MONTANA
TECHNOLOGICAL UNIVERSITY

Chemical Hygiene Plan

Revised 2024

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Table of Contents

MONTANA
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STATEMENT OF POLICY

On January 1, 1990, the Federal Occupational Safety and Health Administration (OSHA) adopted the Occupational Safety and Health Standards for Hazardous Chemical in the Laboratories Final Rule (29 CFR 1910.1450, hereinafter referred to as the Laboratory Standard), which regulates exposure to hazardous chemicals in the laboratories.

Montana Tech's policy is to comply with all applicable requirements of the Laboratory Standard by addressing the unique exposure conditions under which laboratory work is performed, and to protect laboratory workers from adverse health effects that may result from their work in laboratories, regardless of what hazardous substances are used.

Accordingly, this Chemical Hygiene Plan (CHP) was developed for Montana Tech, Butte, Montana. The CHP is readily available to laboratory employees in all Montana Tech labs and can also be obtained from the Office of Environmental Health and Safety (EHS.)

The purpose of the CHP is to set forth procedures, equipment, personal protective equipment and work practices to protect employees from the health hazards presented by hazardous chemicals used at Montana Tech. The CHP includes standard operating procedures for safety and health, criteria for the implementation of control measures, measures to ensure proper operation of engineering controls, provisions for training and information dissemination, provisions for medical consultation, designation of responsible personnel, and identification of particularly hazardous substances.

All laboratory personnel must know and follow the procedures outlined in this plan. All operations performed in the laboratory must be planned and executed in accordance with the procedures in the CHP. In addition, all laboratory participants are expected to develop safe personal chemical hygiene habits aimed at the reduction of chemical exposures to themselves, coworkers and students.

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CHEMICAL HYGIENE RESPONSIBILITIES

The Chancellor has ultimate responsibility for chemical hygiene within the institution, and with other administrators, provides continuing support for institutional chemical hygiene.

The Environmental Health and Safety Director will serve as the Chemical Hygiene Officer (CHO). The CHO will:

- Enforce the provisions of the CHP on behalf of and in concert with, the Safety Committee.
- Help departments develop precautions and aid in complying with the CHP.
- Conduct laboratory surveys.
- Maintain relevant records.
- Provide information relative to regulated substances and their proper use.
- Accompany any regulatory inspector having jurisdiction over health and safety matters.
- Serve as a resource to deans, department heads, and program managers in identifying chemical hygiene issues.

Montana Tech's Safety Committee is responsible for ensuring that the College complies with the CHP, and accurately and completely meets institutional needs and regulatory mandates. The Committee will administer and enforce the provisions of Montana Tech's CHP, and will revise or modify it as necessary. The Vice Chancellor for Administration and Finance shall appoint the members of the Safety Committee.

Deans, Department Heads and Program Managers will:

- Have overall responsibility for chemical hygiene in the laboratory but may delegate some of the duties below to the lab director or other competent person.
- Ensure laboratory employees and students are informed of, and follow, the chemical hygiene rules and procedures.
- Ensure the appropriate personal protective equipment (gloves, lab coats, goggles, etc.) and health and safety equipment (shields, spill control materials, etc.) are available and used as required.
- Ensure the appropriate chemical hygiene training has been provided.
- Conduct a visual survey of the laboratory on a periodic basis to ensure safe working conditions.
- Immediately report improperly functioning equipment to the appropriate person(s).
- Ensure accidents are reported immediately to EHS and the Workers' Comp representative.

Laboratory employees and students will:

- Read and follow the lab's CHP, and the safety procedures of the department.
- Read Safety Data Sheets (SDSs) (previously known as Material Safety Data Sheets (MSDSs)) for each chemical used – **prior to initial use**.
- Understand the proper use of personal protective equipment (PPE) and use it as required.
- Understand the proper use of engineering controls, such as fume hoods and use as required.
- Avoid over-exposure to hazardous chemicals, but report symptoms of a chemical exposure to the supervisor.
- Report all spills, accidents and injuries to the supervisor immediately.
- Dispose of hazardous waste according to Montana Tech's procedures.
- Plan and conduct each operation in accordance with the general procedures.
- Maintain good personal chemical hygiene habits.
- Immediately report improperly functioning equipment such as fume hoods to the department head or program manager.

Physical Facilities will:

- Prepare a maintenance schedule for all engineering controls required by the Chemical Hygiene Plan.
- Provide regular maintenance of laboratory equipment such as safety showers, eyewashes, filters, and fume hoods, etc. in accordance with the approved maintenance schedule.
- Promptly repair improperly functioning equipment or notify the proper authorities if the repairs can't be done.
- Notify affected laboratory personnel prior to removal or shut down of utilities or laboratory safety equipment.
- When appropriate, work with Deans, Department Heads and Program Managers to develop cost-effective techniques and systems to deal with chemical hygiene problems.

LABORATORY FACILITIES

All laboratory facilities at Montana Tech shall have:

- Properly functioning laboratory fume hoods for operations that give off noxious odors, flammable or poisonous vapors, or radioactive materials and that:
    - are vented so that a minimum average face velocity of 100 feet per minute, with minimum face velocity at any point not less than 75 feet per minute, is provided;

  - whenever possible, have ducted exhaust fans located outside the building on the roof;
  - in circumstances where perchloric acid is heated above ambient temperature, must contain washdown provisions to remove trapped vapors within the hood and duct exhaust system.
- Fully charged ABC or carbon dioxide fire extinguishers located at the laboratory exit and within 50 feet of any point in the laboratory. At least one fire extinguisher shall be provided for each 2500 square feet of laboratory area.
- A fixed overhead or flexible handheld deluge shower and eyewash located within the work area where the eyes or body of any person may be exposed to injurious corrosive materials.
- Properly functioning laboratory sinks and drains.
- Appropriate spill control material/equipment such as sodium bicarbonate for acid spills, boric or citric acid for alkali spills, activated charcoal for organic solvent spills, or commercial spill control pads, pillows and booms.
- A campus telephone prominently labeled with emergency phone numbers for fire and medical emergencies, facilities emergencies and EHS. Areas without a campus phone will have an emergency phone numbers list posted.

Maintenance
Physical Facilities personnel will regularly inspect and test eyewash units and safety showers at least once every month. Physical Facilities personnel shall check fire extinguishers within and outside the laboratory monthly. Malfunctioning safety equipment and discharged fire extinguishers should be reported immediately to Physical Facilities for prompt repair or replacement.

Evaluation
The quality and quantity of local exhaust ventilation shall be evaluated upon installation and whenever a change in local ventilation devices is made. Hood face velocity shall be inspected yearly by an outside contractor. Facilities is in charge of the contract. Hood face velocity may be periodically measured by EHS, or upon request.

CONTROL MEASURES

All laboratory personnel who handle hazardous chemicals must comply with the following standard operating procedures. In addition, project directors and principal investigators must develop written safety protocols for any research projects involving specific hazards of a particular chemical or class of chemicals. Please refer to Appendix A regarding standard operating procedures for “high-hazard” chemicals and physical hazards in the laboratory.

Work Habits

- Be familiar with the chemical characteristics, hazards and exposure limits before using a chemical. READ the SDS!
- Label ALL primary and secondary containers clearly. Check and re-check labels while dispensing, especially when handling more than one chemical.
- Avoid unnecessary or routine exposure to chemicals by any route (inhalation, skin contact, eye contact, ingestion). Be alert to circumstances that can result in inadvertent exposure. Bending down to clean up a spill of an extremely volatile liquid, for example, may result in an inhalation exposure. Chemicals can be absorbed through the skin when clothing, shoes, or lab coats are contaminated with chemicals.
- When diluting a concentrated acid, always add the acid to the water.
- Handle glassware properly and carefully. Do not use damaged glassware. Use extra care with Dewar flasks and other evacuated glass apparatus. Consider shielding or wrapping them to contain chemicals and fragments should implosion occur. Use a designated glass disposal container when disposing of broken glass
- Keep work areas clean and uncluttered, with chemicals and equipment properly labeled and stored. Clean up the work area upon completion of an operation or at the end of each day.
- If possible, do not conduct hazardous operations or procedures alone. If it is not possible to have someone working with you, inform security or someone outside the lab and ask to be checked at regular intervals.
- Leave laboratory lights on when an operation is unattended. Place an appropriate sign on the door, briefly stating the nature of the experiment, contact person, and phone number. Provide for the containment of the toxic substances in the event of failure of an engineering control such as a fume hood or utility service.
- Avoid practical jokes or other behavior that might confuse, startle, or distract another worker.
- Don't underestimate risks. Assume that any mixture will be more hazardous than its most hazardous component and that all substances of unknown toxicity are toxic.

Laboratory Hygiene

- Do not attempt to identify chemicals by smell or taste. Never use mouth suction for pipetting or starting a siphon.
- Avoid eating, drinking, chewing gum, using chewing tobacco, or applying cosmetics in areas where laboratory chemicals are present. Wash hands before conducting any of these activities. Avoid storage, handling, or consumption of food or beverages in chemical storage areas. Refrigerators, glassware, or utensils that are used for laboratory operations must not be used for any other purposes.

- Wear the appropriate personal protective equipment (goggles, gloves, face shield, etc.) as designated by the lab director, supervisor, principal investigator, etc.
- Contact lenses may be worn in laboratories in some cases, however; check with the supervisor before wearing the lenses in the lab. Proper eye protection must still be worn. Regulations prohibit the use of contact lenses when working with methylene chloride, 1,2-dibromo-3-chloropropane, acrylonitrile, ethylene oxide, and methylenedianiline.
- Thoroughly wash areas of exposed skin before leaving the laboratory. Avoid the use of solvents for washing skin. Washing with a solvent may facilitate absorption of a toxic substance.
- Confine long hair and loose clothing. Wear shoes at all times in the laboratory. Do not wear shorts or open-toed shoes in the laboratory.

Engineering Controls

Engineering controls such as laboratory fume hoods, glove boxes, and the design of closed-system experiments are the primary means of controlling or minimizing hazardous chemical releases. Fume hoods provide ventilation to carry away airborne contaminants to the outside. The sash of the fume hood provides shielding to protect the user and also containment for small fires and explosions. Any work performed with chemicals must be adjusted to the quality of the ventilation protection that is available.

Instrument Equipment and Use

Instruments and equipment that operate at high voltage, high pressures, high speeds or high temperatures are dangerous. Be aware of the hazards and use the following precautions:

- Never attempt to operate a machine or instrument until your supervisor has trained you in proper procedures and use. Training must be documented and a copy sent to the EHS office.
- Keep the area around instruments and equipment clear of obstructing materials.
- For vacuum pumps, a cold trap should be placed between the apparatus and the pump to prevent volatiles from getting into hot pump oil and vaporizing into the atmosphere. All vacuum pumps should have a belt guard to prevent hands and clothing from being pulled between the belt and pulley. If you must wear a necktie, wear a clip-on if you are working near machinery with belts and pulleys.
- If possible, connect all exit ports from gas chromatographs, atomic absorption spectrometers and other analytical instruments to an exhaust ventilation system to exhaust toxic contaminants from the laboratory.
- Do not leave oil baths unattended. Place the oil bath in a plastic or metal tray to contain any spills.

Personal Protective Equipment (PPE)

Eye Protection

- Ordinary prescription glasses do not provide adequate protection from injury to the eyes. **Safety glasses are the minimum requirement for laboratory eye protection**. Enclosed chemical goggles or a face shield over your safety glasses must be worn if there is a danger of splashed liquids or shattering glass. If you work with ultraviolet or laser light, wear protective lenses specific for the wavelength.
- Protective eye and face devices must comply with the *American National Standard for Occupational and Educational Personal Eye and Face Protection Devices* (ANSI Z87.1) established by the American National Standards Institute (ANSI).
- Use of contact lenses in the laboratory should be discussed with the supervisor.

Hand Protection

- Skin contact is a potential source of exposure to toxic materials; proper steps must be taken to prevent such contact.
- Appropriate gloves should be available in all laboratories. (Notify the lab supervisor with a latex allergy. Many non-latex products are available.) Be aware that **vinyl and latex gloves offer no protection from many corrosives and organic solvents**. Gloves should be selected on the basis of the material being handled, the particular hazard involved, and their suitability for the operation being conducted. Use the glove compatibility chart in Appendix B to choose the appropriate glove for the chemical(s).
- Be aware all gloves can be permeated by chemicals to some degree. They are not meant to provide protection from prolonged immersion in chemicals. Use tongs to retrieve items from the bottom of an acid bath. Don't reach into any liquid with a gloved hand. Your hand could go deeper than the cuff, or the glove could fail.
- Before each use, gloves should be inspected for discoloration, punctures and tears.
- Before removing any gloves, wash them appropriately to avoid skin contact with the chemical during removal of the glove. For reusable gloves, washing will prolong their useful life and prevent the spread of chemical contamination from the dirty gloves. (Note: Some gloves such as leather and polyvinyl alcohol are water permeable.)
- Gloves should be worn whenever you are handling corrosive materials, rough or sharp-edged objects, very hot or very cold materials, or whenever protection is needed against accidental exposure to chemicals. Gloves should not be worn around moving machinery.

Respiratory Protection

The Occupational Safety and Health Administration (OSHA) has strict requirements for respirator use. This includes a hazard determination, a medical evaluation, a respirator fit-

test, and training. If you think you need a respirator, you must contact the Office of Environmental Health and Safety. The use of engineering controls such as a fume hood or glove box is the preferred method for controlling exposures rather than wearing a respirator.

Clothing

- Wear clothing that protects the skin.
- Shoes should completely cover the feet; sandals are not permitted.
- Wear long pants; no shorts or skirts.
- Use a lab coat for further protection. The coat sleeves keep splashes, aerosols and dusts from touching forearm and wrist.
- Have a plastic or rubber apron available when working with strong caustics or corrosives.

CHEMICAL HYGIENE AND HOUSEKEEPING PROVISIONS

Persons in charge of laboratories on the Montana Tech campus shall conduct a visual survey of their laboratories on a periodic basis (at least monthly) to ensure safe working conditions. See Appendix C for a laboratory monthly checklist. The monthly inspection must be turned into the office of EHS. Some general requirements are listed below.

Safe laboratory working conditions require the following:

- Clear walkways, with unobstructed exits and no slipping/tripping hazards.
- Unobstructed access to safety equipment such as fire extinguishers, eyewashes, and safety showers.
- Equipment in safe operating condition, including: electrical wires in good condition and not overloaded to any one outlet, pumps, belt guards on pumps, all equipment electrically grounded, and refrigerators properly designated and used (food/chemicals/flammables).
- Reasonably neat and clean counter tops and shelves.
- Exposed chemical storage must be limited to daily needs only. Chemicals not required for the procedure(s) in progress are to be stored in the appropriate places (flammable cabinets, acid cabinets, etc.)

STANDARD OPERATING PROCEDURES

Chemical Procurement and Distribution

Montana Tech utilizes a Chemical Inventory Management System. Each department has a Chemical Acquisitions Manager (CAM) who is the "gatekeeper" for chemical acquisitions for the department (purchases, donations, etc.). **Everyone** must go through a CAM to acquire

chemicals. NO EXCEPTIONS! If the departmental CAM is unavailable, another CAM on campus may be used. The OSHA Hazard Communication Standard requires complete inventory of all the chemicals on site. Our chemical management system is designed to ensure all chemicals are inventoried and the safety data sheets are secured for each chemical.

