MARQUETTE UNIVERSITY

COLLEGE OF ENGINEERING

CHEMICAL HYGIENE PLAN AND SAFETY MANUAL

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Preface

The purpose of this document is to furnish Marquette University College of Engineering students, faculty and staff with safety guidelines. These guidelines apply to both the teaching and research laboratories.

A COPY OF THIS MANUAL MUST BE PRESENT IN EVERY LABORATORY AND A SIGNED COPY OF THE CHEMICAL HYGIENE PLAN CLEARANCE FOUND IN THE APPENDIX MUST BE COMPLETED BY EVERY INDIVIDUAL CONDUCTING RESEARCH IN THE FACILITY.

Emergency Telephone Numbers

Public Safety	X6800
Fire, Police, Ambulance	1911
Poison Control Center	266-2222
Enviromental Health and Safety	288-8411

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Part I – Introduction

Policy

Within this manual, the College of Engineering at Marquette University delineates the means for providing a safe and healthy workplace in compliance with the Occupational Safety and Health act of 1970 including CFR 1910.1450 "Occupational Exposure to Hazardous Chemicals in Laboratories."

Objective

This document establishes the Chemical Hygiene Plan and Safety Manual for the College of Engineering. Our objective is to describe correct practices, procedures, operations equipment and facilities to be followed by faculty, students, employees, visitors and any personnel working in a laboratory or stockroom to protect them from potential health hazards presented by chemicals used in these areas and to maintain exposures below safe, specified limits. It is the full responsibility of the faculty, research, and supervisory personnel to know and to follow provisions of this Plan.

Personnel Covered by the Plan

This Plan and Safety Manual applies to all work involving hazardous substances conducted in space assigned to the College of Engineering in Haggerty Hall, Olin Engineering Complex, and labs in Cramer Hall.

Disclaimer

The materials contained in the manual have been compiled to provide a basic safety manual for use in the Marquette University College of Engineering. It is intended to serve as a starting point for good practices and does not purport to specify minimum legal standards. No one should assume that all necessary warning and precautionary measures are contained in the document or that other or additional information on measures may not be required.

Acknowledgement

Many portions of this document were drawn from the ACS pamphlet "Safety in Academic Chemistry Laboratories", the text "Prudent Practices for Handling Hazardous Chemicals in Laboratories", the MIT "Chemical Hygiene Plan and Safety Manual" and the Dartmouth College "Chemical Hygiene Plan and Safety Manual".

Part II – Responsibility, Authority

Department Chairpersons

This person has the responsibility and authority to insure that the Plan and Manual is written, updated and implemented. The individual labs are under direct responsibility of the Principal Investigator and each Principal Investigator is designated and the Chemical Hygiene Officer for their respective laboratories. The Department Chairpersons also have responsibility for the health and safety of faculty, students, employees, visitors and other personnel conducting work in the assigned laboratories of the Departments.

Laboratory Supervisors

The Supervisor's duties as defined in the Plan are the responsibility of the principal investigator (faculty member) in charge of each laboratory. In addition, supervisors of the undergraduate laboratories have comparable responsibilities.

The primary responsibility of the faculty member is to implement the Plan and ensure compliance with the OSHA Laboratory Standard. The faculty member duties include, among other, the following:

- Instruct all personnel to conduct work in accordance with the Department's Chemical Hygiene Plan;
- Define the location of designated areas for work with particularly hazardous substances and ensure that an inventory of these substances is properly maintained;
- Review and approve standard operating procedures for work involving hazardous substances;
- Define hazardous operations, designating safe practices and specifying protective equipment;

- Ensure that all staff receive instructions and training in safe work practices, use of personal protective equipment and procedures for dealing with accidents involving toxic substances;

- Direct all personnel to obtain protective equipment necessary for the safe performance of their job;

- Monitor the safety performance of personnel with regard to required safety practices and techniques;

- Conduct formal laboratory inspections regularly to monitor compliance with existing laboratory procedures and regulation;

- Formulate procedures for dealing with accidents that may result in the unexpected exposure of personnel or the environment to toxic substances;

- Investigate all accidents and report them to the Chemical Hygiene Officer. Institute procedures that will minimize the repetition of accidents;

- Report to the Chemical Hygiene Officer incidents that cause (1) personnel to be seriously exposed to hazardous chemicals or materials, or that (2) constitute a danger of environmental contamination;

- Take action to correct work practices and conditions that may result in the release of toxic chemicals;

- Instruct laboratory personnel to properly dispose of unwanted and/or hazardous chemicals and materials;

- Make copies of the approved Chemical Hygiene Plan and Safety Manual available to the support staff;

- Arrange for non-laboratory personnel (e.g. contractors and support personnel) to be informed of potential hazards they may be exposed to when working in the laboratory and provide proper instruction to minimize the risk of harmful exposure to hazardous substances;

- Ensure that an updated inventory list of particularly hazardous chemicals (e.g. peroxidizable and explosive types, short lived chemicals, etc.) is maintained. Such chemicals should be labeled with date received and a decision date for disposal.

Employees, Staff and Research Personnel

Employees, as defined by the Plan, are those staff personnel under the direction of the faculty member. Employees not under the direction of the faculty member, but who are in an area under the direction of the faculty member, are also subject to the Plan and the standard operating procedures in effect in that area. Also subject to the Plan are all "non-employee" personnel including graduate and undergraduate students, postdoctoral associates and visiting scientists.

It is the responsibility of employees and other non-employee personnel to follow the procedures outlined in the Plan and all standard operating procedures developed under that Plan. These include the following:

1. Understand and follow all standard operating procedures;

2. Understand all training received;

3. Understand the function and proper use of all personal protective equipment. Wear personal protective equipment when mandated;

4. Report, in writing to your supervisor, any significant problems arising from the implementation of the standard operating procedures;

5. Report to your supervisor all facts pertaining to every accident that results in exposure to toxic chemicals and any action or condition that may exist that could result in an accident. Report accidents by filling out the appropriate standard accident forms and forward same to your supervisor or responsible faculty member.

Part III - Information and Training

Initial Training

All personnel conducting research using chemicals in the College of Engineering must complete the following steps prior to working in areas where chemicals are in use.

- Read and understand the Department's Chemical Hygiene Plan and Safety Manual and submit a signed and dated copy of the Chemical Hygiene clearance to the Principal Investigator. This form also must be signed by the responsible faculty member.

All personnel whose work will involve the use of hazardous substances must attend the Chemical and Waste Handling Seminar conducted by Marquette University Environmental Health and Safety. A record of personnel who have attended the lecture will be maintained by the Marquette University Health and Safety Office. A certificate is provided to the attending individuals which must be present in the laboratory.

