potential explosives.

(b) When storing or moving a cylinder have the protective cap securely in place to protect the valve stem.

(c) When moving large cylinders, strap them to a properly designed, wheeled cart to ensure stability.

(d) Do not expose cylinders to temperatures higher than about 50°C. Some rupture devices on cylinders will release at about 65°C. Some small cylinders, such as lecture bottles, are not fitted with rupture devices and may explode if exposed to high temperatures.

(e) Never use a cylinder that cannot be identified positively.

(f) Never lubricate, modify, force, or tamper with a cylinder valve.

(g) It is advisable that cylinders of toxic, flammable, or reactive gases should be used in fume hoods whenever possible. They should be stored in appropriately ventilated cabinets.

(h) Suitable racks should be used to hold cylinders at all times.

(I) Cylinders of all sizes must be restrained by straps, chains, or a suitable stand to prevent them from falling.

(j) Under no condition should high-pressure gases be directed at a person.

(k) Compressed gas or compressed air should not be used to blow away dust or dirt, the resultant flying particles are dangerous.

(l) Rapid release of a compressed gas will cause an unsecured gas hose to whip dangerously and also may build up a static charge that could ignite a combustible gas.

(m) Do not extinguish a flame involving a highly combustible gas until the source of gas has been shut off, otherwise it can re-ignite, causing an explosion.

(n) When not in use, cylinder and bench valves should be closed tightly.

(o) Promptly remove the regulators from empty cylinders and replace the protective caps at once. Mark the cylinder “Empty”.

(p) Never bleed a cylinder completely empty. Leave a slight pressure to keep contaminants out. This is especially important for flammable gases to prevent possible ingress of air.

(q) Use the appropriate regulator on each gas cylinder. Adaptors or home made modifications can be dangerous.

(r) Oil or grease on the high-pressure side of an oxygen, chlorine, or other cylinder of an oxidizing agent can lead to an explosion.

(s) Always use a trap or check valve to prevent back-siphonage of chemicals into the cylinder.

(t) Always wear safety glasses when handling and using compressed gases.

2.4 Vacuum Operations

(a) Vacuum desiccators should be enclosed in a box or approved shielding device for protection in case of an implosion. Only chemicals being dehydrated to be kept dry should be stored in a desiccator. When opening a desiccator that is under vacuum, make sure that atmospheric pressure has been restored. A “frozen” desiccator lid can be loosened by using a single-edge razor blade as a wedge, which is then tapped with a wooden block to raise the lid.

(b) Water aspirators for reduced pressure are used mainly for filtration purposes, and only equipment that is approved for this purpose should be used. Never apply a vacuum to a flat-bottomed flask unless it is very small or it is a heavy walled filter flask designed for the purpose. Place a trap and check valve between the aspirator and the apparatus so that water cannot be sucked back into the system if the water pressure should fall unexpectedly while filtering. These recommendations also apply to rotary evaporation operations where water aspirators are being used for vacuum.

(c) All pumps should also have a belt guard to prevent hands or loose clothing from being caught in the belt pulley (older models).

(d) Shielding should be used, especially when the apparatus contains flasks of 1 litre size or greater.

3.0 Handling Chemicals

3.1 General Laboratory Practices

(a) Wash thoroughly with soap and warm water whenever a chemical comes into contact with your skin.

(b) All chemicals are potentially harmful to some degree. Avoid direct contact with any chemical. Some substances now considered “safe” may in the future be found to cause unsuspected long-term disorders. It is especially important to keep chemicals from hands, face, and clothing, including shoes or other foot coverings. Many substances are readily absorbed into the body through the skin and through inhalation. Chemicals can also enter the body through the mouth by contamination of the hands and chemicals can be transferred to the eyes from the hands.

(c) Smoking, drinking, and eating are forbidden in the laboratory or storage areas because of the possibility of hazardous chemicals getting into the mouth or lungs through contamination.

(d) 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, such as in a fume hood. Examples of such substances are:

acetyl chloride
ammonium hydroxide
anhydrous ammonia
arsine
bromine
carbon monoxide
chlorine
chloroform
diborane
dimethyl sulfate
fluorine
hydriodic acid
hyrdobromic acid
hydrochloric acid
hydrofluoric acid
hydrogen selenide
hydrogen sulfide
hydrogen telluride
methyl fluorosulfonate
phosgene
phosphine
phosphorus chlorides
phosphorus oxychloride
stibine (antimony trihydride)
sulfur dioxide
sulfuryl chloride
thionyl chloride

Some of these, e.g. hydrogen halides, hydrogen sulfide, hydrogen selenide, and phosgene, are by-products of certain reactions. Planning for the handling and control of these toxic by-products should be part of the experimental procedure.

Material Safety Data Sheets MSDS’s, (Appendix 3) for all chemicals used in the laboratory should be kept at the location of use and a copy filed with the Safety Committee outlining location of use.

(e) Some solvents, such as dimethyl sulfoxide, serve as vehicles for the rapid transport of dissolved toxic substance through the skin into the body.

(f) Never give anything by mouth to an unconscious person. Be certain to find out exactly what substances were ingested and designate someone to inform the emergency room what chemicals are involved while the injured person is being assisted or transported to medical aid.

(g) All containers of chemicals must be labeled clearly. Do not use any substance in an unlabeled or improperly labeled container. Unlabeled containers and those with printed labels that have been partly obliterated, scratched over or crudely labeled by hand should be returned to the supervisor. The chemicals must be identified and then either made nonhazardous or disposed of in accordance with existing regulations (see Section 6).

(h) Carefully read the label before picking up the container, after picking up the container, and before removing a reagent from its container. Read it again as you promptly recap the container and return it to its proper location. Names of distinctly different substances are sometimes nearly alike, and using the wrong substances can lead to accidents.

(i) Hold a bottle with its label toward your palm to protect the label (and also the hand of the next user) in case some reagent drains down the side of the bottle. Stoppers too small to stand upside down on the bench top should be held at the base and outward between two fingers of the pouring hand. Do not pour toward yourself when adding liquids or powders. Use a funnel if the opening being poured into is small. If a solid material will not pour out, ask for assistance. If a stopper or lid is stuck, use extreme caution in opening the bottle or ask for assistance.

(j) Do not use more material than directed. Remove from the container only approximately what is needed. Never return a chemical to its original container. Dispose of unwanted solids in a labeled solid-waste container. Very reactive chemicals, such as sodium, potassium, or phosphorus, should be disposed of in labeled, covered containers only. Potassium is much more hazardous than sodium, and explosions have occurred when old, heavily crusted potassium metal has been cut with a knife. Some nontoxic, nonflammable, water-soluble liquids may be flushed down the drain in the laboratory sink (never use the trough or a nonlaboratory sink), followed by large amounts of water. Flammable wastes should be placed in safety cans. When in doubt about the disposal of chemicals, consult the supervisor.

(k) Use a fume hood and wear an apron, goggles, and gloves when pouring bromine, hydrofluoric acid, or related materials. Contact with these types of materials will lead to painful burns.

(l) Always add a reagent slowly; never dump it in. Observe what takes place when the first small amount is added and wait a few moments before adding more; some reactions take time to start. If an expected reaction does not initiate, ask your supervisor for advice before adding more reagent.

(m) Before pouring a liquid into an addition or separatory funnel, make sure the stopcock is closed and has been freshly lubricated (if glass). Use a stirring rod to direct the flow of the liquid being poured. Keep a beaker under the funnel in the event the stopcock opens unexpectedly.

(n) To avoid violent reaction and splattering while diluting solutions, always pour concentrated solutions slowly into water or into less concentrated solutions while stirring. This procedure is particularly applicable in preparing diluted acids. Always wear goggles and use in the fume hood when diluting solutions.

(o) Beakers should be supported by holding them around the side with one hand. If the beaker is 500 ml or larger support it from the bottom with the other hand, and consider using heavy-duty beakers. When setting the beaker down, first remove the hand from the base and place the beaker slowly on the clean surface of the bench. If the beaker is hot, use beaker forceps or tongs and place the beaker on a ceramic-centered gauze pad.

(p) Flasks should be grasped by the center neck, never by a side arm. If the flask is round bottomed, it should rest on a proper sized cork ring when it is not assembled for reaction. Large flasks (3L) must be supported at the base during use.

(q) Never look down the opening of a vessel unless the vessel is empty.

(r) Never use mouth suction to fill a pipette. Use an aspirator bulb or a loose-fitting hose attached to a water aspirator. Constantly watch the tip of the pipette, and do not allow it to draw air.

(s) Laboratory storage of large containers of reagents should be kept to a minimum. They should be placed on a low shelf preferably in a tray adequate to contain spills or leakage.

(t) Incompatible materials should not be stored together or in close proximity. The supervisor in charge should direct the arrangement. Safety cans should be provided for quantities of flammable solvent larger than 4 L. If chemical purity requirements preclude use of metal containers, an alternative is to place the glass container inside a metal container. Corrosive liquids should be dispensed in small containers no larger than 500 ml. Use of chemically resistant coated containers is highly advisable.

MSE Liquid Nitrogen Cryogenic Facility

U of T: CONTROL PROGRAM for LIQUID CRYOGENIC TRANSFER FACILITIES

http://www.ehs.utoronto.ca/resources/manindex/cryogenic.htm

Facility Supervisor: Sal Boccia

A facility supervisor is one who has charge of a liquid cryogenic transfer facility, or authority over the activities related to the storage or transfer of cryogenic liquids within the facility.

Cryogenic System, Pressurized

Any system, including pressure vessels, lines, connections, valves and any other hardware that contains cryogenic liquids or gases under pressure greater than atmospheric.