When a chemical is needed, give the CAM all the information for ordering the chemical. The **CAM** will then conduct the following:

- Check the RCRA "P-list" to see if the chemical is a p-listed material. If it is, the user is asked to consider using a less hazardous material, if it is possible.
- Check the campus chemical inventory to see if the chemical is available on campus and if it is available to the person needing the chemical.
- Request the purchase order number and order the chemical(s) requested.
- Receive the chemical when it arrives, add the chemical to the campus inventory by placing a bar code sticker on the container, and enter all the pertinent information into the computer system.
- Ensure a SDS was received and distribute it to the appropriate people and put in the SDS binder in the lab, or department.
- Distribute the chemical to the user for proper handling and storage.
- When a container is empty, remove it from the computer inventory. The CAM must be given the bar code number from the container.
- Make the appropriate changes in the computer if a chemical is redistributed to another person or department or disposed of as hazardous waste.

The CAM must receive the chemical shipments initially to take care of the inventory and SDS requirements.

Chemical Use

Before a substance is used, information on proper handling, storage, and disposal must be made known to those who will be using the chemical or will be exposed to it. The best sources of information are the label and the SDS that accompanies the chemical. The SDSs must be maintained where the chemicals are used and must be readily accessible.

Chemical Labeling

All **primary chemical containers** must be clearly labeled. Labels must provide information on the following:

- Product identifier;
- Signal word;
- Hazard statement(s);

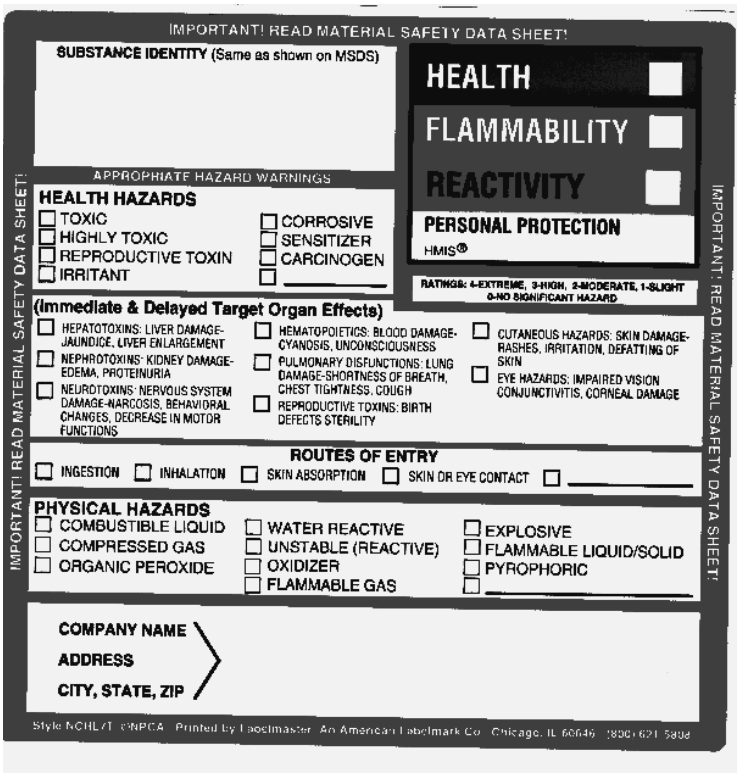
- Pictogram(s);
- Precautionary statement; and,
- Name, address, and telephone number of the chemical manufacturer, importer, or other responsible party.

Storage and handling information and personal protective equipment is not required but is sometimes on the label.

If a chemical is transferred to a **secondary container** the following information is required:

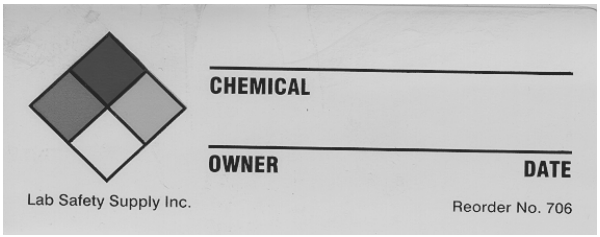
- Product identifier and words;
- Pictures;
- Symbols; or,
- Combination thereof.

The following label is an example of pre-made secondary labels that are available.



The exception to this rule: if the chemical in the secondary container will be used up that day and used only by the person making the transfer, the container does not have to have a label. The Laboratory Standard also exempts test tubes, flasks and beakers from the

complete labeling requirement. However, Montana Tech still requires that some type of identifying label be placed on these containers. It must include what the substance is, the name of the responsible person, and the date.



Labeling Small Bottles

All chemical containers must be labeled to prevent the hazards and disposal problems of unknown chemicals. But labeling many small vials with complete chemical names can be a difficult and tedious task. To make the job easier use these tips:

- Label the entire group. If you have a rack with vials that hold various fractions from a column, label the entire rack with a description of what is contained in the individual vials.
- Refer to your notebook. Give the containers numbers that are referenced in your laboratory notebook.

Expiration dates must be clearly marked for materials known to deteriorate or to become unstable or reactive, including:

- picrics originating at less than 10% hydration
- perchlorates
- peroxides
- peroxidizable materials
- polymerizers that react violently in polymerization or become hazardous after
- polymerization.

Signs and Labels

The following warning signs must be posted at the laboratory entrance if any materials listed below are used or stored in the laboratory:

Water-Reactive Materials
Flammable Gases
Radioactive Material
Biohazard Material

Poisonous Gases

These can be computer generated signs. Warning signs must be posted at areas or near equipment where special or unusual hazards exist, including laser hazards, high voltage hazards, etc. Location signs must be prominently posted to indicate safety showers, eyewash stations, other safety and first aid equipment, exits, and where food and beverage consumption and storage are permitted.

Chemical Transportation

When chemicals of other hazardous materials are being hand-carried, they should be placed in a suitable, break-resistant secondary container, then placed in a suitable outside container or bucket, or in a cart designed for safe transport.

Compressed gas cylinders should always be strapped in a cylinder and the valve protected with a cover cap.

The transportation of chemicals in vehicles on public roads presents additional safety and legal problems. A container of flammable solvent or toxic material ruptured in a road accident drastically increases the risk to your health and makes rescue difficult. Chemicals should never be transported in the passenger compartment of a vehicle.

Chemical Storage and Management

Stocks and inventory of laboratory chemicals need to be actively managed, not just stored. From the time laboratory chemicals are received in lab to the time of disposal, a PI, lab director, and/or CAM needs to maintain the Safety Data Sheets, inventory the chemicals, separate incompatibles, store chemicals safely, and regularly review the status of the chemicals. Stored chemicals must be examined periodically (at least annually) for deterioration and container integrity. Dated chemicals must be disposed of before expiration.

- Hazardous substances shall be stored so that incompatible substances are properly segregated. Refer to the recommended "storage scheme" and Incompatible Chemical List in Appendix D.
- Flammable materials (those with flashpoints <100^{o}F) must be stored in approved flammable cabinets.
- Acids and bases should be stored in acid cabinets, but should NEVER be stored together.
- Use parafilm to make an air-tight seal around the container cap.
- Acids must be stored so that the container does not contact bare metal. Containers of acid can be stored on plastic trays.

- Store nitric acid on plastic away from other acids, bare metals, and wood.
- Never store the following type of chemicals near each other:
    - Organics and acids
    - Cyanide, sulfide or arsenic compounds and acids
    - Alkali or alkali earth metals, alkylithiums, etc., and aqueous solutions
    - Powdered or reactive metals and combustible materials
    - Mercury or silver and ammonium-containing compounds
- Since ethers form explosive peroxides over time, they must be disposed of either 12 months after date of receipt or 6 months after being opened, whichever comes first.
- Store your chemicals in a safe place. Don't use a fume hood for chemical storage - keep it clear for work. For storage of volatile and odorous chemicals, use a ventilated cabinet.
- Avoid exposing chemicals to heat or direct sunlight.
- Use sturdy shelving with ample space for every container. Shelving should have a lip or some method to hold the containers on the shelves.
- Don't store liquids above solids.
- To avoid the risks of lifting and reaching, keep large and heavy items on lower shelves.
- Keep containers off the floor, safe from an accidental kick.
- Use plastic tubs for secondary containment to contain any liquid spills.
- Avoid storing chemicals on shelves more than six feet above the floor. Do not store liquids above eye level.
- Nothing may be stored within 18 inches of a fire sprinkler head on the ceiling. Nothing combustible may be stored within 24 inches of a ceiling.

Storage of Flammable and Combustible Chemicals

Improperly stored flammable and combustible chemicals provide fuel that can lead to a catastrophic laboratory fire. Use the following rules for storing flammable chemicals:

- Minimize the amount of flammable liquids in the lab. Buy only what will be use in the immediate future, and buy the smallest size needed. Excess flammable solvents risk a fire, a dangerous spill, and personal health.
- In the laboratory, store flammables in a UL-approved (or equivalent) flammable storage cabinet. Unless a cabinet is marked as approved for storage of flammable liquids, flammables may not be stored there. In general, flammable liquids may not be stored in cabinets below fume hoods or sinks.
- Do not store flammable liquids in a refrigerator unless it is approved for such storage. Such refrigerators are designed not to spark inside the refrigerator. Explosion-proof refrigerators have all spark sources completely sealed inside and are safe for flammable atmospheres both within and outside of the refrigerator.

- Store flammables, combustibles, and other fuels away from strong oxidizers, such as perchloric and nitric acids.
- On a benchtop, limit the storage of flammable liquids to only those in immediate use.
- Store bottles of liquids in a tray or pan (secondary containment) to catch any spills.
- Use plastic trays for storage of chemicals in freezers. This prevents the bottles from becoming embedded in ice and frost that often forms in freezers. It also contains spills and drips.
- Always bond metals containers to metal receivers when transferring large volumes of flammable liquids or gases.
- Static electricity can ignite flammable gases or vapors. If static electricity is a problem, minimize static electricity by spraying with an anti-static agent. Use conductive materials (floors, mats, etc.) and use grounding straps on instruments and machines. The greatest hazard from static electricity is in the winter when the air is dry.

Distillation of Organic Solvents

Take precautions with distillations and reactions, especially when they run overnight. Use these guidelines for safe distillations:

- Prevent overheating by ensuring that all hoses and connections are securely tightened.
- Always leave a phone number where you can be reached. Post it on the door of your lab so that emergency responders can contact you for information in case of a fire or emergency.
- Use boiling chips or stir bars to prevent bumping during distillation, refluxing, etc.
- Use extreme caution when distilling chemicals that may contain peroxides. Peroxides are most explosive when heated in reduced volumes.
- Use only round-bottom flasks for vacuum distillations. Erlenmeyer flasks are more likely to implode. Vacuum distillations or evaporations should always be shielded in case of implosion.

Cryogenic Liquids / Liquid Nitrogen

Cryogenic liquids are materials with boiling points of less than -100°F (–73°C). These are hazardous because of the physical and chemical characteristics of their super-cooled state. Cryogenic liquids may cause explosions, fires, asphyxiation, tissue destruction or embrittlement of structural materials. Follow these guidelines for using cryogenic liquids:

- Always wear eye protection, preferably a face shield.
- Keep cryogenic liquids away from all sources of ignition.
- Store cryogenic liquids in a well-ventilated area to avoid buildup of flammable gases or the displacement of air.
- Don't use gloves that can be frozen to the skin.

- Handle Dewar flasks carefully, and tape them up thoroughly to prevent the release of a large number of tiny shards of glass in the event the flask shatters.
- Select work materials wisely. Cryogenic liquids alter the physical characteristics of some materials.
- Use extreme care in transporting cryogenic containers. Use a cart for large cryogenic containers.

Compressed Gases

Compressed gases are potentially explosive and must be handled, used, and stored with caution according to the following guidelines:

- Compressed gas cylinders shall always be secured in an upright position with chains, straps or special stands.
- Use a cart to move cylinders and always move cylinders with the protective cap and restraining chain in place.
- Do not open a cylinder until the correct regulator is in place.
- Keep heat under 50° C (122° F) and keep cylinders away from direct sunlight.
- Store and use cylinders containing toxic, flammable, or reactive gases in a fume hood.
- Try to keep only the cylinders that are necessary for current work in your lab.
- Do not tamper, modify, force or lubricate a cylinder valve.
- Do not use an oxygen regulator for any other gas or vice versa. Do not interchange combustible gas regulators with those for oil-free inert gases.
- Never direct high-pressure gases at a person.
- Never use a cylinder that cannot be positively identified.
- Never use compressed gas to clean dust off a work surface or a person.
- In the event of a compressed gas fire, do not try to extinguish until the gas source has been shut off.
- All valves should be shut off securely when not being used.
- Never bleed a cylinder completely. Leave a small amount of pressure to keep contaminants out.
- Use a trap to prevent back-siphonage of chemicals.
- ALWAYS wear safety goggles when working with compressed gases.
- Clearly label empty cylinders as such (EMPTY)
- Store empty cylinders separately from full cylinders.
- Use flashback arrestors if using flammable gas mixtures.

Precautions for Lecture Bottles

Lecture bottles are small gas containers that can become a serious disposal problem. Exotic and toxic gases (e.g., arsine, phosgene and nitrogen dioxide) are often supplied in lecture bottles. The most expensive to dispose of are lecture bottles that are old, have inoperable

valves or have no markings to indicate the contents. Old lecture bottles can leak or spontaneously rupture. Follow these steps to minimize the hazards and cost of lecture bottle disposal:

- Annually inspect your lecture bottles. Examine them for the integrity of their markings, tare weight tags, and for corrosion. Use a soap solution to check for leaks at the valves. Return all lecture bottles to the vendor that you have no plans to use in the immediate future.
- Store them safely. Lecture bottles should be stored in a separate ventilated cabinet. Lay them on their sides with their valves pointed toward the ventilation port.
- Do not store corrosives with lecture bottles. The corrosive vapors of chemicals such as hydrochloric acid or nitric acid can destroy markings and damage valves.
- Track their use. Attach a clipboard to the cabinet or a tag to the cylinder to record dates and the weight of bottles before and after use.
- Buy what you need; use what you buy. Buy only the amount of gas necessary for your work and use it all. Consider the efficiency of sharing gases with other labs.
- Return unwanted or surplus cylinders or lecture bottles to the vendor. Some vendors will take back surplus gas and empty lecture bottles. When buying gases, talk to the vendor about providing this service. Consider the high cost of disposal if the vendor will not accept surplus gases for return.

Hazardous Waste Management

The aim of the waste disposal program is to assure that minimal harm to people, other organisms, and the environment will result from the disposal of waste chemicals, as well as to ensure compliance with all applicable city, state and federal waste disposal regulations.

As a generator of hazardous waste, Montana Tech is legally required to institute a hazardous waste minimization program to reduce the volume or toxicity of hazardous waste, and all departments and programs must participate whenever possible. Refer to Appendix E, Waste Minimization Guide. Montana Tech's chemical purchasing plan is designed to reduce the amount and toxicity of chemicals being brought onto the campus. Other waste minimization methods include:

- Reduce to a minimum the number of different products used.
- Implement micro-level or small-scale operations.
- Order chemicals in smaller containers, and order only the amount of material needed for a project.
- Substitute a less toxic material(s) whenever possible.
- Properly segregate and consolidate wastes.
- Recycle, reclaim, and reuse hazardous materials whenever possible.