Material Safety Data Sheets (MSDS's)

Material Safety Data Sheets (MSDS's) are valuable sources of information on hazardous substances. All personnel who may be exposed to hazardous substances may request a copy of the "Right to Know Pocket Guide for Laboratory Employees". (Genium Publication Corp. 1990). This is an excellent guide to understanding MSDS's as well as delineating safety tips, physical and health hazards, chemical exposure limits, terms and abbreviations on labels and in MSDS's.
MSDSs should be the first source of information about the hazards associated with a chemical. They are available Online from multiple sources.
Typically, MSDSs will contain the following information, usually in separate sections on the sheet:

- name, address, and phone number of manufacturer
- chemical name, synonyms, and Chemical Abstracts (CAS) Number
- physical properties
- a listing of hazardous constituents for mixtures
- health hazard information
- first-aid measures
- fire fighting measures
- handling and storage precautions
- exposure controls/personal protection
- stability and reactivity

Newer MSDSs will contain the following additional information:

- toxicological information
- ecological information
- disposal considerations
- transport information
- regulatory information
- other information

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In addition a number of companies such as Aldrich provide MSDS at their web site.
Other web sites with connections to MSDS data sheets

ttp://siri.org/msds/

http://hazard.com/msds/index.php

Part IV - Safety in the Teaching Laboratories

At the beginning of the semester, any lab which conducts experimentation involving use of chemicals will contain a section explaining lab safety. The purpose of the meeting will be to orient those who may be in contact with chemicals as to safety protocols and basic emergence response actions.

A. The teaching staff and students should become familiar with the location and use of safety facilities and supplies.
   1. Location and proper usage of Personal Protective Equipment (PPE).

   2. Safety showers and eye washes are located in the laboratories and in the corridors. Instructors should tell their students to remember the location of the nearest shower and eye wash to their working areas.

   3. Fire extinguishers are to be used in case of a fire. Breaking the seal on the extinguisher indicates that it has been used.

   4. First aid kits. They should be used without hesitation when an accident occurs.

B. Common sense measures should be followed in the laboratories. For example, acids and bases should be washed off the skin as soon as possible after contact; flammable solvents should never be heated in the open over a flame; reactive chemicals should be mixed slowly with caution, etc. For the safety of the cleaning crew combustibles like paper should be placed in the tall waste containers at the end of the benches; chemicals and noncombustibles like broken glass should be placed in the short waste containers along the wall near the hoods.

C. If an accident occurs, the "Accidental Injury Report" should be obtained and completed immediately and given to the laboratory Principal Investigator. A copy of the report is in the Appendix and should be on hand in laboratories.

D. The procedure for obtaining medical treatment for accidents in undergraduate laboratories is as follows:

   If a minor injury has occurred, the Public Safety Department should be called at # 1911. The accident should be described briefly and a request made to take the injured student to the Student Health Service. Give your location. The Health Service is open from 8:30 a.m. to 4:30 p.m. If injury occurs at some other time, treat it as you would a major injury (see below).

If a major injury has occurred, the Public Safety Department should be called as in the case of a minor injury. The accident should be described briefly and a request should be made to take the student to the emergency room of a hospital. The Public Safety officer will usually take the injured person to Mt. Sinai or Good Samaritan Hospital.

F. An occasional occurrence in the laboratory is the breaking of thermometers with consequent spilling of mercury. The spillage can be picked up as an amalgam. A powder made for this purpose is available from the second floor storeroom. The powder should be used immediately after mercury spillage.

Non-biodegradable chemicals should not be poured into the laboratory sinks. Instead, a bottle will be provided for the students to discard these chemicals. The bottle should be labeled with the name of the chemical and given to the stockroom after it is no longer in use.

G. Laboratory instructors should familiarize themselves with the chemicals being used in an experiment (e.g. corrosiveness, flammability, reactivity, stability and toxicity).

H. Students should be encouraged to wear appropriate clothing including a protective apron or laboratory coat. Long hair should be confined. Open-toed shoes or sandals should be discouraged.

I. Eating, drinking and smoking are not allowed in the laboratories.

Part V - Medical Consultation and Emergency Procedures
Emergencies and Accidents

In case of an injury or accident, it is prudent practice to call Public Safety, 1911 is used in case of emergencies and 8-6800 is used for non-emergencies.

For a minor injury, students can request help by going to the Student Health Service. For major injuries, minor injuries of non-students or when the Health Service is closed, you should request help in going to the Emergency Room of a hospital. The Public Safety officer will usually take the injured person to Mt. Sinai or Good Samaritan Hospital.

Fire

In the event that a fire is uncontrollable, in that it cannot be extinguished by a fire extinguisher, a fire alarm should be sounded. Fire alarms are located near the stairways on all floors. They are activated by lifting. Faculty, students and staff should familiarize themselves with the alarm locations near their offices and laboratories.

Activating the fire alarm will set off a pulsing ringing on all floors of the building. When the fire alarm sounds, the building should be evacuated immediately. Stairs should be used; the elevator should not be used.

Accidents Involving Chemicals

In the event of a toxic spill, follow procedures described in this document. Locate a chemical spill kit and utilize according to instructions, or call Environmental Health and Safety if you are uncertain what procedure to use. Also consult the appropriate MSDS and clean-up promptly when feasible.

Every laboratory door is posted with an information card with the names and phone numbers of personnel to be called in the event of an emergency.

Accident Reports

Accident reports should be filled out describing the nature of all accidents as well as action taken to avoid such accidents in the future. Copies should be sent to the Chemical Hygiene Officer and to the supervisor or faculty member. A spill of a hazardous/toxic substance that occurs outside a designated and confined area also mandates a written report. The Accident Report Form is in the Appendix.

Part VI - Protective Equipment

Personal Protective Equipment (PPE)

Suitable gloves must be worn when handling hazardous/corrosive chemicals. Gloves should be inspected carefully to insure that they are free of holes and tears.
Skin contact with any chemical (obvious exceptions, water, salt, etc.) should be avoided. Glove compatibility and practice guidelines are in the Appendix.

Wearing of laboratory coats or aprons on a regular basis in the laboratory is a sensible way to prevent injury.

Sandals or open toes shoes should not be worn in the laboratory.

Laboratory Hoods

Fume hoods must be used when conducting laboratory experiments with hazardous chemicals. Fume hoods of all sizes are available in the research and instructional laboratories. Obstructions caused by large objects, reagent bottles, etc., can cause turbulence/abnormal air flow patterns, which result in inefficient and dangerous hood operations.

Average face velocity for the 6' and 8' hoods located in the research and advanced chemistry laboratories is 100'/minute. Flows are labeled with a marker, which indicates the maximum safe operating sash height. Safety factors that should be kept in mind when operating within a hood are outlined in "Prudent Practices for Handling Hazardous Chemicals in Laboratories" pp. 199-200. Among these are:

- The hood sash should be maintained in the lowest possible position; this will not only provide optimum fume containment, but the lowered sash may also act, in part, as a safety shield. Keep the sash closed when the hood is not used.

- Keep the hood clean without bottle or equipment clutter. Hoods should not be used for storage of chemicals.