Liquid Cryogenic Transfer Facility

A liquid cryogenic transfer facility is any physical location designated as such by the pertinent Department which:

(a) is a central source of cryogenic liquid(s) to the department; and

(b) has bulk quantities of cryogenic liquids stored and/or dispensed within it.

HAZARDS OF LIQUID CRYOGENS

The general hazards associated with liquid cryogens are summarized as follows:

Oxygen Deficiency

The release of cryogenic liquids in the work area can result in the rapid displacement of air and the potential for asphyxiation (suffocation) by reducing the concentration of oxygen in air below levels necessary to support life.

Cryogenic liquids have very high volume expansion rates. For example, one litre of liquid nitrogen spilled in an enclosed area will expand to approximately 700 litres of nitrogen gas at standard temperature and pressure.

Exposure to oxygen-deficient atmospheres may produce dizziness, nausea, vomiting, loss of consciousness and death. Such symptoms may occur in

seconds without warning. Death may result from errors in judgement, confusion or loss of consciousness which prevents self-rescue.

Pressure Build-Up Hazard

Overpressurization will develop in inadequately vented pressurized systems due to the expansion of cryogenic liquid vaporizing into large volumes of gas. Sudden release of this pressure can cause personal injury by issuing cold gas or liquid, or by expelling parts, as a result of leaks or bursts. The low temperatures of liquid cryogens also result in their potential to freeze water or other materials rapidly, and subsequent blockage and pressure build-up.

Cryogenic Burns and Frostbite

Exposure to liquid cryogens or the cold "boil off" gases can result in extensive tissue damage or severe skin burns. Contact with uninsulated pipes or metal containers which are used to contain or transfer cryogenic materials can cause the flesh to stick and be torn when attempts to withdraw it are made. Prolonged exposure to cold can also result in hypothermia or frostbite.

Cold Stress to Materials

Common materials such as carbon steel, plastics and rubber can become brittle and weak, or fracture under stress at cryogenic temperatures. These can cause spills or leakages as a result of system rupture or failure.

Condensation of Atmospheric Oxygen

Oxygen in surrounding air can condense when exposed to the temperatures of cryogens such as liquid nitrogen. Such oxygen enrichment may result in increased flammability and explosion hazards.

3.2 Procedures for Handling and Dispensing Liquid Nitrogen

(a) Always wear eye protection and avoid wearing anything capable of trapping spilled liquid nitrogen adjacent to the skin. Do not wear gloves. Safety shoes or closed top shoes must be worn.

(b) Dispense only into a clean, dry Dewar flask.

(c) Place Dewar flask on a low stand. Do not pour above shoulder height.

(d) Place the hose in Dewar mouth.Open tap of tank very <u>slowly</u> so as to cool the flask slowly.

(e) As the Dewar flask cools, slowly increase the flow.

(f) When the Dewar flask is full, turn tap off. Wait a few moments for the hose to warm up and then carefully remove the Dewar flask.

(g) Do not seal a container containing liquid nitrogen.

(h) In case of a spill, notify others in the vicinity and evacuate the area to avoid asphyxiation.

3.3 Transportation of Gas Cylinders, Cryogenics and Containers of Toxic or Flammable Chemicals

Gas cylinders and glass containers of toxic and flammable chemicals must be labeled as to contents and may be moved around the building only using approved methods. Gas cylinders must be chained to the transportation cart, and regulators must be removed and replaced with cylinder caps before transportation. On no occasion may a gas cylinder or any container of toxic, flammable or cryogenic material be carried in a passenger elevator.

4.0 Chemical Spills

4.1 General Spills

(a) Immediately alert your neighbours and the supervisor.

(b) All contaminated clothing must be removed immediately and the skin washed with soap and water. Flush skin with water for no less than five minutes. Clothes must be laundered before reuse (do not wash with other clothing).

(c) If reasonable to do so confine the spill as outlined in (g) below.

(d) If there is no fire hazard and the material is not particularly volatile or toxic, clean it up as directed by the supervisor. To facilitate cleaning up liquids, use an absorbent material that will neutralize the liquids if possible (trisodium phosphate, sand followed by sodium bicarbonate solution or powder for acids, sodium thiosulfate solution for bromine etc.) Commercial absorbents (e.g. Oil-Dri and Zorb-All), vermiculite, or small particles (about 30 mesh) of other satisfactory clay absorbents are also recommended. (Dry sand is less effective.) A dustpan and brush should be used, and rubber gloves should be worn. While wearing gloves, clean the contaminated area with soap and water and mop it dry. If the spill is on the floor, some absorbent should be sprinkled on the spot to prevent slipping. **Caution**: Vermiculite and some other absorbents create a slipping hazard when wet. A dry-chemical powder fire extinguisher (sodium bicarbonate) is an effective spill control agent to neutralize and immobilize small spills.

(e) If a volatile, flammable, or toxic material is spilled, immediately warn everyone to extinguish flames and turn off spark-producing equipment such as brush-type motors. Shut down all equipment and vacate the room until it is decontaminated. Contact the Office of Environmental Health and Safety at 7000.

(f) The supervisor will be responsible for designating the extent of evacuation and the proper cleanup procedure. The following substances are very hazardous and cleanup should be handled only under the direction of the supervisor:

aromatic amines	cyanides
bromine	ethers
carbon disulfide	organic halides
nitro compounds	

Avoid skin contact and to prevent inhalation, wear appropriate breathing apparatus. Clothing which has been splashed should be immediately removed to prevent skin penetration.

(g) Many liquid spills (< 100 ml) can be absorbed with paper towels, sand or an absorbent. However, paper towels can increase the surface area and evaporation, increasing the fire hazard. Spilled flammable liquids can be absorbed by vermiculite, sand or paper towels; the resultant solid is highly flammable and gives off flammable vapours. An adsorbent, e.g. activated charcoal, should be used instead. Most solid spills can be brushed up and disposed of in appropriate solid-waste containers, but care must be exercised to avoid reactive combinations. Don't leave paper towels or other materials used to clean up a spill in open trash cans in the work area. Dispose of them properly.

(h) **Acid chlorides**. For acid chloride spills, use calcined absorbent products, such as Oil-Dri or Zorb-All, or dry sand. Avoid contact with skin. The supervisor will direct disposal.

(i) **Mercury**. Because of the high toxicity of mercury vapour, spilled mercury should be immediately and thoroughly cleaned up using an aspirator bulb or vacuum device. If a mercury cleanup unit is available, become familiar with its location and proper use. Mercury spilled into floor cracks can be made nonvolatile by amalgamation with zinc dust. Domestic vacuum cleaners must not be used because they will only redisperse mercury as aerosols and spread the contamination. A mercury vapour monitoring instrument is available from the Office of Environmental Health and Safety for determining the effectiveness of the cleanup. Mercury spill kits are located in Room 51, Wallberg Building and in Room 225, Mining Building.

(j) **Alkali-metal**. A spill of alkali metal should be smothered with powdered graphite or Met-L-X extinguisher and removed to a safe location where it can be disposed of by reaction with a dry secondary alcohol or by open-air burning under controlled conditions to ensure that the smoke is properly dispersed. Be aware of any regulations for open-air burning in your facility. Sodium-potassium alloys (Na-K) present even greater hazards than either sodium or potassium alone; strict observations of suppliers' recommendations must be followed. Particles of alkali metal splattered on the skin should be rapidly removed and the skin flushed quickly with water. If any metal on the skin becomes ignited, deluge it with cold water immediately.

(k) **White (yellow) phosphorus**: A spill of white (yellow) phosphorus should be blanketed with wet sand or wet absorbed and disposed of by controlled burning outdoors (consult regulations). If any white phosphorus is splattered on the skin, flush the skin with cold water and remove adhering phosphorus. Copper sulfate solution provides a visual aid in removing particles because it produces a dark colour in contact with elemental phosphorus.

4.2 Chemical Spilled on the Body Over a Large Area

Quickly remove all contaminated clothing while using the safety shower. Seconds count, and no time should be wasted because of modesty. However be careful not to spread the chemical on the skin, especially the eyes. Immediately flood the affected body area in cold water for at least 15 minutes. Resume if pain returns. Wash off chemicals with a mild detergent and water, but do not use neutralizing chemicals, unguents, creams, lotions, or salves. Get medical attention as soon as possible.

It should be made certain that the medical personnel understand exactly what chemicals are involved. The exact chemical name should be supplied. For example, exposure to hydrochloric acid is very different medically than exposure to hydrofluoric acid, yet both are sometimes called simply “acids”.

4.3 Chemicals on the Skin

Immediately flush with cold water for no less than five minutes and wash with a mild detergent, preferably soap and water. If there is no visible burn, wash with warm water and soap, removing any jewelry to facilitate removal of any residual materials. If a delayed reaction is noted (often the next day), seek medical attention immediately and explain carefully what chemicals are involved.

4.3.1 Bromine on the Skin

Flush with cold water as soon as possible and apply a compress saturated with a dilute thiosulfate solution. No other chemicals should be used either as a first aid treatment or as a cleanup agent on the skin.

4.3.2 Hydrogen Fluoride

Hydrogen Fluoride is a very serious hazard. Both its gas and solutions are toxic, and it is rapidly absorbed through the skin and deep into the body tissues, causing long-term excruciating pain and burns that are slow to heal. Prompt removal of contaminate clothing while the injured person is being flushed with water under a safety shower is essential. Continuous flushing with cool water is vital until any whitening of the tissue has disappeared. Swath the injured person with soaking wet, iced clothes. Wrap to protect from shock and exposure. Get immediate medical help. Under no circumstances should ointments be applied. Although immediate pain is felt from the concentrated acid, action of the acid may be insidious, and contact with less concentrated solution may go unnoticed for hours. In all cases of body contact with hydrogen fluoride obtain medical aid.