- Improve housekeeping practices to reduce the production of waste (i.e. arrange for prompt repairs of leaking equipment or spill cleanup.)

Hazardous waste containers (satellite containers) are permitted in laboratories, provided that the subsequent guidelines are followed:

- Deposit chemical waste in appropriately labeled waste containers (see below). Acceptable containers for waste are:
    - Flammable solvents: glass bottles or metal cans
    - Chlorinated solvents: glass bottles, metal cans (if nonaqueous), or polyethylene containers
    - Contaminated acids: glass bottles or polyethylene containers
    - Contaminated bases: glass bottles or polyethylene containers
    - Solids: glass containers and/or Ziplock plastic bags
    - Silica gel: double plastic bags
    - Broken glass: designated boxes or cans or sharps containers
    - Needles/syringes: approved disposable plastic containers for sharps
    - Solutions of heavy metals: glass bottles
- Hazardous waste containers must be labeled clearly with the words "HAZARDOUS WASTE" or "ACUTE HAZARDOUS WASTE," or the substance name with the word "WASTE" such as 'WASTE TOLUENE," whatever is appropriate.
- A log must be kept of all waste going into the container, including the name of the person adding the waste, the date, and the name, concentration and amount of each chemical added.
- Original chemical shipping containers may be reused as hazardous waste containers if the container is compatible with the waste materials, and the container is re-labeled.
- Waste containers must have caps or lids capable of containing materials if the container is tipped over. Aluminum foil or plastic wrap are not adequate.
- Use the smallest size container possible. Don't put 20 g or 20 ml of waste in a 2.5-liter bottle.
- Leave two inches headspace in liquid containers. Do not fill bottles to the top.
- Segregate solvent wastes into three separate classes/containers:
    - Halogenated (i.e. chloroform)
    - Water miscible, non-halogenated (i.e. acetone, alcohols)
    - Non-water miscible, non-halogenated (i.e. hexane)
- Do not mix inorganic wastes with organic wastes.
- Do not mix heavy-metal wastes with organic wastes.
- NEVER mix mercury compounds with any other wastes.
- Segregate acid waste from base waste, unless you are neutralizing the material. Do not mix either acids or bases with solvents.

- Never mix acute (P-listed) hazardous waste with any other waste as it all becomes acute waste and is more expensive to dispose of.
- Do not accept wastes from outside parties for disposal through Montana Tech.
- A hazardous waste container must be closed during storage except when adding or removing waste. The regulations allow for a hazardous waste container to be opened at the beginning of a laboratory class period (provided that materials are not volatile) so students have easy access to the container. The waste container must be closed securely when the class is over. This exemption does not apply to the performance of research. Hazardous waste containers in research laboratories must be kept closed at all times.
- When a waste container is full or the process or study that created the waste is terminated, the waste can then be transferred to the Office of Environmental, Health and Safety for disposal.

Disposal of hazardous waste chemicals by pouring them down the drain or by adding them to mixed refuse for landfill burial is not allowed. Such chemicals include:

- concentrated acids or bases
- organic solvents
- aqueous solutions containing toxic organic solutes
- heavy metals
- radioactive isotopes
- highly toxic, malodorous, or lachrymatory substances
- substances that might interfere with the biological activity of waste water treatment plants, create fire or explosion hazards, or cause structural damage or impeded water flow.

If there is any doubt as to what chemicals may go down the drain or into the solid refuse stream, refer to the Chemical Disposal Guide, Appendix F.

Other guidelines include:

- Fume hoods must not be used for evaporative disposal of volatile chemicals.
- Unlabeled containers of chemicals and solutions from projects or experiments should undergo prompt disposal. If partially used, they should not be reopened since some substances form unstable decomposition products.
- Before the termination of a research project, chemicals that have been used or processed during the project must be properly disposed of or returned to storage. This procedure should be coordinated through EHS. Proper disposal of all accumulated hazardous chemicals will be the responsibility of the department or research project.

- EHS-approved disposal by recycling, consolidation, or chemical decontamination or deactivation (neutralization, precipitation, etc.) should be used whenever possible.
- Empty, uncapped chemical containers, free of visible residue and contamination, can be placed in the regular trash unless the contents were extremely hazardous.

EMERGENCY RESPONSE

Refer to Montana Tech's Emergency Action and Crisis Protocol Manual for instructions. In addition to the information found in the Manual, the following applies in laboratory situations:

1. Call 9-911
   - Identify yourself and the reason you are calling.
   - Identify the exact location of the emergency.
   - Identify the nature of the emergency, any injuries or symptoms involved.
   - Identify any hazardous materials involved if you know them.
2. For situations that threaten fire or explosion, and spills in which hazardous vapors are present;
   - Evacuate the area and tell others to evacuate. Pull the fire alarm.
   - Call Campus Security who will then notify EHS and Physical Facilities.
   - Close, but do not lock doors behind you to isolate the area.
   - If you have time to do so safely, close fume hood sashes.
   - If you have time to do so safely, post a sign to warn others not to enter the area.
3. Be available to advise emergency response personnel by identifying yourself when they arrive. Someone responsible for that room or building should be present to provide details of the incident to emergency responders. This individual should be able to identify types and quantities of chemicals stored there, and their locations within the rooms.

Fire Safety

Be prepared for fires. Know where the emergency exits, fire extinguishers, and nearest fire alarms are. Your ability to respond quickly and competently with the appropriate fire extinguisher can keep a minor flame from turning into a major conflagration.

Evacuation

- Evacuation of the building is required any time the alarm sounds.
- Exit your laboratory or office, turning off all equipment in your path of travel, and close but do not lock the laboratory door as you exit.

- Exit the building via the staircase. Never use the elevator. Do not reenter the building for any reason until you are permitted to do so by the Fire Department, Security, or Sheriff.

Fire Extinguishing

Extinguishing should only be attempted on small fires that can be extinguished with the available portable fire extinguisher by an individual who has been trained in its use. In general:

- Remove the extinguisher from its bracket, maintain the means of egress to your back to provide a means of escape in the event the fire is not extinguished.
- Remember "PASS"
  - **P**ull the pin
  - **A**im nozzle at the base of the fire
  - **S**queeze the handle to discharge the product
  - **S**hoot the product at the base of the fire, moving the nozzle in a sweeping motion from side to side
- Do not stop the discharge of product from the extinguisher until you have backed away from the fire source.
- Once the fire is extinguished, the Security office (4357), Physical Facilities (4168), and EHS (4463) must be notified for inspection and the proper removal of burned and/or contaminated materials, and replacement of the fire extinguisher.

Explosions

If an explosion occurs, follow the emergency response procedures in the Emergency Action and Crisis Protocol Manual.

- Be aware of secondary explosions, fires, and spills or releases of toxic chemicals due to glass container damage triggered by the first blast.
- Stay clear of windows.

Hazardous Chemical Releases and Spills

Laboratory emergencies require prompt action to prevent or reduce undesirable effects. Laboratory employees must be able to immediately take control of the situation and quickly assess the existing and potential hazards, and carry out the appropriate response actions.

Immediate hazards of fire, explosion, and release of toxic vapors and gases are of prime concern. The following emergency response procedures contain minimum specifications that must be followed by all Montana Tech laboratory workers. In addition, written emergency response actions for specific hazards in the laboratory (such as skin contact with hydrofluoric acid) must be developed by the department, reviewed by EHS, and provided to

the laboratory workers. These written emergency response procedures must also specify the proper spill control equipment or material to be used.

Assessing Spills

Persons causing simple spills are responsible for cleanup to the extent of their abilities and available personal protective equipment.

- A simple spill is defined as one that does not spread rapidly, does not endanger people or property except by direct contact, and does not endanger the environment outside the building. A simple spill can be neutralized, absorbed, or otherwise managed by the user of the chemical.
- No notification of emergency responders is necessary for simple spills. However, the Office of EHS (4463) and Physical Facilities (4399) must be notified for cleanup and disposal issues.
- All other spills or releases should be considered high hazard emergencies, and Emergency Response Procedures should be followed (call 911, etc.)
- Even a small amount of spilled flammable liquid or reactive substance presents a significant fire hazard. There are many spark sources in laboratories. Do not hesitate to evacuate, notify the fire department and pull the fire alarm if you are unsure of the spill's fire potential. When in doubt, get out.
- Any uncontained chemical that can disperse fumes, gases, or dusts may be hazardous to your health and the health of those around you. If you suspect that the spilled or released chemical is toxic, evacuate the area. If others in the area could be exposed to the chemical, evacuate the area or building and follow the Emergency Response Procedures.

Spill Control Equipment

Where appropriate, each department shall make available appropriate spill control items in each laboratory. Items may include commercial spill control products such as absorbent pads, pillows, rolls, booms, etc., and/or other suitable neutralizing or absorbing items such as sodium bicarbonate for acid spills, boric acid or citric acid for alkali spills, or activated charcoal for solvent spills.

Spill Control for Acids, Alkalis and Solvents

As a general guideline, spills of less than 1 liter of these materials are considered small. However, spills of particularly hazardous substances, regardless of the amount spilled, may require immediate EHS notification and assistance. Particularly hazardous substances include select carcinogens, reproductive toxins and substances with a high degree of acute toxicity.

Whenever a spill occurs, treat the spill as a potentially dangerous situation until the spill is cleaned up or there are positive indications (for example, instrumental monitoring) that no hazard is present. Departments, in conjunction with EHS, must develop spill response contingency plans to deal with potential releases of *extremely* hazardous materials that are used in their department.

The following are generic standard operating procedures for chemical spills or releases:

- Quickly assess whether there are any injured persons and attend to any person who may have been contaminated.
- If an emergency exists, follow the Emergency Response Procedures.
- Evacuate the immediate area until the hazardous release has been characterized and controlled. A spill of a hazardous chemical can produce a very dangerous situation or can be fairly minor, depending on many factors, such as chemical toxicity, physical state, vapor pressure, reactivity and temperature.
- In the event of a flammable spill, extinguish ignition sources on your exit route and remotely shut off electrical power to the laboratory, if possible.
- Close the laboratory doors after everyone has safely exited in order to control the potential spread of the release.
- Conduct clean-up of small spills (less than 1 liter) **only** if you have the proper spill control materials and personal protective equipment. Contact EHS if you have any questions about what to use.
    - Wear personal protective equipment such as laboratory coats, eye goggles, face shield, and gloves that will provide chemical resistance protection. Latex surgical gloves do not provide adequate protection against most materials.
    - Respirators may be necessary even in a small spill clean-up, depending on the substance. **Only** those employees who are approved to wear respirators can attempt small spill clean-up requiring respiratory protection.
    - Use proper spill clean-up materials. Commercial pads, pillows, booms, rolls, etc. are available from several manufacturers, but vary in what substances they control. For example, many commercial absorbents cannot be used with a hydrofluoric acid spill clean-up. In addition to commercial products mentioned above, the following can be used:
        - Sodium bicarbonate for acid spills
        - Boric acid or citric acid for alkali spills
        - Activated charcoal for solvent spills
    - Confine the spill to a small area. Do not let it spread. Dispose of all spill clean-up material in an appropriately marked hazardous waste container and label the contents.

- Fill out an incident report form and contact EHS for follow-up and to arrange for proper disposal.

Mercury Spills

Mercury spills present a special problem because of the difficulty in picking up the tiny droplets and the hazards of undetected residues.

- Prevention is the best way to handle mercury. Trays or tubs should be used under equipment wherever a mercury spill is possible.
- Wear gloves when cleaning up mercury spills. Although the main exposure route is through inhalation, it can also be absorbed through the skin.
- Never use laboratory sinks or drains to dispose of mercury or mercury-contaminated waste.
- NEVER ADD MERCURY WASTE TO ANY OTHER WASTE OR VICE-VERSA. It all becomes mercury waste, which is very expensive to dispose of.

Small mercury spills (those of less than 5 milliliters)

- Pick up glass or other large debris, then pick up the spilled metallic mercury. You can use a side arm flask connected to a vacuum pump or sink aspirator to vacuum up small beads.
- Alternately, you can consolidate the spill by using a thin piece of cardboard or plastic. The mercury can be pushed onto another thin piece of cardboard or plastic and transferred to the disposal container.
- Use mercury spill powder, mercury absorbent paper or mercury sponges to decontaminate the area and clean up spill residues.
- Put the mercury into an airtight container labeled, “Waste Mercury.”
- Glassware and other debris that cannot be cleaned will have to be sealed in a container and disposed of as hazardous waste. Contact EHS.
- Glassware and other debris that are clean (no visible mercury) may be discarded in the normal trash.

Broken Mercury Thermometers

Put the mercury in an air-tight container labeled “Waste Mercury” or carefully wrap the sharp ends of the broken thermometer and place in a plastic bag, wide-mouth jar, or other puncture resistant container.

Large mercury spills (greater than 5 milliliters, including spills from manometers and barometers) call EHS. Close off and post the area to prevent mercury or vapors from spreading.

Mercury Spill Powder

A mercury spill powder can be made with the appropriate materials and can be used to clean up mercury spills. Mix 85 grams of finely powdered sodium thiosulfate with 15 grams of finely powdered EDTA. Follow this procedure:

1. Pick up all the large drops of mercury using an aspirator or other means.
2. Sprinkle the powder on the spill area, wet it down with a water mist (pump operated spray bottles work well.)
3. Let it sit overnight.
4. Depending on what is being cleaned up, the powder can be swept up or mopped up. The resultant powder should be disposed of through EHS. Residue from mopping can be discarded down the sanitary sewer.

Biohazard Spills

- Quickly assess whether there are any injured persons and attend to any person who may have been contaminated. Remove contaminated clothing immediately and decontaminate.
- Close the laboratory door.
- To clean up the spill and decontaminate the area, wear personal protective equipment (lab coat, appropriate gloves, and eye protection - safety glasses or goggles). Wear a mask if necessary.
    - Cover spill area with an absorbent material;
    - Apply a 1:10 solution of household bleach (sodium hypochlorite) directly to the spill area;
    - Allow the solution to remain for at least 30 minutes before rinsing;
    - Dispose of all material using a mechanical device such as forceps and place in a BIOHAZARD BAG.
- Notify EHS

Radioactive Spills

Montana Tech has terminated the Nuclear Regulatory Commission (NRC) license; therefore, no radioactive materials may be purchased or brought onto the Montana Tech campus, unless, it meets the requirements of those exempt by regulatory rules and don't require a NRC license.

Minor Spills

- NOTIFY: persons in the area that a spill has occurred.
- PREVENT THE SPREAD: Cover the spill with absorbent paper.
- CLEAN UP: Use disposable gloves and remote handling tong. Carefully fold the absorbent paper and pad. Insert into a plastic bag and dispose of in a radioactive

waste container. Also insert into the plastic bag all other contaminated materials such as contaminated gloves.
- SURVEY: With a low-range thin-window GM survey meter, check the area around the spill, hands, and clothing for contamination.

Major Spills
- CLEAR THE AREA: Notify all persons not involved in the spill to vacate the room.
- PREVENT THE SPREAD: Cover the spill with absorbent pads, but do not attempt to clean it up. Confine the movement of all personnel potentially contaminated to prevent the spread.
- SHIELD THE SOURCE: If possible, the spill should be shielded, but only if it can be done without further contamination or without significantly increasing your radiation exposure.
- CLOSE THE ROOM: Leave the room and lock the door(s) to prevent entry.
- PERSONAL DECONTAMINATION: Contaminated clothing should be removed and stored. If the spill is on the skin, flush thoroughly and then wash with mild soap and lukewarm water.