- An emergency plan should be devised in the event of ventilation (power) failure or other unexpected events (fire/explosion) in the hood.

Fire Extinguishers, Safety Showers, Eyewash Facilities and First Aid

Laboratories are equipped with CO_2 extinguishers as well as several other types. Each laboratory must contain at least one fire extinguisher. The seals should not be broken on the release handle. If the seal is broken, then the fire extinguisher needs immediate repressurizing.

- CO_2 extinguishers for Class B (flammable solvents) and Class C fires (electrical. Do not use them in fires involving reactive metals (Na, K, Al, lithium aluminum hydride, etc.).
- Dry Powder extinguishers for Class B & C fires.
- Met-L-X extinguishers for burning reactive metals, metal alloys, hydrides, organometallic compounds (Class D).
- Sand for any type of fire, especially Class D.
- Water extinguishers for Class A fires (wood/paper/trash) only.

The Chemical Hygiene Safety Committee will conduct unannounced laboratory inspections several times each year. These are thorough inspections, which include surveys of safety equipment, fire extinguishers, laboratory housekeeping, hood conditions, chemical and solvent storage, etc.

Chemical Hygiene Plan

Part VII - Standard Operating Procedures for Work with Hazardous Substances

The OSHA Laboratory Standard (29CFR 1910.1450) defines a hazardous substance as "a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents which act on the hematopoietic systems and agents which damage the lungs, skin, eyes or mucous membranes". Highly flammable and explosive substances also comprise an addition al category of hazardous chemicals. PPE and specific handling methods mentioned in MSDS is required.

Carcinogens

In order to familiarize personnel with the classes of compounds and functional groups that have been correlated with carcinogenic activity, a listing of these types is given in Appendix 4. The select carcinogens are asterisked. These compounds are particularly hazardous and there is evidence from human studies that exposure to such chemicals can cause cancer. The listing that follows were drawn from substances identified as carcinogens or potential carcinogens by OSHA, the International Agency for Research on Cancer and publications by the National Toxicology Program.

Reproductive Toxins

These compounds cause chromosomal damage (mutagens) and have lethal or teratogenic effects on fetuses. Many toxins exhibit chronic effects causing damage as a result of lengthy exposures with symptoms, which become evident only after long latency periods. The following Table lists some common chemicals suspected to be reproductive toxins.

acrylic acid	hexachlorobenzene
aniline	iodoacetic acid
benzene	lead compounds
cadmium	mercury compounds
carbon disulfide	nitrobenzene
N, N-dimethylacetamide	nitrous oxide
dimethylformamide (DMF)	phenol
dimethylsulfoxide (DMSO)	polychlorinated and
diphenylamine	polybrominated biphenyls
estradiol	toluene
formaldehyde	vinyl chloride
formamide	xylene

This listing is not complete. Researchers and their supervisors should evaluate compounds used in their work that have similar structures and determine if they should be handled as reproductive toxins. The periods of greatest susceptibility to embryo toxins is the first 17-55 days of pregnancy. Use with extreme caution and follow handling guidelines specifically.

Corrosive Substances

These materials cause destruction or visible alterations in living tissue at the site of contact. Corrosive chemicals include strong acids, strong and some weak (ammonium hydroxide) bases, dehydrating agents (sulfuric acid, sodium hydroxide phosphorous pentoxide, calcium oxide) and oxidizing agents such as hydrogen peroxide, chlorine, bromine.

Irritants

These substances are non-corrosive, but cause reversible inflammatory effects on tissue at the contact side. A very large number of both organic and inorganic chemicals fall into this class and therefore skin contact with almost all chemicals should be avoided.

Toxic and Highly Toxic Agents

OSHA regulations define toxic and highly toxic agents with median lethal dose (LD_{50}) values in the following ranges:

	Toxic	**Highly Toxic**
Oral LD_{50} (albino rates)	50-500mg/kg	<50mg/kg
Skin Contact LD_{50}	200-1000mg/kg	<200mg/kg
Inhalation LD_{50}	200-2000 ppm/air	<200 ppm/air

Hazardous Substances with Toxic Effects on Specific Organs

Substances included in this category include (a) hepatotoxins (substances that produce liver damage such as nitrosamines and carbon tetrachloride); (b) nephrotoxins (agents causing damage to the kidneys, such as certain halogenated hydrocarbons); (c) neurotoxins (substances that produce their primary toxic effects on the nervous system, such as mercury, acrylamide, and carbon disulfide); (d) agents which act on the hematopoietic system (such as carbon monoxide and cyanides that decrease hemoglobin function and deprive the body tissues of oxygen); (e) agents that damage lung tissue, such as asbestos and silica.

Sensitizers

A sensitizer or allergen is a substance that causes allergic reaction in normal tissue after repeated exposure to the substance. Examples of allergens include diazomethane, chromium, nickel, formaldehyde, isocyanates, arylhydrazines, benylic and allylic halides, and many phenol derivatives.

Flammable and Explosive Substances

A number of highly flammable substances are in use in the College of Engineering. Explosive substances are materials that decompose under conditions of mechanical shock, elevated temperature or chemical action, with the release of large volumes of gases and heat. Examples include acetylene, hydrogen, carbon monoxide and hydrogen sulfide. Acetylene and hydrogen are especially dangerous because of their wide flammability limits, which in turn add greatly to their potential fire and explosion hazards.

Procedures for Laboratory Work with Hazardous and Toxic Substances

It is not within the framework of this document to provide standard operating procedures for specific hazardous substances. Too little is known about many of the thousands of compounds that might be involved in research operations. Instead, in the following section, general procedures are suggested for work with any and all hazardous substances.

A Partial List of Good Laboratory Practices

- All work areas should be maintained in a clean and orderly manner.
- Reagent, solvent clutter on floors and in hoods must be eliminated. Also exit obstructions must be eliminated.
- Researchers are required to label all materials used and be aware of their flammability, reactivity, corrosiveness and toxicity.
- All laboratory set-ups should be reviewed for safety by the researchers and coworkers.
- All accidents that require medical attention must be reported .
- Compressed gases must always be secured to avoid being knocked over. Large tanks require belt clamps or chains. Small tanks require a base of a large diameter that clamps on the tank.
- Vacuum pumps should have belt guards. The guards prevent clothing or part of the body form being caught in the pump's moving parts.
- Most refrigerators and freezers in the College of Engineering are for chemicals and should not contain food items. There are a few that are not. These should be clearly marked. Signs should be posted on each unit. A spark from opening and closing the door or from the compressor motor could cause an explosion with these refrigerators and freezers if flammables are stored in them. Flammable liquids for our purposes are liquids that have a boiling point less than 200^{o}C and burn in air.