Simple flushing with water does not remove hydrogen fluoride deep in the tissues, and additional treatment is required.

5.0 Hazardous Chemicals

The Ministry of Labour has “designated” certain biological, chemical and physical agents for special regulation. A “designated” substance regulation contains requirements for the following: (I) assessment of exposure, (ii) exposure standards, (iii) control program requirements, (iv) workplace monitoring requirements, (v) medical surveillance requirements, (vi) code for respiratory protection, and (vii) code for sampling and measurement. Before using a “designated” substance, contact the Office of Environmental Health and Safety, University of Toronto. The following substances are currently “designated”:

Acrylonitrile
Arsenic
Asbestos
Benzene
Ethylene Oxide
Isocyanates
Lead
Mercury
Noise
Silica
Vinyl Chloride

5.1 Organic Peroxides and Peroxide Formers

Organic peroxides are a special class of compounds with unusual stability problems. These peroxides are among the most hazardous chemicals normally handled in chemical laboratories and in manufacturing. As a class, organic peroxides are low-power explosives. They are hazardous because of their extreme sensitivity to shock, sparks, or other forms of accidental ignition. Many peroxides that are routinely handled in laboratories are more sensitive to shock than primary explosives such as TNT. Peroxides have a specific half-life, or rate of decomposition, under any given set of conditions. A low rate of decomposition may autoaccelerate into a violent explosion, especially in bulk quantities of peroxides. They are sensitive to heat, friction, impact, and light as well as to strong oxidizing and reducing agents. All organic peroxides are extremely flammable, and fires involving bulk quantities of peroxides should be approached with extreme caution. A peroxide present as a contamination reagent in a solvent can change the course of a planned reaction. Compounds of the following types are known to form peroxides:

(a) Aldehydes

(b) Ethers, especially cyclic ethers, and ethers derived from primary and secondary alcohols. Containers of ethyl or isopropyl ether should be labeled with the date they are opened, and the contents of the container should be destroyed by the user within one month. Several acceptable colorimetric tests for peroxides in ether are available. If a test is “positive”, filter the contaminated liquid through a column of chromatographic, base-grade, aluminum oxide until the test is negative. Promptly discard the contaminated alumina in the appropriate solid-waste container. Ethers must never be distilled unless known to be free of peroxides. If there is sufficient peroxide present to form a precipitate, the container and its contents must be discarded with extreme care.

(c) Compounds containing benzylic hydrogen atoms. Such compounds are especially susceptible to peroxide formation if the hydrogens are on tertiary carbon atoms, e.g., cumene (isopropyl benzene).

(d) Compounds containing the allylic (CH_2=$CHCH_2$-) structure including most alkenes.

(e) Ketones, especially cyclic ketones.

(f) Vinyl and vinylidene compounds, e.g. vinyl acetate and vinylidene chloride.

Specific examples of chemicals that can form dangerous concentrations of peroxides with long exposure to air are:

cyclohexene
cyclooctene
decalin (decahydronaphthalene)
p-dioxane
ethyl ether
tetrahydrofuran (THF)
tetralin (tetrahydronaphthalene)

It has been suggested that if you think you ought to make a test for the presence of peroxides, then you have probably kept the material too long and should dispose of it in a suitable manner. Store peroxide formers away from heat and light in closed vessels, preferably in the container furnisher by the supplier.

5.1.1 Precautions for Handling Peroxides

(a) Limit the quantity of peroxide to be handled to the minimum amount required. Do not return unused peroxides to the container. Avoid exposure to vapour. All containers should be dated when received and kept only as long as is safe.

(b) Clean up all spills immediately. Solutions of peroxides can be absorbed on vermiculite.

(c) The sensitivity of most peroxides to shock and heat can be reduced by dilution with inert solvents such as aliphatic hydrocarbons. However, toluene is known to induce the decomposition of diacyl peroxides.

(d) Do not use solutions of peroxides in volatile solvents under conditions which the solvent will be vaporized, thereby increasing the peroxide concentration in the solution.

(e) Never use a metal spatula with peroxides: contamination by metals can lead to explosive decompositions. Use ceramic or wooden spatulas.

(f) Smoking, open flames, and other sources of heat should not be permitted near peroxides.

(g) Avoid friction, grinding, and all forms of impact especially with solid peroxides. Glass containers with screw-cap lids or glass stoppers should not be used. Use polyethylene bottles.

(h) Peroxides should be stored at the minimum safe temperatures to minimize the rate of decomposition. **Caution**: Do not refrigerate liquid or solutions of peroxides at or below the temperature at which the peroxide freezes or precipitates. Peroxides in these forms are extremely sensitive to shock and heat.

5.1.2 Disposal of Peroxides

Caution: Only a “bomb” squad should dispose of pure peroxides. Peroxides normally must be diluted before disposal.

(a) Small quantities (25 g or less) of peroxides are generally disposed of by diluting with water to a concentration of 2% or less and then transferring them to a polyethylene disposal bottle containing an aqueous solution of a reducing agent such as ferrous sulfate or sodium bisulfite. The material is then handled like any other waste chemical; however, it must not be mixed with other chemicals for disposal. Spilled peroxides should be absorbed on vermiculite as quickly as possible. The vermiculite-peroxide mixture may then be burned directly or may be stirred with a suitable solvent to form a slurry, which is then treated as noted above. **Caution:** Never flush organic peroxides down the drain.

(b) Large quantities (in excess if 25 g) of peroxide require special handling. Each case should be considered separately and a handling, storage, and disposal procedure, determined by the physical and chemical properties of the particular peroxide and prevailing regulations. In preparing a disposal procedure consult “Destroying Peroxides of Isopropyl Ether”, by

A.C. Hamstead, Ind. Eng. Chem., 56 , (6), 37, (1964) or contact the Office of Environmental Health and Safety at 7000.

5.2 Cyanides and Nitriles

Cyanides and nitriles are among the most toxic and rapidly acting substances encountered in the chemical laboratory. Symptoms of toxicity occur if these materials are swallowed, inhaled, or absorbed through the skin. A few breaths (inhalations) of hydrogen cyanide (HCN) can be fatal.

(a) First-aid treatment for cyanide and nitrile poisoning. Because the toxic action of inhaling cyanides and nitriles is so rapid, first-aid treatment and an antidote (amyl nitrite) must be administered immediately. Persons using cyanide should have amyl nitrite ampules pinned to their lab coats and taped to the hood. The person administering first aid should break open an amyl nitrite ampule and hold it under the affected persons nose for about 15 seconds and continue administering at two-minute intervals until help arrives. Excess nitrite will reduce the blood pressure. If the patient is not breathing, artificial respiration must also be administered.

(b) Disposal. All workers using cylinders must be thoroughly familiar with methods to convert the material to cyanates and with proper disposal methods. The most effective way to dispose of hydrogen cyanide and waste solutions containing cyanide is dilution with an equal amount of alcohol and combustion in a solvent incinerator. See also the national Academy of Sciences' report "Prudent Practices for Disposal of Chemicals from Laboratories", or contact the Office of the Environmental Health and Safety at 978-7000.

5.3 Hydrogen Sulfide

Hydrogen sulfide is extremely dangerous. Exposed persons quickly lose their ability to smell it, even though it still present in the air. Exposure to low concentrations causes irritation of all parts of the respiratory system and eyes, followed by headache, dizziness, and nausea. Higher concentrations may cause immediate loss of consciousness followed by respiratory paralysis. All laboratory operations with hydrogen sulfide should be carried out in a fume hood. Note: thioacetamide, which is frequently used as a replacement for hydrogen sulifde in the qualitative analysis of many inorganic cations, is a suspected carcinogen. Students should avoid skin contact and should wash their hands each time after using thioacetamide.

5.4 Solvents

(a) Hazards. Most of the commonly used solvents are volatile and are harmful when relatively small amounts are inhaled. Many are readily absorbed through the skin. Most are flammable. All organic solvents should be regarded as hazardous unless definitely known to be innocuous.

(b) Flammable liquids. A flammable liquid itself does not burn; it is the vapour from the liquid that burns. The rate at which a liquid produces flammable vapours depends on its vapour pressure. The vapourization rate increases as the temperature increases; therefore, a flammable liquid is more hazardous at elevated temperatures than at normal temperatures.

(c) Fire and explosion hazards associated with flammable liquids can be minimized by observing the following precautions:

1. Keep flammable liquids away from heat and direct sunlight.
2. Do not heat flammable liquids directly over a burner or an electrical device that can generate sparks or that has a surface temperature in excess of that which might cause autoignition.
3. Do not dispose of organic solvents in sinks or drains.
4. A fume hood should be used when appreciable quantities of flammable materials are transferred from one container to another, allowed to stand in open containers, or heated in open containers.

d) Toxicity. The toxicity of common solvents must be recognized. Solvents requiring special care include:

aromatic hydrocarbons, especially benzene (see below)
carbon disulfide
esters of acetic or other organic acids
glycols, glycol esters, and glycol ethers
halogenated hydrocarbons
methyl alcohol
nitrogen bases, such as amines

5.5 Benzene

One particularly dangerous formerly common solvent is benzene. It is a suspected human carcinogen and should never be used as a solvent without specific authorization by a supervisor. Chronic poisoning can occur by inhalation of relatively small amounts of benzene over a long period of time. The toxic action is primarily on the blood-forming organs. Contact of benzene with the skin should be avoided because of potential skin absorption. Also, like other

solvents, it causes dryness and cracking of the skin, which open the way to infection and allergic responses. Benzene is also a very flammable solvent and should be handled and disposed of with extreme care in accordance with all prevailing regulations. Whenever possible, toluene or xylene should be substituted for benzene as a reagent. Your supervisor should advise you when this is possible.