Leaking Compressed Gas Cylinders

If a leak is suspected, use a flammable gas leak detector or soapy water or other suitable solution. If the leak cannot be remedied by tightening a valve gland or a packing nut, notify the supplier. Laboratory employees should never attempt to repair a leak at the valve threads or safety devices.

The following are generic standard operating procedures:
- Promptly alert the lab director, department head or principal investigator.
- For flammable, inert, or oxidizing gases: move the cylinder to an isolated, well-ventilated area and, if possible, post warning signs describing the hazard and precautions to be taken.
- For corrosive gases: corrosive gases may increase the size of the leak during release, and some corrosives are also oxidizers or flammable. Move the cylinder to an isolated, well-ventilated area, and if possible, use suitable means to direct the gas into an appropriate chemical neutralizer. Post warning signs describing the hazard and precautions to be taken.
- For toxic gases: move the cylinder to an isolated, well-ventilated area and use suitable means to direct the gas into an appropriate chemical neutralizer. Post warning signs describing the hazards and precautions to be taken.
- The cylinder may not be empty even when the leak stops. Proceed with caution.

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MEDICAL PROGRAM

Certain situations or exposure conditions may warrant medical consultation or monitoring of laboratory personnel which will be conducted at no cost to the affected employee. Medical monitoring of laboratory personnel, including follow-up exams, shall occur when:

- An employee develops signs and symptoms of exposure to a hazardous chemical. Such symptoms may include headache, rash, nausea, coughing, tearing, irritation or redness to the eyes, irritation of the nose or throat, dizziness, or loss of motor ability or judgment;
- An employee has direct skin or eye contact with a hazardous chemical;
- A chemical emergency release (spill, leak, fire, explosion) results in the likelihood of a hazardous exposure;
- Air monitoring results reveal an airborne concentration of a hazardous substance routinely above the OSHA action level (or in the absence of an action level, the OSHA PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements.

First Aid

If you have been trained to administer first aid, you can help treat minor injuries or help direct interim measures until medical personnel can take over. The following are first aid procedures that may be useful in a laboratory setting:

- Smoke or other gaseous inhalation: victim should be moved to an area of fresh air, resuscitated with rescue breathing if necessary and given shock prevention treatment (victim lying down, lightly covered to preserve body heat, and comforted to reduce anxiety).
- Chemical splash in the eyes: remove contact lenses if present (if possible) and flush the opened eyes for at least 15 minutes in an emergency eyewash.
- Chemical splash on the body: immediately rinse off the affected area in the nearest emergency shower, or other water source for at least 15 minutes. Immediately remove all contaminated clothing, including undergarments and jewelry. This is no time for modesty. Removing saturated clothing from the victim promptly can greatly reduce the severity of a chemical burn.
- Thermal burns: immerse the burned area in cold water or hold under cold running water until the pain stops. Cover with a sterile dressing.
- Poisons: call the Poison Control Center (9+1-800-525-5042) for advice about poisoning and chemical toxicity.
- Bleeding: if someone else is bleeding and you need to assist, protect yourself with latex or vinyl gloves. Hold a clean pad directly on the wound and apply hand pressure.

If necessary, elevate the bleeding extremity and apply pressure to a pressure point to reduce blood flow.

- Clothing fires: put out burning clothing or hair by dousing the victim in a safety shower or other water source, or by smothering the fire with a cotton lab coat or fire blanket. If these resources are not available, make the victim roll on the ground to put out the flames.
- Always get medical attention for the victim after administering first aid.

REPRODUCTIVE HEALTH IN THE LABORATORY

State and federal laws protect students and employees from discrimination on the basis of pregnancy. These protections are described in the following state and federal laws:

- Montana Law: https://erd.dli.mt.gov/human-rights/human-rights-laws/sex-discrimination/pregnant-employees
- Pregnancy Discrimination Act, an amendment to Title VII of the Civil Rights Act of 1964: https://www.eeoc.gov/fact-sheet/facts-about-pregnancy-discrimination

Pregnancy may raise particular concerns for the safety of the mother or the health of the unborn child. Likewise, there may be particular concerns about effects of workplace hazards on reproductive health.

An overview of student and employee rights as they relate to pregnancy and reproductive health in the laboratory are listed below.

Managing Risk in the Laboratory

Health risks posed in science laboratories vary according to the materials and processes used. Safety in laboratories is managed by administrative and engineering controls as well as through the use of personal protective equipment. While there is no comprehensive list, certain chemical, physical, and disease-causing agents may present particular risks to pregnant women, the fetus or person with reproductive health concerns. Educating yourself about these risks by reading the Safety Data Sheets (SDSs) for chemicals you may be exposed to, and consulting with the instructor, or principal investigator and a licensed health care provider can help you make informed decisions about how you would like to manage these risks.

If you have reproductive health concerns, are pregnant or are planning to become pregnant and are working or studying in a Montana Tech laboratory, be aware of the following:

- You are urged to review and understand the hazard(s) of the workplace or course(s).
- Review the SDSs for chemicals used and stored in the laboratory.
- Understand and follow all safety procedures related to work or study.

- Review the guidance from the National Institute for Occupational Safety and Health (NIOSH):
  - The Effects of Workplace Hazards on Female Reproductive Health: https://www.cdc.gov/niosh/docs/99-104/
  - The Effects of Workplace Hazards on Male Reproductive Health: https://www.cdc.gov/niosh/docs/96-132/
- Consult with your medical care provider.

ACCIDENT REPORTING

All work-related accidents, whether or not an injury occurs, must be reported within one working day (24 hours) to the Personnel Office (4380.) The immediate supervisor or department head shall make the initial investigation and report using the Montana University System (MUS) First Report Injury form. The completed form shall be sent to the Personnel Office within 24 hours of the incident.
Any **non-work-related** incidents involving students or visitors must be reported immediately to the Personnel Office (4380.) If the injury involves a student or visitor, the Montana Tech's Student/Visitor Incident Report form shall be used. The completed form shall be sent to the Personnel Office within 24 hours of the incident.

An accident report **must** be initiated:

- Even if the employee does not seek medical attention. This protects both the employee and Montana Tech. If an employee does not complete a report form and later decides to see a doctor, Montana Tech has no documentation that the accident occurred at work, and the claim may be questioned or challenged by Montana Tech and the Worker's Compensation carrier, and consequently may be denied.
- Even if no injury or property damage resulted from the incident. A "near-miss[1]" signals that something is not right and should be investigated to prevent further incidents.

In the event of the death of any employee from a work-related incident, or the in-patient hospitalization of three or more employees as a result of a work-related incident, Montana Tech shall report the fatality or multiple hospitalization by telephone to the Department of Labor and Industry – Montana Safety Bureau within 8 hours of the accident.

[1] A near miss is defined as an incident that has the potential to cause serious injury or property damage. The incident reveals a physical condition or employee action that could lead to future serious injury or property damage if not corrected.

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EMPLOYEE INFORMATION AND TRAINING

Deans, program managers and department heads are responsible for ensuring that health and safety training is provided to laboratory employees. EHS is available to assist in the training, and assist the department to ensure the proper training requirements are met. The following outline lists what is required by the OSHA Laboratory Standard for training:

- Overview of the OSHA Laboratory Standard
- Hazard recognition:
    - Chemical hazards: fire/explosion, corrosive, etc.
    - Physical hazards: compressed gas cylinders, electrical, etc.
    - Specific laboratory hazards
    - Hazardous substance recognition: signs and symptoms of exposure
    - Labels and Safety Data Sheets (SDS) – prior to use
    - Medical surveillance (i.e. if respirator is required, etc.)
- Hazard Control
    - Engineering controls and safety equipment
    - Work practices
    - Standard operating procedures
    - Personal protective equipment
    - Housekeeping
- Emergency response
    - Fire/explosion
    - Chemical spills
    - Equipment failure
    - Evacuation route and assembly area
- Hazardous waste management
- Resources: SDSs, computer resources, health and safety references

In addition, the principal investigator, department head, researcher, or lab manager has the responsibility to inform his/her laboratory employees of specific hazards related to the work or research conducted in his/her laboratory, as well as any associated methods of control for dealing with those specific hazards.

All employees must be trained at the time of initial assignment and prior to the use of a new hazardous chemical or procedure. The principal investigator, department head, researcher, etc. shall determine when refresher training is needed.

All training must be documented and contain the following information:

- Date of training

- Employee name, signature
- Training outline
- Name of trainer, signature
- Copies of all training documentation must be sent to EHS for evaluation and record retention.

RECORDKEEPING

Accident reports are maintained in the Office of EHS and the Personnel Office.

Laboratory health and safety training records are maintained in the Office of EHS. Any laboratory health and safety training conducted by the department must be documented as noted above and sent to the Office of EHS.

Hazardous waste disposal forms and manifest records are retained by the Office of EHS.

Chemical emergency releases and incident reports are prepared and maintained by the Office of EHS.

Chemical inventory records are maintained in the computer system and are accessible by the CAMs in each department and Office of EHS.

APPENDIX A
STANDARD OPERATING PROCEDURES FOR HIGH HAZARD SUBSTANCES

The OSHA Laboratory Standard requires that special precautions be taken when working with chemicals with high acute toxicity, select carcinogens, and reproductive toxins. If you use a particularly hazardous substance, be sure to specifically address its storage, use, disposal and possible spillage.

A chemical produces toxic effects if it reaches an appropriate site in the body at a concentration and for a length of time sufficient to produce a toxic response. The effects of toxic substances may appear immediately or soon after exposure (acute toxicity), or they may take many years to appear (chronic toxicity).

Acutely Toxic Substances

Acute effects are due to a single exposure or a few exposures usually occurring within the same 24-hour period. Acute health effects range from complete recovery, recovery with some damage, or death. Highly acute toxic chemicals include hydrogen sulfide and hydrogen cyanide.

Chronically Toxic Substances

Chronic effects are due to repeated exposures to low doses of toxic substances, usually over a longer period of time. Chronic illnesses can occur either from a build-up of the chemical in the body or from an accumulation of the damage. Examples of chronically toxic substances are the heavy metals such as mercury (central nervous system impairment), and organic solvents such as n-hexane (peripheral neuropathy). Chronically toxic substances also include carcinogens.

High Toxicity Chemicals

The following table lists some of the most common chemicals which present a particularly severe risk to health (high toxicity chemicals). This list is not intended to be comprehensive, so you should not assume that if a chemical does not appear on it, the chemical presents a negligible risk.

- Acetic anhydride
- Acrolein
- Acrylamide
- Allyl alcohol
- Allyl chloride

- Aniline
- Butylamines
- Chlorine
- Chloronitrobenzenes
- Chromium compounds
- Cresols
- Cyanides
- Diazomethane
- N, N-dimethylaniline
- Dimethyl sulfate
- Epichlorohydrin
- Ethanolamine
- Ethylene chlorohydrin
- Fluorine
- Formaldehyde
- Formic acid
- Hydrazine
- Hydrochloric acid
- Hydrofluoric acid
- Antimony compounds
- Anisidines
- Arsenic compounds
- Soluble barium Salts
- P-benzoquinone
- Benzoyl peroxide
- Hydrogen cyanide
- Hydrogen peroxide
- Indium salts
- Iodine
- Iodomethane
- Isocyanates
- Maleic anhydride
- Mercaptans
- Mercury
- Mercury compounds
- Nickel carbonyl
- Nitric acid
- Nitrobenzene
- Nitro compounds

- Osmium salts
- Oxalic acid
- Ozone
- Phenol
- Phenylene diamines
- Benzoyl chloride
- Beryllium and its Compounds
- Boron tribromide
- Boron trifluoride
- Bromine
- Phenyl hydrazine
- Phosgene
- Phosphorus pentachloride
- Phosphorus pentasulfide
- Phosphorus trichloride
- Phthalic anhydride
- Propylamines
- Pyridine
- Selenium compounds
- Soluble silver salts
- Sulfur dioxide
- Tellurium compounds
- Thallium compounds
- Tetrachlorethane
- Organotin compounds
- Toludines
- Xylidines

Allergens

Chemical allergy is an adverse, antibody-mediated reaction resulting from a prior sensitization to a chemical. As with environmental allergens such as pollen and animal dander, not everyone's immune system will become sensitized to any particular chemical. For those who do develop a chemical allergy, sensitization usually evolves over a 10 to 21-day period, after which even a low dose exposure to the chemical results in an allergic reaction. The reaction itself usually become apparent 12 to 48 hours after exposure, and can range in severity from minor skin disturbances such as inflammation, itching, and redness, to life-threatening anaphylaxis.

Although any compound possesses the potential to elicit an allergic response in some subpopulation of workers, there are some chemicals that induce allergy more commonly than others. Some common allergens include toluene diisocyanate, beryllium, methylmethacrylate, formaldehyde, dinitrochlorobenzene, and powdered vinyl and latex gloves.

Reproductive Toxins

Reproductive toxics are any compounds that interfere with the normal male or female reproductive processes. Reproductive toxins include mutagens and teratogens. Mutagens change a gene in the sperm or egg cell of the parent. The parent is not directly affected, but the offspring is. Teratogens cause damage to the growing embryo or fetus, even when present in small amounts, and cause severe birth defects. Other types of reproductive toxins may cause diminished fertility, embryolethality (death of a fertilized egg, embryo or fetus), retarded growth and postnatal functional deficits.

Carcinogens

A select carcinogen is any substance which meets one of the following criteria:

1. It is regulated by OSHA as a carcinogen;
2. It is listed under the category "Known to be carcinogens" in the Annual Report on Carcinogens published by the National Toxicology Program (NTP);
3. It is listed under Group 1 "Carcinogenic to humans by the International Agency for Research (IARC) Cancer Monographs; or
4. It is listed in either Group 2A or 2B by IARC or under the category "Reasonably anticipated to be carcinogens" by NTP

General Precautions

Check the label and the Safety Data Sheet (SDS) or any current references that list the toxic properties of the substances that you work with. Employ all specified safety measures in addition to the following general precautions.

1. *Establish a designated area*. Use and store these chemicals only in designated, restricted access areas. Post these areas with the appropriate warning signs. Avoid working alone with these materials.
2. *Chemical Storage and Management*. Store breakable containers in chemical resistant trays or tubs. Work surfaces in the designated area should be covered with stainless steel or plastic trays, dry absorbent plastic-backed paper, or other impervious material. Keep an accurate record of your inventory of these chemicals. Store all hazardous waste in closed, labeled, and impervious containers.
3. *Use a containment device*. Work in a fume hood when using volatile chemicals. Use a glove box if a procedure is likely to generate airborne dusts, aerosols, or vapors.

Vapors or aerosols produced by analytical instruments should be captured through local exhaust ventilation at the site of their production or be vented into a chemical fume hood or other suitable containment. Overtly contaminated analytical equipment should be properly decontaminated.