- Broken glassware should be discarded as soon as possible if not repairable. Repairable broken glassware should be repaired as soon as possible. Glassware and bottles should not be placed on the floor where someone can trip on them.
- Electric cords and wires should be placed where they cannot be tripped on.
- Toxic chemicals should be disposed of when they will no longer be used.
- Solvents should be stored in cabinets provided for this purpose (painted yellow). When in use, the common solvents should be in cans (painted red or stainless steel).
- Researchers must never work with hazardous substances when alone (outside normal hours). Overnight operations must be designed to prevent accidental release of hazardous chemicals by taking appropriate measures, e.g. automatic water turn off devices, wiring of condenser tubing, arranging for periodic inspection of the experiment, etc. Public Safety should be informed where and when a researcher will be alone in a hazardous lab environment.

General Principles

- Be prepared for any accident or eventuality such as a fire, explosion, power failure, etc. Decide in advance what emergency action to take.
- Determine in advance the potential hazards that may be involved with chemicals to be handled and take appropriate preventative measures.
- Avoid all skin contact with hazardous chemicals and conduct your experiments in the hood to prevent inhalation of such chemicals.
- Always assume new compounds and those of unknown toxicity are hazardous and/or toxic.
- Drinking and eating are permitted only in offices and other non-laboratory areas.
- Horseplay, pranks or other acts of mischief are especially dangerous and are absolutely prohibited.
- Avoid skin contact, ingestion and inhalation of hazardous substances. Wearing of gloves, use of aspirators or pipette bulbs (never mouth suction) for filling pipettes, and washing hands after work are important preventive measures you must take when working with hazardous materials. In addition, to prevent inhalation of toxic vapors, gases, and mists, conduct all experiments in fume hoods as discussed earlier.

Part VIII – Disposal and Handling of Chemicals

Department Guidelines for Disposal of Waste Solvents and Chemicals

All Researchers that handle chemicals and chemical waste are required to attend the Waste Handling seminar given by the Environmental Health and Safety department. Proof of attendance (certificate given following attendance) must be present in the lab along with this Hygiene Plan and Chemical Hygiene Clearance documents.

- Waste labels must contain:
  1) name of researcher
  2) date that accumulation of waste began
  3) lab room number
  4) chemicals in bottle (Do not use abbreviations or figures.)
  5) approximate amounts of each chemical

- If the waste is Hazardous, a Red Hazardous Waste sticker should be applied to the container and used for labeling purposes.

- Waste Containers should be stored in a safe location, labeled as the Waste Accumulation site.

- Use as small a container as is reasonable.

- Mercury waste must be stored separately. Keep volumes to a minimum.

- Handlers should contact Environmental Health and Safety when a waste container is in need of disposal and fill out a Chemical Waste Disposal sheet. This sheet is provided in the Appendix.

Removing Chemical Waste entails the following steps:

1) Identifying and labeling the principal hazard and/or precaution to be aware of in disposal (e.g. carcinogen, radioactivity, peroxides, explosive, strong acids/bases, lachrymator, dermal irritant, flammable, etc.).

2) Contacting Health and Safety office for inspection and removal.

Sanitary Sewer (sink drain) Disposal of Chemicals

Marquette University is presently (as of August, 2009) working with Veolia and MMSD to obtain a listing of chemicals and neutralization or dilution procedures for common chemicals that can be disposed of in a sanitary sewer. Currently, we are modeling our disposal practices to those used by the University of Wisconsin Madison Safety Department and the listing provided to them by The Madison Metropolitan Sewage District. A copy of the disposal procedures and listing by chemical is on file in the College of Engineering Environmental Lab SOP and Chemical Safety binder in Olin Room 430.

For chemicals commonly used in each lab, it is advisable to have specific disposal protocols in place and on file in a safety binder or along with the chemical hygiene plan.

When a protocol is not in place for a particular chemical, or the chemical constituents of a solution is unknown, it must be treated as hazardous and collected and disposed of through Environmental Health and Safety chemical waste collection.

A brief 'Sink Disposal' guideline created by Marquette Environmental Helath and Safety department is provided in the Appendix.

Inorganic chemicals and some acids and bases, such as salts, mineral acids, and alkalies, it is preferable to neutralize followed by water dilution before drain disposal. Dilute solutions of inorganic salts may be disposed via drain only if both cation and anion are listed in the 'Sink Disposal' guide in the Appendix.

Water insoluble compounds, lachrymators, amines, mercaptans and other odoriferous materials of those capable of converting to same or toxic types, monomers and highly flammable compounds should <u>never</u> be discharged into laboratory drains. Ethers normally should be disposed of as discussed above (non-halogenated category).

Additional examples of chemicals <u>NOT</u> to be discharged under any circumstances into laboratory drains: mercury and mercury salts, lead compounds, arsenic compounds, chromium compounds, cyanides, nickel salts and complexes, strong oxidizing agents-peroxides and <u>all</u> carcinogens and suspect carcinogens.

Transporting Hazardous Chemicals

Department policy mandates that hazardous chemicals and solvents be carried in approved secondary containers (with handles) made of rubber, metal or plastic. Bottles small enough to be carried in the palm of the hand can be transported by that method. Compressed gas cylinders need to be capped and restrained during transport. Transport of all waste containers is performed by Health and Safety department personnel.

Procedures for Handling Accidental Release and Spills of Hazardous Chemicals including Solvents

Spills must be cleaned up and confined promptly by the person responsible for the spill. If responsibility cannot be determined, then the Chemical Hygiene Officer will take appropriate action and designate a person or persons to help with the clean-up process. Spill control pillows, absorbents, neutralizing agents for acids and bases, as well as pails, brooms, etc. should be present in every lab that utilizes any chemical that requires the specific spill containment. If a spill is large or personnel is not comfortable handling cleanup, the Environmental Health and Safety department should be contacted immediately for advice on how to proceed once personnel have been safely removed from the spill location.
Spills of a highly toxic substance require special handling. In this case, the person responsible should not attempt clean-up alone. Assistance from a supervisor and perhaps the Milwaukee Fire Department may be necessary.
If highly flammable solvents such as diethyl ether, THF, low boiling hydrocarbons are spilled, alert other laboratory personnel immediately. Turn off any spark producing equipment and mop up the spill promptly with spill control pillows.

Procedures for working with Flammable and Explosive Substances

Flammable Solvents

Heating solvents except water must be carried out in a hood. Use of the hood is recommended for the heating of flammable solvents even when the apparatus is enclosed (reflux, distillation), especially when the quantities are significant. A steam bath, heating mantle, oil bath or similar device should be used, but never a flame.
Because some hotplates pose a dual fire hazard**, restrict their use for recrystallization to non-flammable solvents such as carbon tetrachloride and chloroform, solvents with relatively high flashpoints such as ethanol and solvents which boil too high for the steam bath. Do not use them with solvents such as diethyl ether, methanol, pentane, hexane, petroleum ether, benzene and tetrahydrofuran. If the solvent is flammable, be careful to operate the hotplate at the lowest practical temperature and to avoid placing the hot flask in front of the hotplate whence vapors can be drawn inside the device.