5.6 Carbon Tetrachloride

Another dangerous formerly common solvent is carbon tetrachloride. It is a suspected human carcinogen, and care must be taken to avoid exposure to the liquid and its vapours. All operations should be carried out in a fume hood. High concentrations in the air can rapidly lead to death from respiratory failure. Less severe exposure can lead to kidney and liver damage. Carbon tetrachloride is also absorbed through the skin. Whenever possible, another chlorinated hydrocarbon, such as ethylene chloride (CH_2Cl_2) should be substituted for carbon tetrachloride (on the supervisors direction). It should be noted, however, that almost all chlorinated hydrocarbons have been found to be toxic to some degree.

5.7 Formaldehyde

Formaldehyde is a colourless, pungent, irritant gas that is water soluble and most frequency is marketed as 37-56% aqueous solutions, commonly known as formalin. It is also provided as a solid polymer that decomposes to its monomer upon heating. It is a suspected human carcinogen, and inhalation of the vapours may result in severe irritation of the upper respiratory tract and edema. Skin sensitization can result from repeated exposure. Formaldehyde is a severe eye irritant, causing delayed effects that are not appreciably eased by eye washing. Laboratory operations with formalin in open vessels should be carried out in a fume hood. Because repeated exposure to formaldehyde can lead to formaldehyde allergy, it is well to avoid skin contact with aqueous solutions by appropriate use of neoprene, butyl rubber, or polyvinyl chloride gloves. Splash-proof goggles must be worn to avoid any possibility of splashing formaldehyde in the eyes.

5.8 Perchloric Acid

This is a powerful oxidizing agent that may react explosively with reducing agents and organic compounds. It should be used in a water wash-down fume hood of noncombustible construction. Frequent inspections should be made to prevent perchloric acid and perchlorate accumulation in the exhaust system of the fume

hood. Do not use around wooden tables or benches. Keep perchloric acid bottles on glass or ceramic trays that have enough volume to hold all the acid should the bottle break. Organic matter should be digested with nitric acid before addition of perchloric acid. Never heat perchloric acid with sulfuric acid because dehydration may produce anhydrous perchloric acid. Perchlorate esters have the same shattering effect as nitroglycerine and their use is forbidden. Transition metal perchlorates are also capable of exploding. (See "Handling Perchloric Acid and Perchlorates" in the "Handbook of Laboratory Safety," edited by N.V. Steere, and "Perchloric Acid and Perchlorates" by A.A. Schilt or contact the Office of Environmental Health and Safety.)

5.9 Picric Acid

Dry picric acid is a high explosive. As commercially supplied, picric acid contains from 10% to 15% water. When the moisture content is less than 10%, picric acid should be handled as though it were shock, spark, and heat sensitive. Whether or not it is also friction sensitive when it contains less than 10% moisture is controversial. To be on the safe side, assume that it is friction sensitive. Avoid shock, impact, friction, spark, flame and sources of heat sufficient to dry out or melt the solid. Avoid contact with oxidizing agents.

Picrate salts are notoriously friction and shock sensitive, wet or dry. Unless it is certain that no metal pirates or related salts are present, the conservative assumption is that they might be present. Handle accordingly. Avoid contact with metals, with ammonia, with ammonium compounds, or with acid-decomposable metal compounds (e.g., concrete, plaster, and lime).

To maintain 10% or more water in a container of picric acid, weigh it upon receipt from the supplier and record the weight. Before opening, weigh again. If there has been a weight loss, assume it now has less than 10% water and do not open the container. After removal (if warranted) of any picric acid from a container, reweigh and record the new, lesser weight; continue to follow the same precautions. **Caution:** Weighing of large containers may be misleading, water may have drained to the bottom, leaving the upper portion of the contents with less than 10% water.

Picric acid known or assumed to contain either picrate salts or less than 10% water, or both, should be handled carefully and destroyed as soon as possible. Wet or dry, picric acid and its salts are toxic. Avoid skin and eye contact, ingestion, and inhalation.

6.0 Laboratory Cleanliness and Disposal of Chemicals and Broken Glass

In the laboratory and elsewhere, keeping things clean and neat generally makes things safer. Work spaces should be kept clean and neat. Broken glassware, leftover chemicals, and even scraps of paper can cause problems. Careless disposal can cause problems too. The wrong two chemicals spilled together on a lab bench or put into the same disposal container can catch fire spontaneously or explode. Solid or liquid chemicals put into the sink drain can damage the environment. Jagged edges of a broken breaker in a waste paper basket can injure the person who empties that basket.

We can promote safety, however, by following a few common sense practices when cleaning up a lab space and disposing of chemicals. One basic principle applies: keep each different kind of leftover chemical in a separate disposal container.

Put ordinary waste paper in a wastepaper basket or into some other kind of container. But if a piece of paper is contaminated, such as a paper toweling used to clean up a spill, put the contaminated paper in the special container that is marked for this use.

Broken glass belongs in its own marked waste container, while broken plastic apparatus in a different marked waste container. Broken glass must be stored in yellow pails that can be obtained from caretakers. After placing the lid firmly on top, caretakers should be informed and they will dispose of the pails. Broken thermometers may contain mercury in the fragments: these belong in their own special "broken thermometer" container.

Clean glassware at the laboratory sink. Use hot water if available and soap or other detergent and mild scouring powder if necessary. Wear impervious gloves that have been checked to ensure that no holes are present. Use brushes of suitable stiffness and size. Avoid accumulating to many articles in the cleanup area. Usually, work space around a sink is limited and piling up not-yet-cleaned or cleaned glassware leads to breakage. Remember that the turbid water in a sink may hide a jagged edge on a piece of broken glassware that was intact when put into the water.

Unless specifically instructed to do so, and then only when wearing proper protective equipment, avoid the use of strong chemical cleaning agents such as nitric acid, chromic acid, sulfuric acid, other strong oxidizers, flammable liquid solvents, or any chemical with a "per" in its name (such as perchloric acid, ammonium persulfate, etc.). A number of explosions involving strong oxidizing cleaning solutions, such as chromic-sulfuric acid mixtures, have been reported.

Dispose of excess, leftover reactives, or otherwise hazardous chemicals promptly. Directions for disposal should be obtained from the supervisor or by consulting the Hazardous Chemical Control Section of the Physical Plant Department at 978-7000. Examples include:

- sodium and other alkali metals
- finely divided metals of any kind
- most metal hydrides, acetylides, carbides
- any chemical with "per" in its name
- strong oxidizing agents
- strong reducing agents
- flammable liquids and solids
- strong acids
- strong alkalies
- most concentrated solutions
- highly toxic chemicals, such as mercury compounds and cyanides
- most alcohols, bromine, iodine, phenol, and many others

What should be done with leftover and unused chemicals? Put each solid in its own specially marked container. Put each liquid in its own specially marked container. Close these containers after each such use. Never deliberately put chemicals, solid or liquid, into the sink or down a drain. If it happens accidentally, notify you supervisor. In some laboratories, it is permissible to pour small quantities of dilute aqueous (water) solution down the sink drains without harm to the environment. If this is allowed in your laboratory work, your supervisor will tell you.

Details of correct container selection and labelling for hazardous chemical wastes are given in Appendix 4. Storage of waste chemicals prior to disposal by the Hazardous Chemical Control Section is located in the fume hood in Wallberg Room #50. Chemical wastes must be segregated during storage prior to disposal according to their relative reactivities. Details of proper storage and chemical incompatibilities are given in Appendix 4 and are located on the inside of doors of the fumehood in Room # 50.

The waste generator bears the primary responsibility for proper packaging, labelling and segregation of chemical wastes.

7.0 Electrical Hazards and Safety Procedures

While electricity is in constant use by the researcher, both within and outside the laboratory, significant physical harm or death may result from its misuse. With direct current (D.C.), a person can detect a "tingling" feeling at 1mA and the median "let-go" threshold (the current at which one cannot release the conductor) is 76mA. For 60 Hertz alternating current (A.C.), the values are 0.4 mA and 16 mA respectively. Women are more sensitive to the effects of electrical current; approximately 2/3 of the current is needed to produce the same effects as in a man. Higher currents produce respiratory inhibition, then ventricular fibrillation, and ultimately cardiac arrest.

Although minute electrical shocks are generally considered annoying rather than harmful, such shocks constitute an ominous warning to the presence of potentially hazardous conditions. The device in question should be disconnected immediately and the cause ascertained by a person competent in such matters. Work on electrical devices should be done only after the power has been shut off in such a manner that it cannot be turned on accidentally. All laboratory personnel should know the location of circuit breakers and how to cut off all electrical service to a laboratory in case of fire or accident. Internal current-carrying devices such as capacitors must be discharged.

All "home-made" electrical apparatus should be inspected and approved by someone competent in electrical circuitry **before** being placed in service. Approval of such equipment is reflected in an orange "Ontario Hydro" certification sticker. Three terminal electrical wiring is coded as follows: white - neutral, black - live wire, green - ground wire.
The following are a list of rules for working with electrical equipment:

1. Use only tools and equipment with non-conducing handle when working with electrical devices.
2. All current transmitting parts of any electrical devices should be enclosed.
3. When checking an operating circuit keep one hand either in pocket or behind back.
4. Maintain a workspace clear of extraneous materials such as books, papers, and clothes.
5. Never change wiring with circuit plugged into power source.
6. Never plug leads into power source unless they are connected to an established circuit.
7. Avoid contacting circuits with wet hands or wet materials.
8. Wet cells should be placed on a piece of non-conducting material.
9. Check circuits for proper grounding with respect to the power source.