4. *Personal Protective Equipment (PPE).* At a minimum, a long-sleeved fully buttoned lab coat must be worn to protect street clothing. Such lab coats must never be worn outside the lab. Chemical-resistant gloves appropriate for the chemical(s) with which you are working are absolutely necessary. Remember that latex or vinyl gloves provide no protection from many chemicals. Eye protection must also be appropriate for the chemical(s). READ THE SDS to see what is recommended. In the event of contamination of any PPE, remove it immediately and dispose of or decontaminate it.
5. *Vacuum lines* including water aspirators should be protected (e.g., with an absorbent or liquid trap and a HEPA filter) to prevent entry of any high-hazard chemical into the system. When using volatile chemicals, a separate vacuum pump should be used. This device should be placed within or vented into an appropriate laboratory-type hood.
6. *Stock quantities of high-hazard chemicals* must be stored in a clearly designated and labeled storage area or cabinet. Keep working quantities to a minimum.
7. *Any spill or accidental release* of any high-hazard chemical, regardless of the amount, should be reported immediately to EHS (4463). If necessary, treat as a high hazard emergency.
8. *Decontamination Procedures.* If surfaces become contaminated, use a wet mop or a HEPA filtered vacuum cleaner to decontaminate surfaces; never dry-sweep powders. Decontaminate any equipment or glassware removed from the area.
9. *Laboratory personnel of childbearing age* should be informed of any known male or female reproductive toxins in the laboratory. Any pregnant employee or any employee planning to conceive and who is working with reproductive toxins should contact EHS to assess potential exposure and determine whether work practices or controls may have to be instituted to minimize risk.
10. *If hood or equipment failure* occurs, close the hood sash and follow Emergency Response Procedures by evacuating the area and calling 911.

Chemicals that have a Specific OSHA Standard

Due to the hazard of the chemical, OSHA has specific standards for exposure to the following:

- Asbestos
- Coal tar pitch volatiles
- 4-nitrobiphenyl
- Alpha-naphthylamine

- Methyl chloromethyl ether
- Beta-naphthylamine
- Benzidine
- 4-aminodiphenyl
- Ethyleneimine
- Beta-propiolactone
- 2-acetylaminofluorene
- 4-dimethylaminoazobenzene
- N-nitrosodimethylamine
- Vinyl chloride
- Inorganic arsenic
- Lead
- Benzene
- 1,2-dibromo-3-chloropropane
- Acrylonitrile
- Ethylene oxide
- Formaldehyde
- Methylene chloride

If you work with any of the above chemicals, you need to be aware of and comply with the specific OSHA standards governing their use. These standards are above those required by the OSHA Laboratory Standard and, in some cases, may require **special signs, medical surveillance and routine air monitoring** of your workplace. If you use these chemicals routinely, even for short periods of time, contact EHS for a review to assure that your work practices and engineering controls are sufficient to keep your exposures below the OSHA specified limits. The most common of these used in laboratories are formaldehyde (formalin), benzene, and methylene chloride.

- Formaldehyde is a potent irritant, a skin sensitizer, and a carcinogen. The current Permissible Exposure Limit (PEL) for formaldehyde is 0.75 ppm, although the National Institute of Occupational Safety and Health (NIOSH) recommends a threshold limit value (TLV) of 0.016 ppm. The odor threshold for most people is 1 ppm. If you can routinely smell formaldehyde in your work area, you may be overexposed. First try to find a less toxic substitute material. If you must use formaldehyde, perform all operations in a fume hood. Wear splash proof goggles and neoprene, butyl rubber, nitrile or polyvinyl gloves.
- Benzene is a known human carcinogen with an OSHA PEL of 1 ppm. (NIOSH recommends 0.1 ppm.) Generally accepted safety guidance for carcinogen exposure is to limit one's exposure to the lowest level feasible. Perform all operations in a fume

hood, wear splash proof goggles, and check the "Chemical Compatibility Guide for Gloves" in Appendix B. Use a less hazardous substance such as xylene or toluene.

- Methylene chloride is listed as a suspected carcinogen and creates both acute and chronic hazards. The OSHA PEL has been lowered from 500 ppm to 25 ppm. Methylene chloride must be used in a properly functioning fume hood if a less hazardous substitute cannot be found. Proper eye protection and gloves must be worn. OSHA suggests Silvershield or 4H as an inner glove and abrasion-resistant nitrile or neoprene for outer glove protection.

Precautions for Storing Osmium Tetroxide

Osmium tetroxide is used in electron microscopy. It is a strong oxidizer, acutely toxic, volatile and difficult to contain, its storage merits special precautions. Poorly stored osmium tetroxide is an unusually difficult disposal problem.

Generally, all of the osmium tetroxide in an ampule is used at one time, but if surplus needs to be stored, it should be contained in the smallest container possible. This minimizes the amount of vapor in the headspace and the release of volatile hazardous material when the container is opened.

Storage of concentrated solutions (1-5%) is a problem for the electron microscope labs because usually only small amounts are used at a time. Seal spare crystals or solutions in glass ampules, using a flame to melt the glass. To avoid the problems of large surpluses, purchase tetroxide solutions in small, resealable ampules.

Wrapping a ground glass stopper with Teflon tape may adequately contain osmium tetroxide if done carefully. A Teflon or polyethylene stopper in precision ground glass may also work. Plastic snap-on caps on smooth rim volumetric flasks are suitable if they fit correctly. Polyethylene snap-top tubes work as well, but they can splash upon forcing open the snap-top.

Other attempts to contain osmium tetroxide usually fail; even the best ground glass stoppers allow tetroxide to leak. Silicone grease or parafilm wrapping only postpones the eventual leaking.

Precautions for Corrosive Chemicals

Corrosives are materials that cause destruction on contact with living tissue. Precautions for corrosives focus mainly on preventing such contact. Acids with a pH<2 and bases with a pH>12 are especially dangerous.

Eye protection that forms a complete seal around the eyes (goggles) and appropriate gloves must always be used when handling corrosive materials. A face shield over safety glasses, a rubber apron and rubber boots may also be appropriate. An eyewash and safety shower must be readily accessible in areas where corrosives are used and stored.

When mixing acids with water, slowing add the acid into the water. Acids that generate heat during dilution, such as sulfuric, should be mixed over an ice bath to quench the heat.

Acids and bases should be stored separately. Organic acids should be stored in a flammable cabinet, separate from oxidizers and oxidizing acids.

Precautions for Reactive Chemicals

The hazards of reactive chemicals are specific to each chemical's properties. Before working with reactive chemicals, understand their dangers. Read the label for recommended precautions.

With all reactive chemicals, use as small a quantity as possible. When working with reactive chemicals, use a hood sash, a safety shield or a face shield. Segregate your reactive chemicals and store them away from heat and sunlight.

- Oxidizers: Oxidation reactions are a frequent cause of chemical accidents. When stored, segregate oxidizers from flammable and combustible materials, organic material and reducers.
- Pyrophoric Chemicals: Pyrophoric materials (e.g., boranes, n-butyllithium, white phosphorus) ignite spontaneously on contact with air. Avoid a flammable spill by storing breakable glass bottles inside a rubber or plastic bottle carrier. Use and store all pyrophoric chemicals in an inert atmosphere (e.g., stored under nitrogen or argon).
- Shock-Sensitive/Explosive Materials: Shock-sensitive and explosive materials can spontaneously release large amounts of energy when struck, vibrated, dropped or agitated. Some chemicals become increasingly shock sensitive with age, so inspect your stock of reactive chemicals regularly to see if they are degraded and should be disposed of. Many laboratory accidents occur from the inadvertent formation of explosive or shock sensitive materials, such as peroxides, perchlorates and azides.

Precautions for Peroxide-Forming Chemicals

Peroxide-forming chemicals are a class of compounds that have the ability to form shock-sensitive explosive peroxide crystals. Certain chemicals can turn into dangerous organic peroxides with prolonged storage and/or concentration. Therefore, it is extremely important that procedures be followed regarding the identification, handling, storage, and disposal of peroxide-forming chemicals. Peroxide-forming chemicals react with oxygen – even at low

concentrations – to form peroxy compounds. The risk associated with peroxide formation increases if the peroxide crystallizes or becomes concentrated by evaporation or distillation. Factors that affect rate of peroxide formation include exposure to air, light, heat, moisture, and contamination from metals. Avoid the prolonged storage of all peroxide-forming chemicals. Especially dangerous are ether bottles that have evaporated to dryness. The following tables list compounds that are known to auto-oxidize to form peroxides and classes of chemicals that can form peroxides upon aging.

Peroxide crystals may form on the container plug or the threads of the lid and detonate when the lid is twisted. Do not open a liquid organic peroxide or peroxide-forming chemical if crystals or a precipitate are present.

Types of compounds known to auto-oxidize to form peroxides

- Aldehydes
- Ethers, especially cyclic ethers and those containing primary and secondary alkyl groups (never distill an ether before it has been shown to be free of peroxide)
- Compounds containing benzylic hydrogens
- Compounds containing allylic hydrogens (C=C-CH), including most alkenes; vinyl and vinylidene compounds
- Compounds containing a tertiary C-H group (e.g., decalin and 2,5-dimethylhexane)

Classes of Chemicals that can form Peroxides Upon Aging

Class A – Severe peroxide hazard: spontaneously decompose and become explosive to air without concentration

- Butadiene (liquid monomer)
- Chloroprene (liquid monomer)
- Divinyl acetylene
- Isopropyl ether
- Potassium amide
- Potassium metal
- Sodium amide (sodamide)
- Tetrafluoroethylene (liquid monomer)
- Vinylidene chloride

Class B – Concentration hazard: require external energy for spontaneous decomposition. Form explosive peroxides when distilled, evaporated, or otherwise concentrated.

- Acetal
- Acetaldehyde
- Benzyl alcohol

- 2-Butanol
- Cumene
- Cyclohexanol
- Cyclohexene
- 2-Cyclohexen-1-ol
- Decahydronaphthalene
- Diacetylene
- Dicyclopentadiene
- Diethylene glycol dimethyl ether (diglyme)
- Diethyl ether
- Dioxanes
- Ethylene glycol dimethyl ether (glyme)
- Furan
- 4-Heptanol
- 2-Hexanol
- Methylacetylene
- 3-Methyl-1-butanol
- Methylcyclopentane
- Methyl isobutyl ketone
- 4-Methyl-2-pentanol
- 2-Pentanol
- 4-Penten-1-ol
- 1-Phenylethanol
- 2-Phenylethanol
- 2-Propanol
- Tetrahydrofuran
- Tetrahydronaphthalene
- Vinyl ethers
- Other secondary alcohols

Class C – Shock and heat sensitive: highly reactive and can auto-polymerize as a result of internal peroxide accumulation. The peroxides formed in these reactions are extremely shock and heat sensitive.

- Acrylic acid
- Acrylonitrile
- Butadiene (gas)
- Chloroprene
- Chlorotrifluoroethylene
- Methyl methacrylate

- Styrene Vinylpyridine
- Tetrafluoroethylene (gas)
- Vinyl acetate
- Vinylacetylene (gas)
- Vinyladiene chloride
- Vinyl chloride (gas)

Class D – Potential peroxide forming chemicals: may form peroxides but cannot be clearly categorized in Class A, B, or C.

- Acrolein
- Allyl ether
- Allyl ethyl ether
- Allyl phenyl ether
- p-(n-Amyloxy)benzoyl chloride
- n-Amyl ether
- Benzyl n-butyl ether
- Benzyl ether
- Benzyl ethyl ether
- Benzyl methyl ether
- Benzyl-1-napthyl ether
- 1,2-Bis(2-chloroethoxyl)ethane
- Bis(2-ethoxyethyl)ether
- Bis(2-(methoxyethoxy)ethyl) ether
- Bis(2-chloroethyl) ether
- Bis(2-ethoxyethyl) adipate
- Bis(2-methoxyethyl) carbonate
- Bis(2-methoxyethyl) ether
- Bis(2-methoxyethyl) phthalate
- Bis(2-methoxymethyl) adipate
- Bis(2-n-butoxyethyl) phthalate
- Bis(2-phenoxyethyl) ether
- Bis(4-chlorobutyl) ether
- Bis(chloromethyl) ether
- 2-Bromomethyl ethyl ether
- beta-Bromophenetole
- o-Bromophenetole
- p-Bromophenetole
- 3-Bromopropyl phenyl ether
- tert-Butyl methyl ether

- n-Butyl phenyl ether
- n-Butyl vinyl ether
- Chloroacetaldehyde diethylacetal
- 2-Chlorobutadiene
- 1-(2-Chloroethoxy)-2-phenoxyethane
- Chloroethylene
- Chloromethyl methyl ether
- beta-Chlorophenetole
- o-Chlorophenol
- p-Chlorophenetole
- Cyclooctene
- Cyclopropyl methyl ether
- Diallyl ether
- p-Di-n-butoxybenzene
- 1,2-Dibenzyloxyethane
- p-Dibenzyloxybenzene
- 1,2-Dichloroethyl ethyl ether
- 2,4-Dichlorophenetole
- Diethoxymethane
- 2,2-Diethoxypropane
- Diethyl ethoxymethylenemalonate
- Diethyl fumarate
- Diethyl acetal
- Diethylketene
- Diethoxybenzene (m-o-p)
- 1,2-Diethoxyethane
- Dimethoxymethane
- 1,1-Dimethoxyethane
- Di(1-propynl) ether
- Di(2-propynl) ether
- Di-n-propoxymethane
- 1,2-Epoxy-3-isopropoxypropane
- 1,2-Epoxy-3-phenoxypropane
- p-Ethoxyacetophenone
- 1-(2-Ethoxyethoxy) ethyl acetate
- 2-Ethoxyethyl acetate
- (2-Ethoxyethyl)-a-benzoyl benzoate
- 1-Ethoxynaphthalene
- o,p-Ethoxyphenyl isocyanate

- 1-Ethoxy-2-propyne
- 3-Ethoxypropionitrile
- 2-Ethylacrylaldehyde oxime
- 2-Ethlybutanol
- Ethyl-b-ethoxypropionate
- Ethylene glycol monomethyl ether
- 2-Ethylhexanal
- Ethyl vinyl ether
- 2,5-hexadiyn-1-ol
- 4,5-Hexadien-2-yn-1-ol
- n-Hexyl ether
- o,p-Iodophenetole
- Isoamyl benzyl ether
- Isoamyl ether
- Isobutyl vinyl ether
- Isophorone
- b-Isopropoxypropionitrile
- Isopropyl-2,4,5-trichlorophenoxy acetate
- n-Methylphenetole
- 2-Methyltetrahydrofuran
- 3-Methoxy-1-butyl acetate
- 2-Methoxyethanol
- 3-Methoxyethyl acetate
- 2-Methoxyethyl vinyl ether
- Methoxy-1,3,5,7-cyclooctatetraene
- b-Methoxypropionnitrile
- m-Nitrophenetole
- 1-Octene
- Oxybis(2-ethyl acetate)
- Oxybis(2-ethyl benzoate)
- b,b-Oxydipropionitrile
- 1-Pentene
- Phenoxyacetyl chloride
- a-Phenoxypropionyl chloride
- Phenyl-o-propyl ether
- p-Phenylphenetone
- n-Propyl ether
- n-Propyl isopropyl ether
- Sodium 8-11-14-eicosatetraenoate

- Sodium ethoxyacetylide
- Tetrahydropyran
- Triethylene glycol diacetate
- Triethylene glycol dipropionate
- 1,3,3-Trimethoxypropene
- 1,1,2,3-Tetrachloro-1,3-butadiene
- 4-Vinyl cyclohexene
- Vinylene carbonate

References
National Safety Council: Data sheet I-655 Rev. 87
NFPA: NFPA 432, Code for the Storage of Organic Peroxide Formulations
Reactive Hazards Reduction, Inc.
FDNY:3 RCNY chapter § 10-01 – Chemical Laboratories.