Properties of Some Flammable Solvents

Compound	Boiling Point (^{o}C)	Flash Point (^{o}C)	Auto ignition Point
Acetic Acid	118	+40	465
Acetone	56	-17.8	538
Acentonitrile	82	+5	524
Benzene	80	-11	562
Carbon disulfide	46	-30	100
Ethanol	79	12.8	793
Diethyl ether	35	-45	180
Ethyl acetate	77	+7	427
Isopentane	29	-56	420
Isopropanol	83	-12	399
n-Heptane	98	-4	223
n-Hexane	69	21.7	248
Methanol	65	-11	470
n-Pentane	35	-40	309
Tetrahydrofuran	66	-17	321
Toluene	111	+4.4	480

Explosive and Flammable Substances

Any work with explosive materials mandates the use of protective equipment, such as face shields (with snap-on throat protector), gloves and safety shields.
Of the explosive materials handled in the Department laboratories, organic peroxides are the most frequently used and are also among the most dangerous because of their extreme sensitivity to shock, friction, heat, light, oxidizing and reducing agents. Be wary of peroxides contained in screw cap bottles. Twisting the cap may cause an explosion and fire. Organic peroxides are also highly flammable.

Commercially purchased peroxides, such as benzoyl peroxide, t-butyl hydroperoxide, etc., are best stored in a flammable storage or suitably modified refrigerator. Compounds that form peroxides by an autoxidation process are aldehydes, ethers with primary and/or secondary alkyl groups (including acyclic and cyclic types, ketals and acetals), hydrocarbons with allylic, benzylic or propargylic hydrogens, conjugated dienes, enzymes and diynes and saturated hydrocarbons with tertiary hydrogens. Examples of especially dangerous peroxide formers are diisopropyl ether, diethyl ether, THF, divinylacetylene, decalin and 2,5 dimethylhexane. (See Appendix 7)

Procedures for Handling Chemicals that Pose Hazards Because of Acute Toxicity, Chronic Toxicity or Corrosiveness

All work with these substances must be confined to designated laboratory areas such as a given laboratory, laboratory area or a fume hood. The designated areas must be posted with appropriate warning signs.

The listings for carcinogens, select carcinogens, reproductive toxins as well as that for corrosive substances are in this document.

The following Table lists some of the compounds that may be in current use in the Department laboratories and which have a high degree of acute toxicity:

acrolein
acrylic acid
acrylonitrile
allyl alcohol
allylamine
bromine
chlorine
diazomethane
diborane (gas)
1,2-dibromoethane
dimethyl sulfate
ethylene oxide
hydrazine
hydrogen cyanide
hydrogen fluoride
hydrogen sulfide
mercury salts
methyl fluorosulfonate
methyl iodide
nickel carbonyl
nicotine
nitrogen dioxide
osmium tetroxide
ozone
phosgene
sodium azide
sodium cyanide (and other cyanide salts)
thallium salts

An excellent guideline for the procedures and precautions to take when working with these substances is given in "Prudent Practices, Chapter I.B., pp. 30-50."

Chemical Hygiene Plan

In the course of handling any chemical, you must take care that this substance does not accidentally come in contact with another material with which it is incompatible.

An incompatibility guide is provided in the Appendix.

If contact is made, a serious accident could ensue-explosion, fire or generation of a highly toxic or corrosive product.

APPENDIX follows

Chemical Hygiene Clearance

I have read and understood the contents of the Chemical Hygiene Plan and Safety Manual and I am familiar with the hazards associated with the chemicals in use in my work area.

I understand campus, building, and room specific emergency protocols, including locations/contents/function of fire extinguishers, safety showers, eye washes, and first aid kits.

I have discussed chemical handling protocols and waste disposal with my advisor or lab manager.

I,_____, have discussed chemical hygiene procedures with,
faculty member
_____, and he/she is familiar with the hazards associated with
student
the chemicals in use in our laboratory.

_____ _____
student date

_____ _____
faculty member date

Marquette University
College of Engineering

ACCIDENTAL INJURY REPORT

Time and Place of Accident_____

NAME of Injured Person_____

Was Injured person a Student? Yes_____ No_____ Course #_____ Lab Section_____Room_____

NAME and Category of Supervisor_____
(Teaching Assistant, Faculty, etc.)

DESCRIBE Accident (include the injured's activity, equipment and/or chemicals used and part of the body injured and by what)

_____
_____
_____
_____
_____

Nature and Extent of Injury_____
_____

Type of First-Aid, by_____

Student Health Center? Yes_____ No_____

Hospital Treatment? Yes_____ No_____ Name of Hospital_____

Principal Cause(s) of Accident and Injury_____
_____
_____
_____

Aggravating Causes_____
_____
_____

What should be done and by whom to prevent a recurrence of this or similar accidents?

_____
_____
_____
_____

Signature of Injured Person_____ Date_____

Report Filed by_____ Date_____

Please give this Report to the Lab Coordinator.

Glove Compatibility Guide

GLOVE TYPE:	USE:
Butyl Rubber	**Good** for many organics, ketones, esters; **Poor** for aliphatic, aromatic hydrocarbons, halogenated hydrocarbons, gasoline
Natural Latex	**Not Recommended** due to potential for developing latex sensitivity
Natural Rubber	**Good** for very dilute acids and bases; **Poor** for organics
Neoprene	**Good** for acids and bases, peroxides, fuels, hydrocarbons, alcohols, phenols **Poor** for halogenated and aromatic hydrocarbons
Nitrile	**Good** for wide variety of solvents, oils, greases, some acids and bases
Polyvinyl chloride (vinyl, or PVC)	**Good** for acids and bases, some organics, amines, and peroxides; economical; **Poor** for most organics, petroleum solvents
Polyvinyl alcohol (PVA)	**Good** for aromatic and chlorinated solvents; **Poor** for water-based solutions- *water destroys the gloves!*
Silver Shield™	**Good** for wide variety of toxic and hazardous chemicals; provides the highest level of chemical resistance. Flexible laminate glove; **Poor fit**- comes in small, medium, large
Viton™	**Exceptional** resistance to chlorinated and aromatic solvents; **Good** resistance to cuts and abrasions
4H™	**Good** resistance to many chemicals; better dexterity than Silver ShieldTM

Glove Use Prudent Practice Guide

Select gloves based on the materials being handled, the particular hazard involved and the operation.

- Become familiar with ***permeation*** and ***degradation*** characteristics of the glove material in relation to the material being handled. **Permeation** is a process where the chemical seeps through the glove material. **Degradation** is a reduction in one or more physical properties of a glove material due to contact with a chemical. ***Breakthrough time*** is the time lapse between first contact of the chemical with the glove and the time to detection inside the glove. All gloves are permeable…it's just a matter of time.