10. Do not insert another fuse of larger capacity if an instrument keeps blowing fuses - this is a symptom requiring expert repairs.
11. Keep the use of extension cords to a minimum and cords as short as possible. Tie off excess cord out of pathways.
12. Do not use or store highly flammable solvents near electrical equipment.
13. Multi-strip outlets (cube taps) should not be used in place of permanently installed receptacles.
14. Keep access to electrical panels and disconnect switches clear and unobstructed.

In the event of an electrical fire:

1. Turn off power source and unplug.
2. Use a "C" type or Co_2 Halon extinguisher or sand to put out the fire. Never use water.
3. When the fire is extinguished, check circuit to determine cause.
4. Do not turn on circuit until cause of fire has been established and the fault corrected.
5. When the fire is extinguished report to the University Fire Prevention section at 5151.

8.0 Fire Safety Rules

8.1 Precautionary Procedures

1. Know the location of fire exits, fire alarms, fire blankets and extinguishers. Each laboratory should be equipped with an extinguisher or extinguishers. Fire extinguishers are primarily for use on fires in their incipient stages. Make it your business to learn about the proper use of fire extinguishers. See the following Guide to Classes of Fires.
2. Keep all fire doors closed at all times.
3. Do not block access to fire escape routes.
4. Neatness prevents many fires. Fire spreads much faster when it has cluttered waste materials to feed on. Oily rags, waste or papers improperly stored are important causes of spontaneous combustion. Store these materials in covered metal containers.

8.2 Emergency Procedures

1. If a fire starts, call for assistance by actuating the nearest fire alarm box. Then, only when the fire is not too large, confine and try to extinguish it with the available extinguishers in the lab. If more than one extinguisher is required to control the fire call the fire department at 2222.
2. If there is no injury, and the fire is contained in a vessel, it can usually be suffocated by covering the vessel with an inverted beaker or watch glass. Do not use towels or clothes. Remove nearby flammable materials to avoid possible spread of fire. If the fire is over an area too large to be suffocated quickly and simply, abandon the fire.
3. If evacuation is necessary, and if time allows, shut off power to any equipment. Shut off gas or other open flames. Turn off hot plates and main gas valve.
4. If your clothes ignite, "stop, drop and roll', to smother the flames. Do not run; running only intensifies the flames. When fire blankets are readily available, use them to wrap around yourself to aid in putting out the fire.
5. Exit from the building via staircases - do not take elevators. Remove any objects that may be obstacles in passageways or to fire doors. Do not return to the building unless permitted to do so by the Fire Department.

8.3 Guide to Classes of Fires and Methods of Extinguishment

Class A Fire - Wood, Paper, Textiles and other ordinary combustible materials

To extinguish use: Pressurized water, ABC Dry Chemical, (Multi-Purpose)

Class B Fire - Flammable Liquids: Oils, Solvent, Grease, Paint, etc.

To extinguish use: BC Dry Chemicals, regular Carbon Dioxide, Halon 1211 Multi-purpose dry chemical

Class C Fire - Live or energized Electrical or Electronic Equipment

To extinguish use: Carbon dioxide, Halon 1211 with only minor damage to components BC Dry Chemical, Multi-purpose dry chemical are effective but will destroy electronic gear

Class D Fire - Metals: magnesium, aluminum, sodium, potassium, zirconium, titanium, etc.

To extinguish use: Sand, Special Metal Extinguishers, Special Metal Powders Do not use ordinary fire extinguishers on metal fires because a violent reaction may result.

9.0 Emergencies and First Aid Treatment

In a medical emergency, summon professional medical attention immediately. Provide first aid within the scope of your training while waiting for professional help to arrive. Be prepared to describe accurately the nature of the accident. All personnel should know how to use emergency equipment such as fire extinguishers, spill kits, safety showers, and eye wash apparatus.

There are certain serious injuries in which time is so important that treatment must be started immediately. These injuries include stoppage of breathing, severe bleeding, thermal and chemical burns and traumatic shock.

9.1 Stoppage of Breathing

For stoppage of breathing from electrical shock or asphyxiation, the mouth-to-mouth method of resuscitation is far superior to any other known. Check mouth and throat for obstructions. Rescue breathing must be started at once. Do not look around or go for help. Training in the technique of mouth-to-mouth resuscitation and external cardiac massage are readily available by contacting the Office of Environmental Health and Safety

9.2 Severe Bleeding

Severe bleeding can almost always be controlled by firm and direct pressure on the wound with a pad or cloth. The cleaner the cloth, the more desirable: however, in an emergency use part of clothing. Wrap the injured to avoid shock and call immediately for medical attention. Raise the bleeding part higher than the rest of the body if possible. Keep victim lying down. Never use a tourniquet.

9.3 Thermal Burns

If the burn is minor, apply ice or cold water. In the case of clothing fire, the victim should drop to the floor and roll, not run to a safety shower. A fire blanket, if nearby, should be used to smother the flames. After flames are extinguished, deluge the injured under a safety shower, removing any clothing contaminated with chemicals. Keep the water running on the injured for 15 minutes to remove heat and to wash off chemicals. Place clean, soaking wet, ice-packs cloths on burned areas, and wrap to avoid shock and exposure. Do not use a Carbon Dioxide fire extinguisher on a person with burning clothing as this can lead to suffocation frostbite.

9.4 Chemical Burns

For chemical burns or splashes, immediately flush with water. Apply a stream of water while removing any clothing that may have been saturated with the chemical. If the splash is in the eye, flush it gently for at least ten minutes with clear water. Wash in a direction away from the other eye. If the splash is on the body, flood it with plenty of running water. For chemicals spilled over a large area, quickly remove contaminated clothing while using the safety shower; treat as directed under large THERMAL BURNS. Seconds count, therefore no time should be wasted simply for modesty.

9.5 Traumatic Shock

In cases of traumatic shock, or where the nature of the injury is not clear, keep the victim warm, lying down, legs raised and quiet. Wait until medical assistance arrives before moving the victim.

9.6 Accident Reporting

Accident reporting is an essential element of any Safety Program. Details concerning the correct reporting of accidents and occupational illnesses are given in Appendix 5.

Appendix 1. Laboratory Safety and Housekeeping Inspection Report

Appendix 2. Laboratory Safety Supervisors

Appendix 3. Material Safety Data Sheet (MSDS) Example

Appendix 4. Chemical Waste Disposal Procedures and Examples of Incompatible Chemicals

Appendix 5. Reporting of Accidents and Occupational Illnesses / Forms

Appendix 6. Leave on Overnight Form

Appendix 7. Regulations Concerning the Use of the Rolling Mill

Appendix 1. Laboratory Safety and Housekeeping Inspection Report

Laboratory Safety and Housekeeping Inspection Report

To:_____ For Lab No_____ Bldg_____

Areas of Inspections	Comments and Recommendations
1. Bench Tops	_____
2, Areas under sinks	_____
3. Cabinets, drawers, shelves	_____
4. Chemical storage	_____
5. Hoods	_____
6. Aisles	_____
7. Window ledges	_____
8. Walls and floors	_____
9. Chairs, stools, upholstery, and casters	_____
10. Safety gasses, face shields, lab coats	_____
11. Fire extinguishers	_____
12. Compressed gas cylinders	_____
13. Broken glassware	_____
14. Tubing	_____
15. Guards on moving equipment	_____
16. Interlocks	_____
17. Condition of lab equipment	_____
18. Refrigerators	_____
19. Electric cords and other wiring	_____
20. Eye wash stations	_____
21. Labels on containers	_____
22. Evaluation of amount of chemicals in the lab	_____
23. Evaluation of amount of supplies and equipment	_____
24. Lab desks and bookshelves	_____
25. Office housekeeping	_____
26. Other	_____

Actions taken and other recommendations: _____
_____
_____
_____

Inspection made by: _____ Date:_____
Return completed inspection report to the Safety Committee Chairman

Appendix 2. Laboratory Safety Supervisors

Department of Materials Science and Engineering
Laboratory Safety Supervisors
Wallberg and Materials Science Buildings

Room	Safety Supervisor	Room	Safety Supervisor	Room	Safety Supervisor
36	Erb	81	Hibbard	173	Lu
37	Wang	83	Lian	175	Erb
39	MSE Club	84	Wang	176	Singh
40	Ramsay	85	Perovic	177	Erb
41	Grozea	86	Hibbard	178	Hibbard
42	Grozea	87	Hibbard	179	Erb
43	Grozea	88	Department	180	Wang
44	Grozea			181	Wang
45	Grozea	134	Department	182	Department
46	Grozea	135	Department		
47	Grozea	136	Nogami	**Great Lakes Building**	
48	Grozea	137	Wang	93	Argyropoulos
49	Grozea	138	Perovic		
50	Grozea	139	Department	**Mining Building**	
51	Grozea	140	Department	202	Ruda/Hatton
52	Grozea	141	Lu	208	Barati/Dept.
53	Barati	142	Department	209	and 210 Thorpe
56	Lian	143	Department	212	Thorpe/Lian
59	Lian	145	Department	214	Ruda
60	Erb	147	Barati	215	Ruda
60A	Erb	150	Singh/Ramsay	216	Ruda
61	Department	156	Hibbard	217	and 218 Naguib
65	Lian	159	Hatton	219	Hatton
66	Barati/Dept.	162	Barati	220	Barati/McLean
67	Barati/Dept.	163	Lu	230	Barati
67A	Barati/Dept.	164	Barati	231	Hatton
68	Department	165A-D	Boccia		
69	North	166	Boccia	**Haultain Building**	
70	Wang	167	Department	109	and 110 Ruda
71	Lu	167A	Department	201	Ruda
74	McLean	167B-E	Boccia	203	to 208 Ruda
75	McLean	167F	Department	211	Ruda
76	Lu	167G	Boccia	214	and 215 Ruda
77	Nogami	170	Lu	218	Ruda
79	Argyropoulos	171	Perovic	220	Ruda
80	Argyropoulos	172	Nogami		

Appendix 3. Material Safety Data Sheet (MSDS) Example

UNIVERSITY OF TORONTO

ENVIRONMENTAL HEALTH & SAFETY

April 15, 2013

PLEASE DISTRIBUTE WIDELY

Good day everyone,

The University of Toronto now has access to ChemWatch.