Use the following as a guideline to determine safe storage limits for these chemicals.

Peroxide-forming Chemicals

The most hazardous compounds are those that form peroxides in storage without being concentrated. These are materials that can accumulate hazardous levels of peroxides in storage after exposure to air. Peroxide-forming compounds that are hazardous only when concentrated are in the center column. The right column consists of vinyl monomers that can form peroxides that can then initiate explosive polymerization of the monomers. When they are stored as a liquid, the peroxide-forming potential increases and some of the right column monomers (especially butadiene, chloroprene, and tetrafluoroethylene) should be considered a peroxide hazard on storage.

Peroxide hazard on storage: recommended shelf life: 12 months

- Decahydronaphthalene (Decalin)
- Diethyl ether
- Isopropyl ether
- Divinyl acetylene
- Vinylidene chloride
- Ethylene glycol dimethyl ether
- Dicyclopentadiene
- Methyl acetylene
- Tetrahydronaphthalene
- Cyclohexene
- 1-Pentene
- 1-Octene

Peroxide hazard on concentration: recommended shelf life: 18 months

- Acetal
- Dioxane
- Tetrahydrofuran
- Vinyl ether
- Vinyl acetate
- Vinyl chloride
- Vinyl pyridine
- Chlorobutadiene (chloroprene)
- Ethylbenzene
- Methylcyclopentane
- Benzyl alcohol
- 2-Butanol
- 2-Propanol
- 3-Methyl-1-butanol
- 2-Pentanone
- 3-Pentanone

Hazard due to peroxide initiation of polymerization: recommended shelf life: 18 months

- Styrene
- Butadiene
- Tetrafluoroethylene
- Chlorotrifluoroethylene

The chemicals listed as *Peroxide Hazard on Storage*, above, can form polyperoxide chains or cyclic oligoperoxides that are difficult to detect and eliminate. These peroxides can come out of solution and form crystals or a gel in the bottom of the container. They are extremely unstable and can violently decompose with the smallest disturbance, sometimes even spontaneously. Do not store these chemicals more than 12 months, unless tests show that they contain less than 80 ppm of peroxides.

The chemicals listed as *Hazard Due to Peroxide Initiation of Polymerization* can undergo explosive polymerization initiated by dissolved oxygen. Do not store these chemicals more than 18 months, unless tests show that they contain less than 80 ppm of peroxides.

The chemicals listed as *Peroxide Hazard on Concentration* can form hydroperoxides and ketone peroxides. These peroxides are soluble and can be detected with peroxide test strips

or a KI-starch test. It is common to distill these peroxidizable solvents before use, and this concentrates the dissolved peroxides and subjects them to heat and mechanical shock.

To safely distill peroxidizable solvents:

- Eliminate the peroxides with a chemical reducing agent or pass the solvent through activated alumina.
- Add mineral oil to the distillation pot. This has the combined effect of "cushioning" any bumping, maintaining dilution, and serving as a viscous reaction moderator in case the peroxides begin to decompose.
- Carefully monitor the distillation process to ensure that it does not dry out completely, and then overheat.

Reducing Peroxides During Distillation:

Small pieces of sodium metal can be added to the distillation vessel to reduce peroxides. Use benzophenone as an indicator for the presence of sodium metal (benzophenone, in the presence of sodium metal forms a radical with a deep-blue color). When the blue color disappears, add more sodium metal.

Testing Peroxide-Forming Agents

Prior to working with a listed compound, test its peroxide level.

1. Carefully examine the container for date of receipt and overall condition. Containers that show signs of oxidation (e.g., rusty container or cap) or are stored longer than the recommended shelf life should be handled with extreme caution. Do not open or move any of these containers. Call EHS for assistance.
2. If the material is within the recommended shelf life, determine its peroxide content. Refer to the next section on Peroxide Detection Tests.
3. Materials with peroxide levels less than 80 ppm may be used as usual.
4. Any compound containing peroxides in excess of 80 ppm should be treated and disposed.

Peroxide Detection Tests:

The following tests can detect most (but not all) peroxy compounds, including all hydroproxides.

- Peroxide test strips, which turn to an indicative color in the presence of peroxides, are available commercially. Note that these strips must be air-dried until the solvent evaporates and then exposed to moisture for proper operation.
- Add 1 to 3 milliliters (mL) of the liquid to be tested to an equal volume of acetic acid, add a few drops of 5% aqueous potassium iodide solution, and shake. The appearance of a yellow to brown color indicates the presence of peroxides. Alternatively, addition of 1 mL of a freshly prepared 10% solution of potassium iodide

to 10 mL of an organic liquid in a 25 mL glass cylinder should produce a yellow color if peroxides are present.
- Add 0.5 mL of the liquid to be tested to a mixture of 1 mL of 10% aqueous potassium iodide solution and 0.5 mL of dilute hydrochloric acid to which has been added a few drops of starch solution just prior to the test. The appearance of a blue or blue-black color within a minute indicates the presence of peroxides.
- None of these tests should be applied to materials (such as metallic potassium) that may be contaminated with inorganic peroxides.

Disposal of Peroxides

Pure peroxides should never be disposed of directly but must be diluted before disposal. Small quantities (25 g or less) of peroxides are generally disposed of by dilution with water to a concentration of 2% or less, after which the solution can be transferred to a polyethylene bottle containing an aqueous solution of a reducing agent, such as ferrous sulfate or sodium bisulfite. The material can then be handled as a waste chemical. However, it must not be mixed with other chemicals for disposal.

Spilled peroxides should be absorbed on vermiculite or other absorbent as quickly as possible. The vermiculite-peroxide mixture can be burned directly or may be stirred with a suitable solvent to form a slurry. Organic peroxides should never be flushed down the drain.

Large quantities (more than 25 g) of peroxides require special handling. Each case should be considered separately, and handling, storage, and disposal procedures should be determined by the physical and chemical properties of the particular peroxide.

PHYSICAL HAZARDS

Electrical Safety

The careless handling of electrical equipment starts many laboratory fires. Laboratories have stills, waters baths, and other apparatus that can overheat or cause electrical shocks. Minimize electrical safety hazards with the following:

- Before use, check all electrical apparatus for worn or defective insulation and loose or broken connections. Power cords should be checked closely and replaced if found defective.
- Connect all ground wires to clean metal, avoid painted surfaces. Use three-prong grounded plugs whenever possible.
- Keep electrical wires away from hot surfaces.
- Don’t allow water to leak on electrical wires, switches and outlets.

- Avoid the use of extension cords. The Butte-Silver Bow Fire Marshall only allows extension cords for temporary situations. The cord must be grounded.
- Never touch a switch, outlet or other source of electrical power with wet hands.
- Avoid using homemade or makeshift wiring. Call a qualified electrician for wiring.
- To minimize static electricity and sparks in hazardous areas and in handling flammable solvents and other chemicals, containers and equipment should be properly grounded and bonded, and blanketed with inert gas when needed.

Laser Hazards

- Personnel should use light-tight interlocked enclosures to enclose the laser beam.
- Wear laser safety eyewear whenever working in any laboratory where a laser is in operation.
- Before turning on any laser, close the door to the laboratory and post the following sign on the door:

CAUTION: LASER IN OPERATION
DO NOT ENTER
(The letters must be 3 inches in height and in red.)

- On the door of every laboratory occupied by any laser, and inside the laboratory, the following symbol must be posted. The symbol must be in red and the background must be yellow or white. The letters must be in black and one inch in height.
- Never look directly into any laser beam. Lasers are highly intense focused forms of energy and can permanently damage the eye upon impingement.
- Never expose any part of your body to any laser beam. Besides being potentially hazardous to the eye, lasers can also damage the skin.
- Equipment in the laboratory should consist of non-reflecting surfaces. This will prevent exposure to direct indirect beams.
- General illumination in laser radiation areas shall be at least 30 lumens per square foot, except where conditions of laser operation require lower ambient illumination.
- If only part of the laser beam is to be used, terminate the unused portion with a non-reflecting material.
- Anyone who operates a laser must be aware of the potential hazards of laser beams. Therefore, any users must undergo training.
- All electrical equipment and wiring in any laboratory occupied by a laser must be routinely checked for hazardous conditions. All electrical equipment must be grounded.
- Lasers should be placed horizontally at approximately 4 feet above the ground
- Lasers should not be moved from one laboratory to another.
- Only equipment and minimum amounts of materials needed for operating the laser should be present in the laser laboratory.

APPENDIX B
Chemical Compatibility Guide for Gloves

Choosing a Glove Material? Different glove materials resist different chemicals, no one glove is suited for all chemical exposure. A glove that is suited well for one application may prove dangerous for another. Base your glove material selection on the manufacture's chemical resistance guide. From the guide choose the glove that has the most resistance to the chemical being used. Remember, the actual chemical compatibility of a given glove material can vary from manufacturer to manufacturer.

Glove Material	Applications
Butyl	A synthetic rubber material that offers the highest permeation resistance to gas and water vapors, especially suited for use with esters and ketones.
Neoprene	A synthetic rubber material that provides excellent tensile strength and heat resistance. Neoprene is compatible with some acids and caustics. It has moderate abrasion resistance.
Nitrile	A synthetic rubber material that offers chemical and abrasion resistance a very good general duty glove, Nitrile also provides protection from oils, greases, petroleum products, and some acids and caustics.
PVC (Polyvinyl Chloride)	A synthetic thermoplastic polymer that provides excellent resistance to most acids, fats, and petroleum hydrocarbons, also has good abrasion resistance.
Viton	A fluoroelastomer material that provides exceptional chemical resistance to chlorinated and aromatic solvents. Viton is very flexible, but has minimal resistance to cuts and abrasions
SilverShield	A lightweight, flexible laminated material that resists permeation from a wide range of toxic and hazardous chemicals. SilverShield offers the highest level of overall chemical resistance, but has virtually no cut resistance.
4H	A lightweight patented plastic laminate that protects against many chemicals has good dexterity.
Natural Latex	A natural rubber material that offers good resistance to many acids and bases when used in a reusable glove. Latex gloves offer very limited chemical resistance. Natural rubber offers reasonable abrasion resistance.

Excerpted from Lab Safety Supply, EZ Facts, Chemical Protective Gloves, Document 191

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CHEMICAL COMPATIBILITY GUIDE FOR GLOVES

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This Chemical Resistance Chart is intended to provide general information about the reactions of different glove materials to the chemicals listed. This information is based upon published research data. Variability in glove thickness, chemical concentration, temperature, and length of exposure to chemicals will affect the performance.

Disclaimer: This information should be used for reference purposes only. User must proceed with caution when handling these chemicals.

Note: E = Excellent G = Good F = Fair P = Poor - = No Rating

Chemical	*NR Latex*	*Vinyl*	*Nitrile*	*Neoprene*
Acetaldehyde	F	P	P	F
Acetamide	F	P	P	F
Acetate Solvent	P	F	F	P
Acetic Acid	G	P	F	F
Acetic Acid 20%	P	G	G	E
Acetic Acid 80%	F	F	F	F
Acetic Acid, Glacial	F	P	F	P
Acetic Anhydride	F	P	P	E
Acetone	F	P	P	F
Acetyl Bromide	-	P	-	-
Acetyl Chloride (dry)	P	F	P	P
Acetylene	G	E	G	G
Acrylonitrile	G	G	P	F
Acrylic Acid	G	-	G	-
Adipic Acid	E	E	F	F
Alcohols: Amyl	G	E	G	E
Benzyl	P	P	P	F

Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Butyl	E	E	F	F
Diacetone	P	G	P	P
Ethyl	E	F	F	E
Hexyl	E	E	E	E
Isobutyl	E	E	G	E
Isopropyl	E	E	G	G
Methyl	E	E	E	E
Octyl	G	-	G	G
Propyl	E	E	E	E
Aluminum Chloride	E	E	E	E
Aluminum Chloride 20%	E	E	E	E
Aluminum Fluoride	G	E	E	E
Aluminum Hydroxide	P	E	E	E
Aluminum Nitrate	E	G	E	E
Aluminum Potassium Sulfate 10%	E	E	E	E
Aluminum Potassium Sulfate 100%	E	E	E	E
Aluminum Sulfate	E	E	E	E
Alums	E	-	E	G
Amines	G	P	P	G
Ammonia 10%	P	G	E	E
Ammonia Nitrate	-	G	F	F
Ammonia, anhydrous	P	E	G	E
Ammonia, liquid	P	E	F	E
Ammonium Acetate	E	E	G	E
Ammonium Bifluoride	-	E	G	P

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Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Ammonium Carbonate	E	E	G	E
Ammonium Caseinate	-	-	-	E
Ammonium Chloride	E	E	G	G
Ammonium Fluoride, 30 – 70%	E	-	E	-
Ammonium Hydroxide, 30 – 70%	P	E	P	E
Ammonium Hydroxide <30%	E	-	E	-
Ammonium Nitrate	F	E	E	G
Ammonium Oxalate	-	E	P	E
Ammonium Persulfate	E	E	E	E
Ammonium Phosphate, Dibasic	E	E	E	E
Ammonium Phosphate, Monobasic	E	E	E	E
Ammonium Phosphate, Tribasic	E	E	E	E
Ammonium Sulfate	E	E	E	E
Ammonium Sulfite	E	E	E	E
Ammonium Thiosulfate	-	-	E	E
Amyl Acetate	P	P	P	P
Amyl Chloride	P	P	P	P
Aniline	P	F	P	P
Aniline Hydrochloride	E	G	P	P
Antifreeze	E	E	E	F
Antimony Trichloride	-	E	G	-
Aqua Regia (80% HCl, 20%HNO3)	P	F	P	P
Arochlor 1248	P	-	F	P
Aromatic Hydrocarbons	P	P	P	P
Arsenic Acid	G	E	E	E

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Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Arsenic Salts	-	E	-	-
Asphalt	P	E	G	P
AZT	G	-	-	-
Barium Carbonate	-	E	E	-
Barium Chloride	E	E	E	E
Barium Cyanide	-	P	F	F
Barium Hydroxide	E	E	E	E
Barium Nitrate	E	E	E	E
Barium Sulfate	E	G	E	E
Barium Sulfide	E	E	E	E
Beer	E	E	E	E
Beer Sugar Liquids	E	E	E	E
Benzaldehyde	P	P	P	P
Benzene	P	F	P	P
Benzene Sulfonic Acid	E	E	P	E
Benzoic Acid	P	E	P	G
Benzol	P	-	P	P
Benzonitrile	-	-	-	-
Bromopropionic Acid	G	-	F	-
Benzyl Chloride (a)	P	P	P	P
Bleaching Liquors	P	E	P	P
Borax (Sodium Borate)	E	E	G	E
Boric Acid	E	E	E	P
Brewery Slop	-	-	E	E
Bromine	P	F	P	P