- Check the glove manufacturers' selection guide, MSDS or other reputable sources for your glove selection determination.

- Visually inspect gloves for discoloration, punctures and other defects.

- Multiple gloves can be worn together; double gloving can prolong the overall breakthrough time.

- A defective glove or the wrong glove may be worse than no glove if it allows chemicals to permeate and be held in prolonged contact with the skin.

- Wear cut resistant gloves, or better yet, tools, for handling broken glassware or for activities where there is the potential of skin puncture. See *MU Prudent Lab Practice: Glassware Safety* for additional information.

- Wear non-absorbent insulated gloves when working with very hot or very cold materials (e.g., Nomex®, Kevlar®, etc.). Older asbestos gloves are prohibited and must be submitted for proper disposal. When handling cryogenic liquids, the gloves must be loose enough to be tossed off easily. See *MU Prudent Lab Practice: Cryogenic Liquids* for additional information.

- Don't ***cross contaminate*** while wearing gloves or when removing your gloves! Remove gloves before leaving the work area or before handling any uncontaminated objects (e.g., keyboard, doorknobs, telephones, pens, etc.).

- Replace gloves when necessary, depending on frequency of use, wear and tare, and the permeation-degradation characteristics for the substance handled.

- Gloves may *not* be appropriate when working with machinery. Check with your lab / studio safety representative for safe machinery work practices.

- If a disposable glove becomes contaminated, remove and replace with a new glove. Never reuse contaminated disposable gloves.

Glassware Safety and Prudent Practices

- Injuries from glassware is one of the leading causes of accident and injury at MU. First time users are particularly vulnerable.

- Inspect glassware for cracks and defects before using. Flaws create tensile stress which causes breakage when the glass is subject to thermal stress (rapid change in temperature), bruise (caused by striking a hard surface) or scratch.

- For heating and pressurized operations, ensure that the appropriate glassware is used. Borosilicate glassware (e.g., Pyrex, Kimax) is recommended for all laboratory glassware except for special experiments that use UV, other light sources or extreme temperatures. Check the manufacturer's data sheets for specifications. Keep in mind that vacuum or pressure can change the temperature limits of the glassware.

- Use carriers to transport glass containers of flammable or corrosive substances. Carriers help protect against breakage and limit dispersion of leaking chemicals.

- Leave at least 10 percent air space in containers with positive closures.

- Never use laboratory glassware to serve food or drinks.

- Perform a hazard assessment and wear appropriate eye and glove protection when working with glassware.

Broken Glass and Glass Disposal:

- Clean all broken glass using a broom and dustpan. Avoid picking up broken glass with your hands; if you do so, use a cut resistant glove.

- Dispose of broken glass properly and label the waste container as "Broken Glass" or similar.

- Contaminated glass must be placed in an appropriate durable chemical waste container.

  Broken mercury thermometers require proper decontamination of the spilled mercury. Please reference the *MU Chemical Hygiene Plan* for additional information on mercury thermometers

Table of Incompatible Chemicals

Chemical	Is Incompatible With
Acetic acid	Chromic acid, nitric acid, perchloric acid, peroxides, permanganates
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Acetone	Concentrated nitric acid and sulfuric acid mixtures
Alkali and alkaline earth metals	Water, carbon tetrachloride or other chlorinated hydrocarbons i.e., powdered aluminum or magnesium, carbon dioxide, halogens, calcium, lithium, sodium, potassium
Ammonia (anhydrous)	Mercury (in manometers, for example), chlorine, calcium hypochlorite, iodine, bromine, anhydrous HF
Ammonium nitrate	Acids, powdered metals, flammable liquids, chlorates, nitrites, sulfur, finely divided organic or combustibles
Aniline	Nitric acid, hydrogen peroxide
Arsenical materials	Any reducing agent
Azides	Acids
Bromine	See Chlorine
Calcium oxide	Water
Carbon (activated)	Calcium hypochlorite, all oxidizing agents
Carbon tetrachloride	Sodium
Chlorates	Ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials
Chromic acid and chromium trioxide	Acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids in general
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals, turpentine
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulfide
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acids (organic or inorganic)
Cyanides	Acids
Decaborane	Carbon tetrachloride and some other halogenated hydrocarbons
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Fluorine	Everything
Hydrocarbons (such as butane, propane)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic acid	Nitric acid, alkali
Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane.

Chemical	Is Incompatible With
Hydrogen sulfide	Fuming nitric acid, oxidizing gases
Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
Nitrates	Sulfuric acid
Nitric acid (concentrated)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, copper, brass, any heavy metals
Nitrites	Acids
Nitroparaffins	Inorganic bases, amines
Oxalic acid	Silver, mercury
Oxygen	Oils, grease, hydrogen, flammable liquids, solids, or gases
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils
Peroxides, organic	Acids (organic or mineral), avoid friction, store cold
Phosphorous (white)	Air, oxygen, alkalis, reducing agents
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium chlorate	Sulfuric and other acids
Potassium perchlorate (also chlorates)	Sulfuric and other acids
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid
Selenides	Reducing agents
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium nitrite	Ammonium nitrate and other ammonium salts
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerine, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulfides	Acids
Sulfuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate (similar compounds of light metals such as sodium, lithium)
Tellurides	Reducing agents

POTENTIALLY EXPLOSIVE CHEMICALS AND REAGENT COMBINATIONS

Table F.1 lists some common classes of laboratory chemicals that have potential for producing a violent explosion when subjected to shock or friction. These chemicals should never be disposed of as such.

Table F.2 lists a few illustrative combinations of common laboratory reagents that can produce explosions when they are brought together or that give reaction products that can explode without any apparent external initiating action.

Shock-Sensitive Compounds

Acetylenic compounds, especially polyacetylenes, haolacetylenes and heavy metal salts of acetylenes (copper, silver and mercury salts are particularly sensitive)

Acyl nitrates

Alkyl nitrates, particularly polyol nitrates such as nitrocellulose and nitroglycerine

Alkyl and acyl nitrites

Alkyl perchlorates

Ammine metal oxosalts: metal compounds with coordinated ammonia, hydrazine or similar nitrogenous donors and ionic perchlorate, nitrate, permanganate o xidizing group

Azides, including metal, nonmetal and organic azides

Chlorite salts of metals, such as $AgClO_2$ and $Hg(ClO_2)$

Diazonium salts, when dry

Fulminates (silver fulminate, AgCNO, can form in the reaction mixture from the Tollens' test for aldehydes if it is allowed to stand for some time; this can be prevented by adding dilute nitric acid to the test mixture as soon as the test has been completed.)

Hydrogen peroxide becomes increasingly treacherous as the concentration rises above 30%, forming explosive mixtures with organic materials and decomposing violently in the presence of traces of transition metals.

N-Halogen compounds such as difluoroamino compounds and halogen azides

N-Nitro compounds such as N-nitromethylamine, nitrourea, nitroguanidine and nitric amide.