ChemWatch is an online program which allows universities to maintain an up-to-date repository of MSD's for chemicals in labs. Several Ontario Universities have successfully utilized this program to organize their MSDSs, and it is now available for use by all three campuses of the University of Toronto.

Maintaining an up-to-date collection of MSDSs is a legislated requirement (Regulation 860 R.R.O.1990, Workplace Hazardous Materials Information System), but it can be a time-consuming task to keep updating a binder of hard copies of current MSDSs for every chemical in your lab. By providing an online MSDS database, we can make all MSDSs easily available to the University community, saving time for laboratory staff and ensuring compliance.

ChemWatch offers an extensive database of over 50,000 pure substance MSDSs plus more than 190,000 common chemical mixtures in 40 languages and multiple formats, including GHS and WHMIS compliant formats. It generates risk assessments on the chemicals you store, using its extensive database of chemical properties, and provides reports for first response and firefighting. It also has an advanced, customizable labeling system that will produce any size label. All chemicals in ChemWatch are reviewed and updated quarterly.

ChemWatch includes information on exposure limits, WHMIS, waste handling and transportation, and valuable and sometimes hard-to-find data on PPE, odour safety, ecotoxicity and environmental fate and toxicological information.

ChemWatch can be accessed from any UofT computer – and only from UofT computers. Use the following link. We recommend the "Gold" MSDS database as a starting point.

http://jr.chemwatch.net/chemgold3

To start, click on the button on the left hand side that says "Gold MSDS" and enter a search term.
If you wish to have a training demonstration on how to use the tool please go to:

Long demo = http://youtu.be/AB_7J4RTidI

If you have any questions please contact the Office of Environmental Health and Safety at: ehs.office@utoronto.ca

EHS Team

Material Safety Data Sheet (MSDS) Example

Section 1 - Chemical Product and Company Identification

MSDS Name: Acetone
Synonyms: Dimethylformaldehyde; Dimethyl ketone; 2-Propanone; Pyroacetic acid; Pyroacetic ether.
Company Identification: Fisher Diagnostics
For information, call: 800-524-0294
Emergency Number: 800-524-0294

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
67-64-1	Acetone	100.0	200-662-2

Hazard Symbols: XI F
Risk Phrases: 11 36 66 67

Section 3 - Hazards Identification

EMERGENCY OVERVIEW
Appearance: colourless. Flash Point: -4 deg F. Causes respiratory tract irritation. Causes eye irritation. Breathing vapors may cause drowsiness and dizziness. Prolonged or repeated contact may dry the skin and cause irritation. **Danger!** Extremely flammable liquid and vapor. Vapor may cause flash fire.
Target Organs: Central nervous system, respiratory system, eyes, skin.
Potential Health Effects
Eye: Produces irritation, characterized by a burning sensation, redness, tearing, inflammation, and possible corneal injury.
Skin: May be absorbed through the skin. Repeated or prolonged exposure may cause drying and cracking of the skin.

Section 4 - First Aid Measures

Eyes: Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately.
Skin: Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid if irritation develops.

Section 5 - Fire Fighting Measures

General Information: Containers can build up pressure if exposed to heat and/or fire. As in any fire, wear a self-contained breathing apparatus in pressure-

demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Vapors can spread along the ground and collect in low or confined areas.
NFPA Rating: (estimated) Health: 1; Flammability: 3; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Wear appropriate protective clothing to minimize contact with skin. Remove all sources of ignition. Provide ventilation. Clean up residual material by washing area with a 2-5% solution of soda ash.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Ground and bond containers when transferring material. Avoid contact with eyes, skin, and clothing.
Storage: Keep away from heat, sparks, and flame. Keep away from sources of ignition. Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances. Flammables-area.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower.
Exposure Limits: OSHA Vacated PELs: Acetone: 750 ppm TWA
Personal Protective Equipment
Eyes: Wear chemical goggles.
Skin: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance: colourless
Odor: acetone-like
pH: 7
Boiling Point: 133.2 deg F
Freezing/Melting Point:-139.6 deg F
Solubility: Soluble.
Specific Gravity/Density:0.79 (Water=1)
Molecular Formula:C3H6O
Molecular Weight:58.08

Section 10 - Stability and Reactivity

Chemical Stability: Stable at room temperature in closed containers under normal storage and handling conditions.
Conditions to Avoid: High temperatures, ignition sources, temp. above 220°C.

Incompatibilities with Other Materials: Strong acids, strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, irritating and toxic fumes and gases, carbon dioxide.

Section 11 - Toxicological Information

RTECS#:
CAS# 67-64-1: AL3150000
LD50/LC50:
CAS# 67-64-1:
Dermal, guinea pig: LD50 = >9400 uL/kg;
Oral, mouse: LD50 = 3 gm/kg;
Reproductive Effects: TDLo(Oral, rat) = 273 gm/kg;Reproductive - Paternal Effects - spermatogenesis (incl. genetic material, sperm morphology, motility, and count).
Mutagenicity: Sex chromosome loss and nondisjunction(Yeast - Saccharomyces cerevisiae) = 47600 ppm; Cytogenetic analysis(Rodent - hamster Fibroblast)= 40 gm/L.

Section 12 - Ecological Information

Ecotoxicity: Material Safety Data Sheet Rainbow trout LC50=5540 mg/L/96H Sunfish (tap water), death at 14250 ppm/24H Mosquito fish (turbid water) TLm=13000 ppm/48HCas# 67-64-1:LC50 (96Hr.)

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3.

Section 14 - Transport Information

	US DOT	IATA	RID/ADR	IMO	Canada TDG
Shipping Name:	No information available.				ACETONE
Hazard Class:					3
UN Number:					UN1090
Packing Group:					II

Section 15 - Regulatory Information

US FEDERAL
TSCA
CAS# 67-64-1 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.

Section 16 - Additional Information

MSDS Creation Date: 7/26/1999
Revision #7 Date: 2/26/2002

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. In no event shall Fisher be liable for any claims, losses, or damages of any third party.

Appendix 4. Chemical Waste Disposal Procedures and Examples of Incompatible Chemicals

4.1. Chemical Waste Definition

Chemical waste includes solids, liquids or gases containing or contaminated with any of the following:

- flammable solvents (*e.g., acetone, alcohols, acetonitrile)*;
- leachate toxic materials (*e.g., heavy metals, pesticides*);
- corrosives *(e.g., hydrochloric acid, potassium hydroxide pellets)*;
- reactives such as oxidizers, cyanides, sulphides, explosives, unstable materials and water-reactive materials (*e.g., benzoyl peroxide)*;
- toxic materials including mutagenic, carcinogenic, acute or chronic toxicity materials *(e.g., chloroform, ethidium bromide)*;
- polychlorinated biphenyls (> 50 ppm concentration);
- non-returnable gas cylinders.

4.2. Packaging

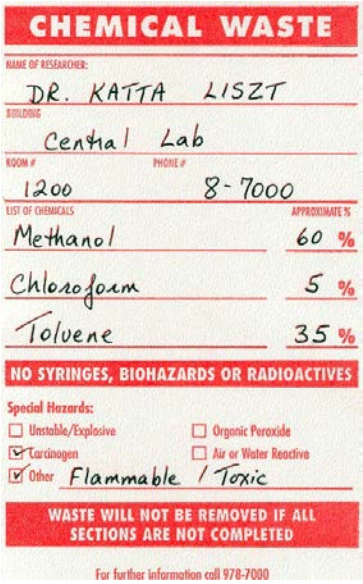
- Never mix incompatible materials together in a single container
- Wastes must be stored in containers compatible with the chemicals stored (e.g., hydrofluoric acid waste **MUST NOT** be stored in glass containers)
- Solvent safety cans should to be used to collect and temporarily store large volumes (10-20 litres) of flammable organic waste solvents. The researcher is responsible for providing these cans to the laboratory. Cans submitted for disposal will be emptied and returned promptly to the laboratory, provided that they are properly identified with the building and laboratory room number.
- Do not insert precipitates, solids or other non-fluid wastes into safety cans.
- Package halogenated and non-halogenated solvents separately, if possible. The University pays a premium for disposing of halogenated solvents (e.g., chloroform, carbon tetrachloride).
- Do not package solid chemical waste into biohazard bags, because this incorrectly indicates a hazard that is not present.

4.3. Labelling

- Attach a Chemical Waste label directly to the waste container. Chemical waste labels are available free of charge from EHS staff.

- All information requested on the Chemical Waste Label should be provided. Chemical generic names of the chemicals must be listed. No abbreviations, acronyms or trade mark names are to be used. Vague categories (e.g., solvent waste) are not acceptable.