Oxo salts of nitrgeneous bases: perchlorates, dichromates, nitrates, iodates, chlorites, chlorates and permanganates of ammonia, amines, hydroxylamine, guanidine, etc.

Perchlorate salts. Most metal, nonmetal and amine perchlorates can be detonated and may undergo violent reaction in contact with combustible materials.

Peroxides and hydroperoxides, organic

Peroxides (solid) that crystallize from or are left from evaporation of peroxidizable solvents

Peroxides, transition-metal salts

Picrates, especially salts of transition and heavy metals, such as Ni, Pb, Hg, Cu and Zn; picric acid is explosive but is less sensitive to shock or friction than its metal salts and is relatively safe as a water-wet paste.

Polynitroalkyl compounds such as tetranitromethane and dinitroacetonitrile

Polynitroaromatic compounds, especially polynitro hydrocarbons, phenols and amines

POTENTIALLY EXPLOSIVE CHEMICALS AND REAGENT COMBINATIONS

Potentially Explosive Combinations of Some Common Reagents

Acetone + chloroform in the presence of base

Acetylene + copper, silver, mercury or their salts

Ammonia (including aqueous solutions) + Cl_2, Br_2 or I_2

Carbon disulfide + sodium azide

Chlorine + an alcohol

Chloroform or carbon tetrachloride + powdered Al or Mg

Decolorizing carbon + an oxidizing agent

Diethyl ether + chlorine (including a chlorine atmosphere)

Dimethyl sulfoxide + an acyl halide, $SOCl_2$ or $POCl_3$

Dimethyl sulfoxide + CrO_3

Ethanol + calcium hypochlorite

Ethanol + silver nitrate

Nitric acid +acetic anhydride or acetic acid

Picric acid + a heavy-metal salt, such as of Pb, Hg or Ag

Silver oxide + ammonia + ethanol

Sodium + a chlorinated hydrocarbon

Sodium hypochlorite + an amine

Chemicals that React Explosively with Water

This appendix lists some common laboratory chemicals that react violently with water and that should always be stored and handled so that they do not come into contact with liquid water or water vapor. They are prohibited from landfill disposal, even in a lab pack, because of the characteristic of reactivity. Procedures for decomposing laboratory quantities can be obtained from the Safety Committee Chairman.

Alkali metals
Alkali metal hydrides
Alkali metal amides
Metal alkyls, such as lithium alkyls and aluminum alkyls
Grignard reagents
Halides of nonmetals, such as BCl_3, BF_3, PCl_3, PCl_5, $SiCl_4$, S_2Cl_2
Inorganic acid halides, such as $POCl_3$, $SOCl_2$, $S0_2Cl_2$
Anhydrous metal halides, such as $AlCl_3$, $TiCl_4$, $ZrCl_4$, $SnCl_4$
Phosphorous pentoxide
Calcium carbide
Organic acid halides and anhydrides of low molecular weight

Chemicals that React Explosively with Air

Many members of the following readily oxidized classes of common laboratory chemicals ignite spontaneously in air. Pyrophoric chemicals should be stored in tightly closed containers under an inert atmosphere (or, for some, an inert liquid), and all transfers and manipulations of them must be carried out under an inert atmosphere or liquid. Pyrophoric chemicals cannot be put into a landfill because of the characteristic of reactivity. Suggested disposal procedures can be obtained from the Safety Committee Chairman.

Grignard reagents, RMgX
Metal alkyls and aryls, such as RLi, RNa, R_3Al, R_2Zn
Metal carbonyls, such as $Ni(CO)_4$, $Fe(CO)_5$, $Co_2(CO)_8$
Alkali metals such as Na, K
Metal powders, such as Al, Co, Fe, Mg, Pd, Pt, Ti, Sn, Zn, Zr
Metal hydrides, such as NaH, $LiAlH_4$
Nonmetal hydrides, such as B_2H_6 and other boranes, PH_3, AsH_3
Nonmetal alkyls, such as R_3B, R_3P, R_3As
Phosphorus (white)

Marquette University

Chemical Waste Inventory Disposal Dept._____

Date _____ Location/Room# _____ Page _____ of_____

Person(s) doing inventory/Contact Person(s)_____ **Phone Ext.**_____

Chemical Name/Description	(S)olid (L)iquid or (G)as	Container Size	Total Quantity Weight/ Volume	Container Type	Number of Containers	Acutely Hazardous "P" or "F" Waste? Yes or No	Comments

03/23/01

SINK DISPOSAL (Preliminary Guideline)

The following materials are the only allowable discharges to laboratory sinks:

- Inorganic solutions with pH between 5.5 and 12
- Soaps / detergents
- Mercury-free bleach, Cidex OPA, Quatricide, Cetylcide II solutions
- Infectious/Biological materials that have been properly treated as described in each lab's chemical hygiene procedure
- Non-contaminated growth media
- Purified biological materials such as amino acids and proteins in aqueous or buffer solutions
- Sugars and sugar alcohols (polyols) such as glycerol, xylitol and sorbitol
- Buffer solutions
- Spent photo developer (not fixer)
- Inorganic salts for which both the cations and anions are listed in the following table:

Cations	Anions
Aluminum, Al^{3+}	Borate, BO_3^{3-}, $B_4O_7^{2-}$
Ammonium, NH_4^+	Bromide, Br^-
Calcium, Ca^{2+}	Carbonate, CO_3^{2-}
Cesium, Cs^+	Choride, Cl^-
Iron, Fe^+	Bicarbonate, HCO_3-
Lithium, Li^+	Bisulfite, HSO_3-, Bisulfate, HSO_4-
Magnesium, Mg^{2+}	Fluoride, F^-
Manganese, Mn^{2+}, Mn^{3+}, Mn^{4+}, Mn^{7+}	Hydroxide, OH^-
Potassium, K^+	Iodide, I^-
Sodium, Na^+	Nitrate, NO_3-, Nitrite, NO_2-
Strontium, Sr^{2+}	Oxide, O^{2-}
Tin, Sn^{2+}	Phosphate, PO_4^{3-}
Titanium, Ti^{3+}, Ti^{4+}	Sulfate, SO_4^{2-}, Sulfide, SO_3^{2-}
Zirconium, Zr^{2+}	Thiosulfate, $S_2O_3^{2-}$

All other materials must be collected and managed as hazardous waste. Refer to Marquette University's Chemical Disposal Guide.