Example of Properly Completed Waste Label



CHEMICAL WASTE

NAME OF RESEARCHER: DR. KATTA LISZT

BUILDING: Central Lab

ROOM #: 1200 PHONE #: 8-7000

LIST OF CHEMICALS	APPROXIMATE %
Methanol	60 %
Chloroform	5 %
Toluene	35 %

NO SYRINGES, BIOHAZARDS OR RADIOACTIVES

Special Hazards:

- ☐ Unstable/Explosive
- ☐ Organic Peroxide
- ☑ Carcinogen
- ☐ Air or Water Reactive
- ☑ Other Flammable / Toxic

WASTE WILL NOT BE REMOVED IF ALL SECTIONS ARE NOT COMPLETED

For further information call 978-7000

4.4. Chemical Incompatibility

When preparing chemical waste for disposal, it is the generator's responsibility to ensure that incompatible chemicals are not stored in the same container. Waste containers should be stored according to their compatible chemical reactivities. A few general examples are:

- Acid-reactive compounds (e.g., cyanides, sulphides) which liberate gaseous products when acidified should not be mixed with any inorganic acid (e.g., sulphuric or hydrochloric acid).
- Organic acids (e.g., glacial acetic acid) should be segregated from inorganic acids. Generally inorganic acids are oxidizing agents while some organic acids may be either reducing agents or combustible.
- Water reactive materials (e.g., sodium) should be kept away from any water source.
- Oxidizers (i.e., any inorganic compound that assists fire such as hydrogen peroxide, lead nitrate) should never be mixed with organic materials (e.g., organic bases such as pyridine, aniline, amines, flammable solvents such as toluene, acetone) or reducing agents (e.g., water-reactive chemicals).

Note: Perchloric acid, although an inorganic acid, is a powerful oxidizing agent and should be considered a powerful oxidizer in its concentrated form.

For any wastes that require special handling such as organic peroxides, PCBs (polychlorinated biphenyls) or explosives, consult the Coordinator, Hazardous Waste Management, Environmental Protection Services (Hazardous Materials) (416) 978-7000 or e-mail <hazwaste.ehs@utoronto.ca>.

4.5. Hazard Symbols

The WHMIS system groups hazardous materials into six classes or categories based on the type of hazard which they represent. These materials are also called controlled products. Each category has its own hazard symbol and it is important that the worker be able to recognize these.

A - COMPRESSED GAS	
B - FLAMMABLE AND COMBUSTIBLE MATERIAL	
C - OXIDIZING MATERIAL	
D - POISONOUS AND INFECTIOUS MATERIAL	
D1- Materials Causing Immediate and Serious Toxic Effects	
D2 - Materials Causing Other Toxic Effects	
D3 - Biohazardous Infectious Material	
E - CORROSIVE MATERIAL	
F - DANGEROUSLY REACTIVE MATERIAL	

Appendix 5. Reporting of Accidents and Occupational Illnesses / Forms

5.1. Reporting of Accidents, Incidents and Occupational Illnesses

These procedures outline the reporting requirements for accidents, occupational illnesses and incidents, which result in or have the potential to result in personal injury or property damage. The procedures cover employees, students, visitors and other persons on university premises.

Reporting of accidents and occupational illnesses involving death, critical injury, lost time or health care (by a medical practitioner) is required for employees under both the Occupational Health and Safety Act and the Workplace Safety and Insurance Act. Reporting of Accidents to the Workplace Safety and Insurance Board (WSIB) is done centrally through the WSIB Administrator, Health and Wellbeing Programs and Services.

The WSIB levies a fine of $250 for late reporting of a lost time or health care claim. Where this late reporting is a result of the failure of a department to report the incident to the WSIB Administrator, the fine will be charged to that department.

In addition to the above legal reporting requirements, the University requires the reporting of all accidents to any person, whether or not a personal injury is involved.

Reportable incidents are those which:

- result in personal injury or lost time from work (including those requiring first aid, and occupational illness);
- have the potential to result in personal injury or property damage even though no injury or damage actually occurred;
- occur to any person on university premises;
- occur to a university employee during the course of his/her work either on or off university premises;
- occur to a student during the course of his/her classroom, laboratory or field work;
- occur to a student during the course of a work placement (either paid or unpaid) which forms part of their university curriculum.

5.2. Reporting of Accidents/Incidents Involving Employees

Employees include all full-time, part-time, sessional, casual employees and graduate teaching assistants when they are performing their duties as teaching assistants.

1. All reportable incidents must be reported to the WSIB Administrator within 24 hours.

2. For incidents involving employees, supervisors must complete and sign the University "Accident/Incident/Occupational Disease Report".

3. The completed form should be faxed (416- 971-3052) or hand delivered to: **WSIB Administrator, Health and Well Being Programs and Services**, **263 McCaul St., 2nd Floor**

4. Where supervisors are unable to fully complete the form within 24 hours, the form, with as much information as is available at the time, should still be sent, with the remaining information to follow later.

5. The WSIB Administrator in Health and WellBeing is responsible for all liaison with the Workplace Safety and Insurance Board and for the ongoing followup of claims. For assistance or information with respect to any claim contact Anne Chreptak at 416-978-8804.

Please note that the Workplace Safety and Insurance Board levies a fine of $250 for late reporting of a lost time or health care claim. Where this late reporting is a result of the failure of a department to report the accident to the WSIB Administrator, Health and Wellbeing, the department will be responsible for paying the fine.

5.3. Reporting of Accidents/Incidents Involving Students and Visitors

Students and visitors include all non-employees present or working in University workplaces. These include undergraduate students, graduate students (except when performing TA duties, when they are employees), visitors and members of the general public.

Accidents involving students or visitors are to be reported on the "University of Toronto Risk Management and Insurance Report" and faxed to Insurance and Risk Management at 971-3061. A copy is also to be faxed to Environmental Health and Safety at 971-1361.

5.4. Reporting of Death or Critical Injury

A critical injury is defined as an injury of a serious nature that:

- places life in jeopardy
- produced unconsciousness (or an altered state of consciousness)
- results in substantial loss of blood
- involves the fracture of a leg or arm, but not a finger or toe
- involves the amputation of a leg, arm, hand or foot, but not a finger or toe consists of burns to a major portion of the body, or
- causes the loss of sight in an eye.

In addition to the reporting requirements outlined above, all critical injuries or fatalities must be immediately reported to the Ministry of Labour. Note that the reporting requirements to the Ministry of Labour for death or critical injury specify "**any person**", so this reporting requirement is not limited to employees. Supervisors are therefore responsible for taking the following steps:

- procure immediate medical attention at 9-911

- notify the University of Toronto Police at 978-2222 for the St. George Campus, or 416-287-7333 for Scarborough Campus, or 905-828-5200 for Mississauga.

- notify the Office of Environmental Health and Safety at 416-978-4467

- notify the Health & Well-Being Programs & Services at 416-978-8804

- notify the Ministry of Labour

  For all campuses in the Greater Toronto area, the Ministry of Labour numbers are:
  - Daytime (8:30 am to 5:00 pm): 416-314-5421 or 1-800-991-7454
  - Nights/Weekends/Holidays: 416-325-3000 or 1-800-268-6060
- notify the appropriate joint health and safety committee for the workplace,
- if the injured person is an employee, notify the appropriate union (if any),
- ensure that the site of the accident remains undisturbed until a Ministry of Labour inspector has arrived, and
- investigate and prepare a written report on the circumstances of the accident.

University of Toronto

BUSINESS AFFAIRS DIVISION - Risk Management and Insurance Department

Personal Injury Incident Report

(Complete this report in block letters please)

Name of department/division:

Name & title of individual completing this report:

Contact information: Phone ( ) E-mail:

Incident information: Date (d/m/y): Time: am/pm

Location of incident: Building Room #

Address:

If location of incident outside, describe where:

Description of exact site of incident and any contributing physical site condition or possible cause:

Describe exactly what happened in injured person's own words if possible (attach separate report if necessary):

What was injured person doing immediately before incident occurred?

Did injured person's actions cause or contribute to the incident? ☐ Yes ☐ No If yes, how?

Was another person alleged to have caused the incident? ☐ Yes ☐ No If yes, who (Name, address, phone)

…/2

Room 300 ♦ 215 Huron Street ♦ Toronto ♦ Ontario ♦ M5S 1A2 ♦ Telephone (416) 978-7484 ♦ Fax (416) 971-3061

Personal Injury Incident Report (cont'd)

Injured person information: Name

Home address: Phone ( )

Student at University ☐ Visitor ☐

Additional information for specific situations if relevant:

Age: Sex: F ☐ M ☐ Height: Weight: Eye glasses: ☐ Yes ☐ No

Footwear: Clothing:

Any medical condition:

Injury description (Its nature and extent, part of body involved):

Treatment received? ☐ Yes ☐ No If yes, by whom:

Medical assistance offered? ☐ Yes ☐ No Accepted? ☐ Yes ☐ No If so, specify type (first aid, medical aid, hospitalization, other):

Witness information (Identification is vital):
Name:

Home address:

Phone ( ) Age: Sex: F ☐ M ☐

Student at University ☐ Employee of University ☐ Visitor ☐

Police Investigation:

Who called UofT Campus Police ☐ or Toronto Police ☐ to the scene?

Officer's name:

Badge number: Occurrence/Incident report number:

Signature **Date**

**Make sure that the injured person receives immediate first aid. Call an ambulance if necessary.*
**Letters from an injured person or his/her lawyer must be sent immediately to the Risk Mgmt and Insurance Dept.*
**Do not admit liability. Legal liability is a complex matter.*

Complete this form and send to both
The Risk Management and Insurance Department ♦ Fax (416) 971-3061 and
The Office of Environmental Health and Safety ♦ Fax (416) 971-1361

UNIVERSITY OF TORONTO

ACCIDENT/INCIDENT/OCCUPATIONAL DISEASE REPORT FOR EMPLOYEES

RELEVANT SECTIONS MUST BE COMPLETED IN FULL BY EMPLOYEE'S SUPERVISOR

SUBMIT WITHIN 24 HOURS TO: HEALTH & WELL-BEING PROGRAMMES & SERVICES
263 McCAUL STREET,2nd Floor OR FAX: 416-971-3052

A: INCIDENT TYPE

○ INCIDENT-NO INJURY ○ MINOR INJURY-NO TREATMENT ○ FIRST AID ○ HEALTH CARE ○ LOST TIME
○ CRITICAL INJURY ○ OCCUPATIONAL DISEASE

B: EMPLOYEE INFORMATION

LAST NAME: _____ FIRST NAME: _____

PERSONNEL NUMBER: _____ SOCIAL INSURANCE NUMBER: _____

HOME ADDRESS: _____ CITY: _____

POSTAL CODE: _____ HOME TELEPHONE: (____)_____

WORK TELEPHONE: (____)_____ E-MAIL: _____

EMPLOYING DEPARTMENT: _____ ORGANIZATIONAL UNIT: _____

JOB TITLE: _____ DATE OF HIRE: _____

DOMINANT HAND (CIRCLE): LEFT AND/OR RIGHT DATE OF BIRTH: _____ SEX: M F

EMPLOYEE GROUP: ○ Academic ○ Administration (Non-Union) ○ Union (name and local #) _____
○ Other (specify) _____

STATUS: ○ FULL TIME ○ PART TIME ○ CASUAL ○ SESSIONAL ○ TEMPORARY
○ OTHER (provide details)_____

C: REPORTING

DATE OF INCIDENT: _____ TIME OF INCIDENT: _____

DATE REPORTED: _____ TIME REPORTED: _____

NAME OF SUPERVISOR TO WHOM ACCIDENT WAS REPORTED: _____

TELEPHONE: _____ E-MAIL: _____

IF THERE WAS A DELAY IN REPORTING THIS ACCIDENT, LIST REASON(S):

_____

_____

IF FIRST AID WAS PROVIDED, GIVE NAME OF PROVIDER:_____

WAS MEDICAL ATTENTION SOUGHT? ○ YES ○ NO
IF YES, PLEASE COMPLETE THE FOLLOWING LINE:
NAME AND ADDRESS OF ATTENDING PHYSICIAN/HOSPITAL:

D: ACCIDENT/OCCUPATIONAL DISEASE DETAILS-STATE EXACTLY (attach letter if required)

1. DESCRIBE THE INJURY, PART OF BODY INVOLVED, AND SPECIFY LEFT OR RIGHT SIDE.

2. WHAT HAPPENED TO CAUSE THE INJURY?

3. EXPLAIN WHAT THE EMPLOYEE WAS DOING AND THE EFFORT INVOLVED.

4. IDENTIFY THE SIZE, WEIGHT, AND TYPE OF EQUIPMENT OR MATERIAL INVOLVED.

5. WHERE DID THE ACCIDENT OCCUR? (location, building, room number)

6. WHAT CONDITIONS ATTRIBUTED TO THE ACCIDENT?

7. WHAT STEPS HAVE BEEN TAKEN TO PREVENT RECURRENCE?

8. NAME AND WORK ADDRESS OF ANY WITNESSES:

E: ADDITIONAL INFORMATION *complete if time was lost from work*

DATE AND HOUR LAST WORKED: _____

NORMAL WORKING HOURS ON LAST DAY WORKED: FROM _____ TO: _____

RATE OF PAY: ○ HOURLY _____ ○ DAILY _____ TOTAL WEEKLY PAY HOURS: _____

SHIFT WORKER: ○ YES ○ NO IF YES, ENTER SHIFT PREMIUM: $_____ per hour

CIRCLE EMPLOYEE'S USUAL WORK DAYS:

Sunday: Monday: Tuesday: Wednesday: Thursday: Friday: Saturday:

ESTIMATED TIME OFF WORK: _____ (days / shifts)

F: CLAIM INFORMATION

To your knowledge, has the worker had a previous similar injury/disease? ○ YES ○ NO
If yes, provide details and whether a similar injury was work related or not.

Was any individual who does not work for you totally or partially responsible for the injury/disease?
○ YES ○ NO If yes, please explain.

If machinery, equipment or a motor vehicle was totally or partially responsible for the injury/disease, refer to the instructions on the reverse of the Employer's Copy and provide particulars.

Do you have any reason to doubt that the injury/disease is work-related? ○ YES ○ NO
If yes, please explain.

TO BE SIGNED BY DEPARTMENT HEAD OR EMPLOYEE'S SUPERVISOR

COMPLETED BY: (please print) TITLE:

_____ _____

SIGNATURE: DATE: TELEPHONE:

_____ _____ _____

WHEN TO COMPLETE THIS FORM

The Workplace Safety and Insurance Board (WSIB) requires that employers file a report within three days of learning of an occupational injury or disease that disables an employee or requires health care. Failure to do so may result in a late filing penalty being levied. Please print clearly in ink. If all of the information is not immediately available to you, please send what you have and submit further information as soon as you have it. If additional space is required, attach a separate letter. First aid only injuries are not reported to the WSIB but the WSIB requires that we keep a record of the details.

TYPES OF INJURIES

NON-INJURY

Refers to an accident in which there was no personal injury, but which has the potential for personal injury.

MINOR-INJURY

When an injury occurs but does not require treatment by a first-aider or by a health professional.

FIRST AID

When an injury occurs but the employee does not require health care, but only the treatment of a first-aider, nurse, or non-medical.

HEALTH CARE

An employee seeks medical attention from a health professional i.e. physician, chiropractor, specialist, physiotherapist, registered nurse (extended class) or dentist but does not lose any time from work beyond the accident date.

LOST TIME

When an employee does not report for work on the next scheduled shift as a result of a work related injury.

OCCUPATIONAL DISEASE OR ILLNESS

Refers to a condition that results from exposure in a workplace to a physical, chemical, or biological agent to the extent that the normal physiological mechanisms are affected and the health of the employee is impaired.

EMPLOYEE RESPONSIBILITIES

1. Promptly receive first aid.
2. Notify your supervisor immediately of any injury, including injuries which do not require medical attention or lost time.
3. Choose a doctor or other qualified practitioner (hospital, physician, chiropractor, physiotherapist, registered nurse - extended class, dentist).
4. Complete and return all report forms received from the WSIB.
5. In the case of a lost time injury, keep your supervisor updated as to your progress.

SUPERVISOR RESPONSIBILITIES

1. Ensure that first aid is received.
2. Provide transportation for the employee to a medical facility or to their home.
3. Investigate the accident and determine causes and make necessary changes.
4. Send a completed accident report to the Office of Environmental Health and Safety within 24 hours.

CRITICAL INJURY IS DEFINED AS AN INJURY OF A SERIOUS NATURE THAT:

(a) places a life in jeopardy
(b) produces unconsciousness
(c) results in substantial loss of blood
(d) involves the fracture of a leg or arm but not a finger or toe
(e) involves the amputation of a leg, arm, hand or foot, not a finger or toe
(f) consists of burns to a major part of the body
(g) causes the loss of sight in an eye

EXAMPLES OF ALTERED STATE OF CONSCIOUSNESS COULD INCLUDE NEAR DROWNING, ELECTRIC SHOCK, OR SEIZURE.

IN THE EVENT OF A CRITICAL INJURY, SUPERVISORS ARE RESPONSIBLE FOR:

1. Procuring immediate medical attention.
2. Notifying the: University of Toronto Police at: 978-2222
   Office of Environmental Health and Safety at: 978-4467
   Ministry of Labour (8:30 a.m. to 5:00 p.m.): 416-314-5421 or 1-800-991-7454
   (Nights/Weekends/Holidays): 416-325-3000 or 1-800-268-6060
   Appropriate Joint Health and Safety Committee for that workplace
   Appropriate Union member representing the injured employee
   Health & Well-Being Programmes & Services 416-978-8804
3. Ensuring the site of the accident remains undisturbed until a Ministry of Labour inspector has arrived.
4. Preparing a written report of the circumstances of the accident.

Appendix 6. Leave on Overnight Form

LEAVE ON OVERNIGHT

(PLEASE DO NOT TOUCH THIS APPARATUS)

IN CASE OF EMERGENCY OR POWER FAILURE

TURN OFF

ELECTRICITY AT _____

→

WATER AT _____

GAS AT _____

IN EMERGENCIES CONTACT

	NAME / ADDRESS / TELEPHONE #
RESEARCHER	
SUPERVISOR	

PERMIT NUMBER: _____

SUPERVISOR'S SIGNATURE: _____

SAFETY REGISTRATION NUMBER: _____

DESIGNATE OF SAFETY COMMITTEE _____

EXPIRY DATE: _____

Appendix 7. Regulations Concerning the Use of the Rolling Mill

1. Keys to the mill will be kept by D. Grozea and S. Boccia. Authorization must be obtained from one of them before using the mill

2. The mill power box must be always be kept locked when not in use

3. Two people must always be present when mill is in use

4. Room door must be left open when mill is in use

5. Samples must be ed in with a smooth push stick

6. No loose clothing/jewelry may be worn near the mill

7. The mill may only be operated during regular working hours

8. Safety glasses and lab coat must be used

Appendix 8. Non-hazardous Laboratory Glass and Plastics Recycling Program

The Recycling Department maintains a recycling program to recycle non-hazardous glass and plastic from labs around campus. See here for the details:

http://www.fs.utoronto.ca/recycle/Non-hazardous_Lab_GlassandPlastics.htm

Starting summer 2011, caretaking will do exchanges of TOTERS (containers) which will be emptied and reused. The collected material will be recycled.

Users will separate their clean, non-hazardous plastics and glass and place the right material in the right toter.

The MSE toters are placed in Walberg-Pratt basement close to Room 84, since they are too big to fit comfortably inside individual labs.