Sulfuric, Hydrochloric, Nitric, Phosphoric and other concentrated acids

#1	Process
pH adjust solutions, COD, Nitrogen, and Phosphorus analysis test methods, stabilizing samples for Metals and VFA analysis.	
#2	**Hazardous Chemicals/Class of Hazardous Chemicals**
Highly Corrosive, Inhalation hazard. Carcinogenic.	
#3	**PPE - Personal protective Equipment**
Skin and Eye Protection with every use. Use heavy resistant gloves when handling larger aliquots. Avoid Inhalation of fumes.	
#4	**Engineering/Ventilation Controls**
Always use and handle large concentrated aliquots in fume hoods	
#5	**Special Handling Procedures and Storage Requirements**
Read MSDS prior to use (hard copy or siri.org/msds). Keep tightly closed. Avoid contact with strong caustics, oxidizers, or metals. Containers should be stored in a cool, dry, well ventilated area away from incompatibles, reactive, powdered metals, and flammable materials. Store stocks in vented Corrosive cabinet.	
#6	**Spill and Accident Procedures**
Small spills: Do not attempt clean-up if you feel unsure of your ability to do so or if you perceive the risk to be greater than normal laboratory operation. Absorb liquid with vermiculite or sand. Collect and transfer to EH&S for disposal. Neutralize surfaces with spill kit contents for acids. Large Spills: Notify others in the area. Evacuate room and notify EH&S.	
#7	**Waste Disposal**
Label waste container on start date. Store in spill containment. Most can be disposed of waste through EH&S. May be diluted, neutralized, and disposed of in sanitary drain per chemical hygiene plan and "Prudent practices for disposal of chemicals from laboratories."	
#8	**Approval Required**
Acknowledgement of reviewing this sheet, MSDS, and general lab safety and cleanup protocols.	
#9	**Decontamination Procedures**
Remove any contaminated clothing and wash skin thoroughly with soap and water as well as environmental surfaces. Flush eyes for at least 15 minutes with water. Seek medical attention for follow-up.	
#10	**Designated Area**
Use concentrated forms in chemical fume hoods in Room 430.	

Training Acknowledgement: ***I have read, asked questions, and understand the hazards of and safe working procedures for the activity/materials described herein.***

Name_____**Date**_____
Name_____**Date**_____
Name_____**Date**_____
Name_____**Date**_____

Strong Bases: Ammonium Hydroxide, Potassium Hydroxide, Sodium Hydroxide

#1	Process
pH adjust solutions and reactors.	
#2	**Hazardous Chemicals/Class of Hazardous Chemicals**
Extremely Corrosive, Extreme Health hazard, Moderate Reactivity, Severe Irritant.	
#3	**PPE - Personal protective Equipment**
Skin and Eye Protection with every use. Use heavy resistant gloves when handling larger aliquots. Avoid contact and Inhalation of fumes.	
#4	**Engineering/Ventilation Controls**
Always use and handle large concentrated aliquots in fume hoods	
#5	**Special Handling Procedures and Storage Requirements**
Read MSDS prior to use (hard copy or siri.org/msds). Keep tightly closed, very hygroscopic. Avoid contact with acids and organic halogen compounds. Contact with metals such as aluminum, magnesium, and zinc causes formation of flammable hydrogen gas. Can react with sugars to produce carbon monoxide. Containers should be stored in a cool, dry, well ventilated area away from incompatibles, reactive, powdered metals, and flammable materials. Store stocks in vented Corrosive cabinet.	
#6	**Spill and Accident Procedures**
Small spills: Do not attempt clean-up if you feel unsure of your ability to do so or if you perceive the risk to be greater than normal laboratory operation. Absorb liquid with vermiculite or sand. Collect and transfer to EH&S for disposal. Neutralize surfaces with spill kit contents for acids. Large Spills: Notify others in the area. Evacuate room and notify EH&S.	
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#10	**Designated Area**
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Name_____Date_____
Name_____Date_____
Name_____Date_____
Name_____Date_____

General Flammables: Acetone, Alcohols, Hexane, Methanol

#1	Process
Solvent extractions, surface sterilization and cleaning.	
#2	**Hazardous Chemicals/Class of Hazardous Chemicals**
Highly Flammable, Moderate to extreme health (poisons), moderate to severe contact. Effects skin and eyes, mucous membranes, central nervous system. Vapors may cause lightheadedness, and can lead to unconsciousness and death.	
#3	**PPE - Personal protective Equipment**
Skin, Eye, and Lab Coat Protection with every use. Use proper gloves when handling larger aliquots. Avoid Inhalation of fumes, use larger aliquots in fume hood. Be aware of location of general purpose or class B fire extinguishers.	
#4	**Engineering/Ventilation Controls**
Always use and handle large concentrated aliquots in fume hoods, and isolated from heat/spark sources.	
#5	**Special Handling Procedures and Storage Requirements**
Read MSDS prior to use (hard copy or siri.org/msds). Store in Flammable cabinet. Keep tightly closed. Avoid contact with strong caustics, strong oxidizers (nitrates, perchlorates, etc.), or metals. Containers should be stored away from incompatibles such as nitric and sulfuric acid mixtures, oxidizing materials, chloroform, alkalis.	
#6	**Spill and Accident Procedures**
Small spills: Do not attempt clean-up if you feel unsure of your ability to do so or if you perceive the risk to be greater than normal laboratory operation. Absorb liquid with vermiculite or sand. Collect and transfer to EH&S for disposal. Provide adequate ventilation, remove heat/spark sources. Large Spills: Notify others in the area. Evacuate room and notify EH&S.	
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Name_____**Date**_____
Name_____**Date**_____
Name_____**Date**_____
Name_____**Date**_____

Organic Solvents: Chlorinated Ethenes, Benzene, Toluene, Xylene, Methylene Chloride

#1	Process
Solvent extractions.	
#2	**Hazardous Chemicals/Class of Hazardous Chemicals**
Highly Flammable, Moderate to extreme health (poisonous, carcinogen, mutagenic), moderate contact. Effects skin and eyes, mucous membranes, central nervous system, kidneys, liver function, blood disorders. Vapors may cause lightheadedness, and can lead to unconsciousness and death.	
#3	**PPE - Personal protective Equipment**
Skin, Eye, and Lab Coat Protection with every use. Use proper gloves when handling larger aliquots. Avoid Inhalation of fumes, use larger aliquots in fume hood. Be aware of location of general purpose or class B fire extinguishers.	
#4	**Engineering/Ventilation Controls**
Always use and handle large concentrated aliquots in fume hoods, and isolated from heat/spark sources.	
#5	**Special Handling Procedures and Storage Requirements**
Read MSDS prior to use (hard copy or siri.org/msds). Store in Flammable cabinet. Keep tightly closed. Avoid contact with strong acids, caustics, strong oxidizers (nitrates, perchlorates, etc.). Containers should be stored away from incompatibles such as nitric and sulfuric acid mixtures, oxidizing materials, chloroform, alkalis.	
#6	**Spill and Accident Procedures**
Small spills: Do not attempt clean-up if you feel unsure of your ability to do so or if you perceive the risk to be greater than normal laboratory operation. Absorb liquid with vermiculite or sand. Collect and transfer to EH&S for disposal. Provide adequate ventilation, remove heat/spark sources. Large Spills: Notify others in the area. Evacuate room and notify EH&S.	
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