MONTANA
TECHNOLOGICAL UNIVERSITY

Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Butadiene	P	F	P	G
Butane	P	F	E	E
Butanol (Butyl Alcohol)	E	F	E	E
Butter	P	-	E	G
Butter Milk	P	E	E	P
Butyl Acrylate	P	-	P	-
Butyl Amine	P	P	-	P
Butyl Cellusolve	G	-	G	-
Butyraldehyde	P	G	-	G
Butyl Ether	P	E	G	P
Butyl Phthalate	P	-	P	P
Butylacetate	P	P	P	P
Butylene	P	E	E	P
Butyric Acid	P	G	P	P
Calcium Bisulfate	E	-	E	E
Calcium Bisulfide	P	E	E	E
Calcium Bisulfite	P	G	E	E
Calcium Carbonate	E	E	E	E
Calcium Chlorate	E	G	E	-
Calcium Chloride (30% in water)	E	F	E	E
Calcium Hypochlorite	P	G	F	P
Calcium Hydroxide	E	G	E	E
Calcium Nitrate	E	E	E	E
Calcium Oxide	G	G	E	E

MONTANA
TECHNOLOGICAL UNIVERSITY

Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Calcium Sulfate	G	G	E	G
Calgon	E	-	E	E
Cane Juice	E	E	E	E
Carbolic Acid (Phenol)	P	P	P	P
Carbon Bisulfide	P	P	F	P
Carbon Dioxide(dry)	G	E	E	G
Carbon Dioxide(wet)	G	E	E	G
Carbon Disulfide	P	P	P	P
Carbon Monoxide	P	E	E	G
Carbon Tetrachloride(dry)	P	P	P	P
Carbon Tetrachloride(wet)	P	-	F	P
Carbonate Water	-	E	E	E
Carbonic Acid	F	E	P	P
Catsup	-	E	E	E
Chloric Acid	-	E	-	-
Chlorinated Glue	-	-	G	P
Chlorine Water	F	E	P	P
Chlorine, Anhydrous Liquid	F	P	P	P
Chlorine(dry)	P	P	G	F
Chloroacetic Acid	P	G	P	P
Chloroacetone	F	P	-	E
Chlorobenzene(mono)	P	P	P	P
Chlorobromomethane	P	P	P	P

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Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Chloroform (a)	P	P	P	P
Chlorosulfonic Acid	P	P	P	P
Chocolate Syrup	P	-	E	E
Chromic Acid (5%)	G	E	P	P
Chromic Acid (10%)	P	E	P	P
Chromic Acid (30%)	P	E	P	P
Chromic Acid (50%)	P	P	P	P
Chromium Salts	-	E	-	-
Cider	-	E	E	E
Citric Acid	E	G	E	E
Citric Oils	-	-	E	P
Clorox (Bleach)	P	E	P	G
Coffee	E	-	E	E
Copper Chloride	F	E	E	E
Copper Cyanide	E	E	E	E
Copper Fluoborate	-	E	G	E
Copper Nitrate	F	E	E	E
Copper Sulfate (5%)	F	E	E	E
Copper Sulfate (>5%)	F	E	E	E
Cream	-	-	E	F
Cresols	P	P	P	P
Cresylic Acid	P	P	P	P
Cupric Acid	G	E	G	E

MONTANA
TECHNOLOGICAL UNIVERSITY

Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Cyanic Acid	-	-	F	F
Cyclohexane	P	P	G	P
Cyclohexanone	P	P	P	P
Cisplatin	G	-	G	-
Cyclohexylamine	P	-	E	-
Detergents	G	E	E	G
Diacetone Alcohol	F	P	P	P
Dibenzyl Ether	F	P	-	G
Dibutyl Phthalate	F	P	-	G
Dichlorobenzene	P	P	P	P
Dichloroethane	P	P	P	P
Diesel Fuel	P	E	E	G
Diethanolamine	F	E	-	E
Diethylamine	E	P	F	E
Diethyl Ether	P	P	P	P
Diethylene Glycol	E	F	E	E
Dimethyl Aniline	P	P	P	P
Dimethyl Formamide	F	P	P	P
Dimethyl Sulfoxide (b)	E	-	G	-
Diphenyl	P	-	P	G
Diphenyl Oxide	P	P	E	P
Dyes	-	G	-	-
Di-N-Butylamine	P	-	E	-

Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Dichloroacetyl Chloride	P	-	P	-
1,3-Dioxane	F	-	P	-
1,4-Dioxane	P	-	P	-
Epichlorohydrin	F	-	P	-
Epsom Salts (Magnesium Sulfate)	G	E	E	E
Ethane	P	E	E	G
Ethyl Acetate	F	P	P	P
Ethanol	E	F	F	E
Ethanolamine	G	P	G	G
Ether	P	P	P	P
Ethyl Acetate	F	P	P	P
Ethyl Benzoate	P	P	P	P
Ethyl Chloride	G	P	E	F
Ethyl Ether	P	P	P	P
Ethyl Sulfate	-	-	E	-
Ethylene Bromide	F	P	P	F
Ethylene Chloride	P	P	P	P
Ethylene Chlorohydrin	F	P	P	E
Ethylene Diamine	G	P	E	G
Ethylene Dichloride (a)	P	P	P	P
Ethylene Glycol	E	E	E	E
Ethylene Oxide	P	P	P	P
Ethylene Trichloride (a)	P	P	-	P

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Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Fatty Acids	F	E	G	F
Ferric Chloride	E	E	E	G
Ferric Nitrate	E	E	E	E
Ferric Sulfate	E	E	E	E
Ferrous Chloride	E	E	E	E
Ferrous Sulfate	G	E	E	-
Fluoboric Acid	E	E	E	E
Flourine	F	P	P	-
Fluosillcic Acid	E	P	E	E
Formaldehyde, 30-70%	G	E	G	G
Formaldehyde, 100%	F	E	F	F
Formic Acid	E	E	F	F
Freon 11	P	E	G	P
Freon 12	F	E	E	E
Freon 22	P	E	P	E
Freon 113	P	G	E	F
Freon TF	P	G	E	E
Fruit Juice	P	E	E	E
Fuel Oils	P	E	P	G
Furan Resin	P	E	P	P
Furfural	P	P	P	P
Gallic Acid	E	G	G	G
Gasoline (high-aromatic)	P	E	E	E

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Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Gasoline, leaded, ref.	P	G	E	G
Gasoline, unleaded	P	F	E	G
Gelatin	E	G	E	E
Glucose	E	E	E	E
Glue, P.V.A	E	F	E	E
Glutaraldehyde,< 5%	G	-	G	-
Glycerol	G	E	E	G
Glycolic Acid	P	G	E	E
Gold Monocyanide	-	-	E	E
Grape Juice	P	E	E	P
Grease	P	E	E	P
Heptane	P	F	E	G
Honey	P	G	E	G
Hydraulic Oil (Petrol)	P	E	E	E
Hydraulic Oil (Synthetic)	P	E	P	E
Hexane	P	P	-	E
Hydrazine	F	-	G	G
Hydrobromic Acid,20%	E	G	P	P
Hydrobromic Acid,100%	E	E	P	P
Hydrochloric Acid, 20%	E	E	G	F
Hydrochloric Acid, 37%	E	G	G	G
Hydrochloric Acid, 100%	P	P	P	P
Hydrochloric Acid, Dry Gas	-	E	-	-

Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Hydrocyanic Acid	G	G	G	G
Hydrocyanic Acid (Gas 10%)	G	E	G	E
Hydrofluoric Acid (20%)	G	G	P	G
Hydrofluoric Acid (50%)	G	G	P	P
Hydrofluoric Acid (75%)	P	F	P	P
Hydrofluoric Acid (100%)	P	F	P	P
Hydrofluosilicic Acid 20%	E	E	E	G
Hydrofluosilicic Acid 100%	E	G	G	G
Hydrogen Gas	G	E	E	E
Hydrogen Peroxide 10%	G	E	P	P
Hydrogen Peroxide 30%	F	E	P	P
Hydrogen Peroxide 50%	F	E	P	P
Hydrogen Peroxide 100%	F	E	P	P
Hydrogen Sulfide (aqua)	F	G	P	E
Hydrogen Sulfide (dry)	F	E	P	E
Hydroquinone	E	G	P	E
Hydroxyacetic Acid 70%	-	P	E	E
Ink	P	F	E	E
Iodine	P	E	G	P
Iodine (in alcohol)	-	E	-	-
Iodoform	G	E	P	E
Isooctane	E	E	E	G
Isopropyl Acetate	P	P	P	P

Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Isopropyl Ether	E	G	G	P
Isotane	-	E	E	P
Isobutyl Alcohol	P	-	E	-
Isopropylamine	P	-	P	-
Jet Fuel (JP3, JP4, JP5, JP8)	P	F	E	P
Kerosene	P	E	E	E
Ketones	E	P	P	P
Lacquer Thinners	P	P	P	P
Lacquers	P	P	P	P
Lactic Acid	E	G	E	E
Lard	P	E	E	P
Latex	-	-	E	-
Lead Acetate	E	G	G	E
Lead Nitrate	E	E	E	E
Lead Sulfamate	G	G	G	E
Ligroin	P	-	E	G
Lime	-	G	E	E
Linoleic Acid	P	E	G	-
Lithium Chloride	G	P	E	E
Lithium Hydroxide	-	-	F	-
Lubricants	P	G	E	P
Lye: KOH Potassium Hydroxide	G	G	G	G
Lye: NaOH Sodium Hydroxide	E	E	E	G

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Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Lye: Ca(OH)2 Calcium Hydroxide	G	G	E	E
Magnesium Bisulfate	G	E	G	G
Magnesium Carbonate	-	G	E	E
Magnesium Chloride	E	G	E	E
Magnesium Hydroxide	E	E	E	E
Magnesium Nitrate	E	E	E	E
Magnesium Oxide	-	-	E	E
Magnesium Sulfate (Epsom Salts)	G	E	E	E
Maleic Acid	G	E	P	P
Maleic Anhydride	P	-	P	P
Malic Acid	G	E	E	P
Manganese Sulfate	E	F	E	E
Mash	-	-	E	E
Mayonnaise	P	P	F	E
Malathion,30-70%	E	-	E	-
Melamine	-	P	F	P
Mercuric Chloride (dilute)	E	E	E	E
Mercuric Cyanide -A A A	-			
Mercurous Nitrate	G	E	G	G
Mercury	E	E	E	E
Methane	P	G	E	G
Methanol (Methyl Alcohol)	E	E	E	E
Methyl Acetate	P	P	P	G

Chemical	*NR Latex*	*Vinyl*	*Nitrile*	*Neoprene*
Methyl Acetone	E	P	P	P
Methyl Acrylate	P	-	P	G
Methyl Alcohol 10%	E	E	E	E
Methylamine	G	E	E	G
Methyl Bromide	P	P	G	P
Methyl Butyl Ketone	P	E	P	P
Methyl Cellosolve	P	P	E	G
Methyl Chloride (a)	P	P	P	P
Methyl Dichloride	-	E	P	-
Methyl Methacrylate	P	-	P	-
Methylene Chloride (a)	F	F	G	F
Methyl Ethyl Ketone	F	P	G	G
Methyl Ethyl Ketone Peroxide	P	-	P	P
Methyl Isobutyl Ketone	P	P	P	P
Methyl Isopropyl Ketone	P	P	P	P
Methyl Methacrylate	P	E	P	P
Methylamine	G	P	G	-
Methylene Chloride (a)	G	P	P	-
Milk	E	E	E	E
Mineral Spirits	P	E	E	F
Molasses	E	E	E	E
Monochloroacetic Acid	-	-	P	E
Monoethanolamine	G	P	G	P

Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Morpholine	E	-	P	P
Motor Oil	-	G	E	G
Mustard	G	G	G	E
Naphthalene (a)	P	P	P	P
Naphtha	P	E	E	P
Natural Gas	-	E	E	E
Nickel Chloride	E	E	E	G
Nickel Nitrate	E	E	E	E
Nickel Sulfate	G	E	E	E
Nitrating Acid(<1% Acid)	F	P	-	E
Nitrating Acid(<15% H2SO4)	F	P	-	E
Nitrating Acid(>15% H2SO4)	F	P	P	E
Nitrating Acid(<15% HNO3)	F	P	-	E
Nitric Acid (5-10%)	P	E	P	G
Nitric Acid (20%)	P	E	P	P
Nitric Acid (50%)	P	G	P	P
Nitric Acid (conc.)	P	G	P	P
Nitrobenzene	P	P	P	P
Nitromethane	G	G	P	P
Nitrous Acid	F	E	-	P
Nitrous Oxide	E	E	-	E
Oils: Aniline	P	P	P	P
Anise	-	-	-	P

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Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Bay	-	-	-	P
Bone	-	-	E	P
Castor	E	E	G	E
Cinnamon	-	P	-	F
Citric	-	G	P	P
Clove	-	-	E	F
Coconut	P	E	E	F
Cod Liver	P	E	E	G
Corn	P	G	P	E
Cottonseed	P	G	E	F
Creosote	P	F	P	F
Diesel Fuel (20, 30, 40, 50)	P	G	E	G
Fuel (1, 2, 3, 5A, 5B, 6)	P	E	G	P
Ginger	-	-	E	E
Hydraulic Acid (Petro)	P	E	E	E
Hydraulic Acid (Synthetic)	P	E	P	E
Linseed	P	E	E	P
Mineral	P	G	E	G
Olive	P	F	P	G
Orange	-	F	E	F
Palm	-	E	E	P
Peanut	P	E	E	G
Peppermint	-	-	P	P

Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Pine	P	P	P	P
Rapeseed	P	-	P	G
Rosin	-	F	E	-
Sesame Seed	-	E	E	P
Silicone	P	E	E	P
Soybean	P	E	E	F
Sperm (whale)	-	-	E	P
Tanning	-	-	E	P
Transformer	P	G	E	G
Turbine	P	E	G	P
Oleic Acid	P	F	G	F
Oleum 25%	P	P	P	P
Oleum 100%	P	P	P	P
Oxalic Acid (cold)	G	G	P	P
Ozone	P	G	P	F
Palmitic Acid	G	G	E	P
Paraffin	G	G	G	G
Pentane	P	E	E	G
PCB(Polychlorinated Biphenyls)	P	-	G	-
Perchloric Acid, 30-70%	F	F	P	E
Pentachlorophenol	P	F	F	P
Perchloroethylene	P	F	F	P
Peroxyacetic Acid	P	-	P	-

Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Petrolatum	F	G	E	E
Petroleum	P	-	E	G
Phenol, 10%	E	F	P	P
Phosphoric Acid, <40%	G	G	P	G
Phosphoric Acid, >40%	G	G	P	G
Phosphoric Acid (crude)	P	G	P	P
Phosphoric Acid (molten)	-	P	-	E
Phosphoric Acid Anhydride	-	-	P	E
Phosphorus	-	E	-	-
Phosphorus Trichloride	P	P	P	P
Photographic Developer	E	E	E	E
Photographic Solutions	G	E	G	G
Phthalic Acid	-	-	P	E
Phthalic Anhydride	E	P	P	E
Picric Acid	P	P	F	E
Plating Solutions:				
Antimony Plating 130 F	-	E	E	E
Arsenic Plating 110 F	-	E	E	E
Brass Plating:				
Regular Brass Bath 100 F	-	E	E	E
High-speed Brass Bath 110 F	-	E	E	E
Bronze Plating:				
Cu-Cd Bronze Bath R. T.	-	E	E	E

Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Cu-Sn Bronze Bath 160 F	-	P	E	E
Cu-Zn Bronze Bath 100 F	-	E	E	E
Cadmium Plating:				
Cyanide Bath 90 F	-	E	E	E
Fluoborate Bath 100 F	-	E	G	F
Chromium Plating:				
Barrel Chrome Bath 95 F	-	E	P	P
Black Chrome Bath 115 F	-	E	F	P
Chromic-Sulfuric Bath 130 F	-	E	P	P
Fluoride Bath 130 F	-	E	P	P
Fluosilicate Bath 95 F	-	E	P	P
Copper Plating (Cyanide)				
Copper Strike Bath 120 F	-	E	E	E
High-speed Bath 180 F	-	P	E	G
Rochelle Salt Bath 150 F	-	P	E	G
Copper Plating (Acid)				
Copper Fluoborate Bath 120 F	-	E	G	F
Copper Sulfate Bath R. T.	-	E	E	E
Copper Plating (Misc.)				
Copper Pyrophosphate	-	E	E	E
Copper (Electroless)	-	E	P	P
Gold Plating:				
Acid 75 F	-	E	E	E

Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Cyanide 150 F	-	P	E	E
Neutral 75 F	-	E	E	E
Indium Sulfamate Plating R. T.	-	E	E	E
Iron Plating:				
Ferrous Am Sulfate Bath 150 F	-	P	E	G
Ferrous Chloride Bath 190 F	-	P	G	P
Ferrous Sulfate Bath 150 F	-	P	E	G
Fluoborate Bath 145 F	-	P	G	F
Sulfamate 140 F	-	E	E	E
Sulfate-Chloride Bath 160 F	-			
Leas Fluoborate Plating	-	P	G	F
Nickel Plating:				
Electroless 200 F	-	P	P	P
Fluoborate 100-170 F	-	E	G	E
High-Chloride 130-160 F	-	P	E	G
Sulfamate 100 -140 F	-	E	E	E
Watts Type 115-160 F	-	P	E	E
Rhodium Plating 120 F	-	E	E	G
Silver Plating 80-120 F	-	E	E	E
Tin-Fluoborate Plating 100 F	-	E	G	F
Tin-Lead Plating 100 F	-	E	G	F
Zinc Plating:				
Acid Chloride 140 F	-	E	E	E

Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Acid Flupborate Bath R. T.	-	E	G	F
Acid Sulfate Bath 150 F	-	P	E	G
Alkaline Cyanide Bath R. T.	-	E	E	E
Potash (Potassium Carbonate)	E	E	E	E
Potassium Bicarbonate	E	E	E	E
Potassium Bromide	E	E	E	E
Potassium Chlorate	E	E	E	E
Potassium Chloride	E	E	E	E
Potassium Chromate	G	E	E	E
Potassium Cyanide Solutions	E	E	E	G
Potassium Dichromate	G	E	E	E
Potassium Ferricyanide	G	E	P	E
Potassium Ferrocyanide	E	E	P	E
Potassium Hydroxide (sat.)	G	E	G	G
Potassium Hypochlorite	F	G	E	G
Potassium Iodide	G	E	E	E
Potassium Nitrate	E	E	E	E
Potassium Permanganate	E	E	F	E
Potassium Sulfate	E	E	E	E
Potassium Sulfide	G	E	E	E
Propane (liquefied)	P	E	E	F
Propylene Dichloride	P	P	-	F
Propylene Glycol	E	F	E	F

Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Pyridine	P	P	P	P
Pyrogallic Acid	-	E	-	E
Resorcinal	-	F	-	P
Rosins	-	F	E	E
Rum	E	E	E	E
Rust Inhibitors	-	-	E	F
Salad Dressings	-	-	E	-
Salicylic Acid	E	G	G	-
Salt Brine (NaCl saturated)	E	E	E	E
Sea Water	E	E	E	G
Shellac (Bleached)	E	-	E	G
Shellac (Orange)	P	-	E	P
Silicon Etch	P	-	P	-
Silver Nitrate	E	E	G	E
Soap Solutions	G	E	E	G
Soda Ash (see Sodium Carbonate)	E	E	E	E
Sodium Acetate	E	G	G	G
Sodium Aluminate	G	E	-	E
Sodium Benzoate	E	G	G	E
Sodium Bicarbonate	E	E	E	E
Sodium Bisulfate	E	E	G	E
Sodium Bisulfide	E	E	E	E
Sodium Borate (Borax)	E	E	E	E

Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Sodium Bromide	E	G	-	E
Sodium Carbonate	E	E	E	E
Sodium Chlorate	E	E	G	E
Sodium Chloride	E	E	E	E
Sodium Chromate	G	-	E	E
Sodium Cyanide	E	E	E	E
Sodium Ferrocyanide	G	E	E	E
Sodium Fluoride	-	E	E	E
Sodium Hydrosulfite	F	F	F	G
Sodium Hydroxide 20%	E	E	E	G
Sodium Hydroxide 50%	E	E	E	G
Sodium Hydroxide 80%	E	E	P	G
Sodium Hypochlorite <20%	F	E	G	F
Sodium Hypochlorite 100%	F	G	P	F
Sodium Hyposulfate	F	-	-	F
Sodium Metaphosphate	E	E	E	G
Sodium Metasilicate	E	E	E	E
Sodium Nitrate	G	E	E	G
Sodium Perborate	G	E	G	G
Sodium Peroxide	G	G	G	G
Sodium Polyphosphate	F	E	E	G
Sodium Silicate	E	E	E	E
Sodium Sulfate	G	E	E	E

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Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Sodium Sulfide	G	E	E	E
Sodium Sulfite	G	E	E	E
Sodium Tetraborate	E	E	E	G
Sodium Thiosulfate (hypo)	G	E	G	E
Sorghum	E	-	E	E
Soy Sauce	-	-	E	E
Stannic Chloride	E	E	E	F
Stannic Fluoborate	-	-	E	E
Stannous Chloride	E	E	E	E
Starch	E	E	E	E
Stearic Acid	-	G	G	G
Stoddard Solvent	P	F	E	F
Styrene	P	P	P	P
Sugar (liquids)	E	-	E	E
Sulfate (liquors)	G	G	E	G
Sulfur Chloride	P	F	P	P
Sulfur Dioxide	-	E	P	G
Sulfur Dioxide (dry)	F	E	P	P
Sulfur Hexafluoride	P	G	G	E
Sulfur Trioxide	F	E	P	P
Sulfur Trioxide (dry)	-	E	P	P
Sulfuric Acid (<10%)	E	E	E	G
Sulfuric Acid (10-75%)	F	E	G	G

Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Sulfuric Acid (75-100%)	P	P	F	P
Sulfuric Acid (cold conc.)	P	P	P	P
Sulfuric Acid (hot conc.)	P	P	P	P
Sulfurous Acid G E G F Tallow	-	-	E	G
Tannic Acid	E	E	E	E
Tanning Liquors	F	E	G	E
Tartaric Acid	E	E	E	E
Tetrachloroethane	P	F	P	P
Tetrachloroethylene	P	P	P	P
Tetrahydrofuran	P	P	P	P
Tin Salts	E	E	E	-
Toluene (a)	P	P	P	P
Toluene-2,4-Diisocyanate (TDI)	P	-	P	-
Tomato Juice	E	E	E	E
Trichloroacetic Acid	F	G	-	P
Trichloroethane	P	F	P	P
Trichloroethylene (a)	P	P	P	P
Trichloropropane	P	-	P	E
Tricresyl Phosphate	G	P	P	F
Triethanolamine	F	E	E	E
Trinitrotoluene	P	P	-	E
Trisodium Phosphate	E	E	E	E
Turpentine	P	P	-	P

Chemical	NR Latex	Vinyl	Nitrile	Neoprene
Urea	-	P	G	G
Uric Acid	-	E	-	E
Urine	P	E	E	P
Varnish	P	P	G	P
Vegetable Juice	-	-	E	-
Vinegar	G	G	G	G
Vinyl Acetate	P	P	P	P
Vinyl Chloride	F	P	P	P
Water, Deionized	E	E	E	E
Water, Acid, Mine	G	G	E	F
Water, Distilled	E	E	E	E
Water, Fresh	E	G	E	E
Water, Salt	E	G	E	E
Weed Killers	-	-	E	F
Whey	-	-	E	-
Whiskey & Wines	E	E	E	F
White Liquor (Pulp Mill)	-	E	E	E
White Water (Paper Mill)	-	E	-	E
Xylene	P	P	P	P
Zinc Chloride	E	G	E	E
Zinc Hydrosulfide	-	-	E	E
Zinc Sulfate	G	E	E	E

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APPENDIX C
LABORATORY MONTHLY CHECKLIST

Monthly Lab Inspction
Chemical Labs
Building & Room Number:_____

	YES	NO	N/A
1. Area appears neat & free of clutter, & floors are free from tripping hazards?			
2. Storage is at least 18" below ceiling?			
3. A spill clean-up kit is available?			
4. Signs are posted: no food, proper attire/PPE, no food in refrigerator, etc.?			
5. Do you see evidence of food, drink in the lab?			
6. Eyewash was flushed and is in good working condition?			
7. Safety equipment, eyewash/shower & fire extinguisher, are not blocked?			
8. Circuit breaker panels are labeled & have a 3-foot clearance around them?			
9. Electrical cords & plugs are in good condition?			
10. Extension cords are not being used as permanent wiring?			
11. All visible chemical containers, including secondary containers, are labeled with chemical name and hazards?			
12. All chemical & waste containers are capped or otherwise sealed & labeled?			
13. Chemicals are stored correctly: incompatibles not together, flammables in flammable cabinet, liquid chemicals not above eye level?			
14. No combustible materials on top of refrigerators?			
15. Gas cylinders are stored appropriately: secured & capped if not in use?			
16. All hoses and gas connections are in good condition?			
17. Storage of chemicals and apparatus kept to a minimum in fume hood, & all hazardous materials kept at least 6" behind sash?			
18. Safety Data Sheets & Chemical Hygiene Plan are visible & accessible?			
19. Emergency phone list is posted?			
20. Exits are visible & unobstructed?			
21. Other concerns?			
Action plan to correct deficiencies:			

Inspection completed by: _____ Date: _____
Lab director reviewing: _____ Date: _____

*Send a copy of inspection to EHS.

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APPENDIX D
CHEMICAL STORAGE SCHEME

SUGGESTED SHELF STORAGE PATTERN – INORGANIC

Inorganic #1 Metals & Hydrides (Store away from any water) (Store flammable solids in flammable cabinet)	**Inorganic #5** Sulfides, Selenides, Phosphides, Carbides, Nitride	**Inorganic #9** Acids, EXCEPT NITRIC *Store Nitric Acid away from other acids unless your acid cabinet provides a separate compartment for Nitric Acid*
Inorganic #2 Halides, Sulfates, Sulfites, Thiosulfates, Phosphates, Halogens, Acetates	**Inorganic #6** Chlorates, Perchlorates, Chlorides, Perchloric Acid, Peroxides, Hypochlorites, Hydrogen peroxide	
Inorganic #3 Amides, Nitrates (not ammonia nitrates (ISOLATE IT!), Nitrites, Azides	**Inorganic #7** Arsenates, Cyanides, Cyanates (Store away from any water)	
Inorganic #4 Hydroxides, Oxides, Silicates, Carbonates, Carbon	**Inorganic #7** Arsenates, Cyanides, Cyanates (Store away from any water)	**Inorganic #10** Sulfur, Phosphorus, Arsenic, Phosphorus Pentoxide

SUGGESTED SHELF STORAGE PATTERN – ORGANIC

Organic #1 Acids, Anhydrides, Peracids (Store certain	**Organic #4** Ethers, Ketones, Ketenes, Halogenated	**POISON**

organic acids in acid cabinet)	hydrocarbons, Ethylene oxide	***STORE SEVERE POISONS IN POISONS CABINET***
Organic #2 Alcohols, Glycols, Amines, Amides, Imines, Indes (Store flammables in a dedicated cabinet)	**Organic #5** Epoxy compounds, Isocyanates	
	Organic #6 Peroxides, Azides, Hydroperoxides	
Organic #3 Hydrocarbons, Esters, Aldehydes (Store flammables in a dedicated cabinet)	**Organic #7** Sulfides, Polysulfides, etc.	
	Organic #8 Phenol, Cresols	

Chemical Incompatibility Guide

Avoid the hazards of chemical incompatibility. Incompatible chemical mixtures can cause violent reactions, explosions, and fires or generate toxic gases. Containers that are incompatible with their contents can leak or catastrophically fail. In a fire or other disaster, containers break and chemicals could combine to fuel a fire or react to injure emergency responders.

Chemical incompatibility hazards should be addressed from three perspectives:

- Containment
- Storage
- Mixing

Rules for Storing Chemicals Safety

- Segregate all incompatible chemicals for proper storage of chemicals for hazard class codes. In other words, store like chemicals together and away from other groups of chemicals that might cause reactions if mixed. Do not simply store chemicals in alphabetical order (see third item below).
- Flammable materials should be stored in an approved, dedicated, flammable materials storage cabinet or room if the volume exceeds ten (10) gallons.

- Chemicals shall be stored separately from non-compatible hazard classes. A suggested storage pattern is included on this page.
- Liquids should be stored in unbreakable or double-contained packaging, or the storage cabinet should have the capacity to hold the contents if the container breaks.
- Avoid floor chemical storage (even temporary).
- Chemicals should be stored no higher than eye level and never on the top shelf of a storage unit.
- Shelf assemblies should be firmly secured to the walls. Avoid island shelves.
- Each shelf should have an anti-roll lip.
- Store acids in a dedicated acid cabinet. Nitric acid may be stored there also, if it is kept isolated from the others.
- Store severe poisons in a dedicated poison cabinet.
- All chemicals should be labeled and dated.
- Look for unusual conditions in chemical storage areas, such as:
    - Improper storage of chemicals
    - Leaking or deteriorating containers
    - Spilled chemicals
    - Temperature extremes (too hot or cold in storage area)
    - Lack of or low lighting levels
    - Blocked exits or aisles
    - Doors blocked open, lack of security
    - Trash accumulation
    - Smoking or open lights or matches
    - Fire equipment blocked, broken, or missing
    - Lack of information or warning signs (“No Smoking”, “Flammable Liquids”, “Acids”, “Corrosives”, “Poisons”, “Chemical Storage”)

Any of these conditions should be corrected immediately. Inspection of chemical storage areas on a routine basis will help to correct deficiencies and prevent accidents.

Suggested Chemical Storage Pattern:

INORGANIC	**ORGANIC**
Sulfur, Phosphorus, Arsenic, Phosphorus Pentoxide	Alcohols, Glycols, etc. (store flammables in dedicated cabinets)
Halides, Sulfates, Sulfites, Thiosulfates, Phosphates, etc.	Hydrocarbons, Esters, etc. (store flammables in dedicated cabinets)

Amides, Nitrates, (not ammonium nitrate), Nitrites, etc.	Ethers, Ketones, etc. (store flammables in dedicated cabinets)
Metals, Hydrides (store away from water)	Epoxy compounds, Isocyanates
Hydroxides, Oxides, Silicates, etc.	Sulfides, Polysulfides, etc.
Arsenates, Cyanides, (store above acids)	Phenol, Cresols
Sulfides, Selenides, Phosphides, Carbides, Nitrides	Peroxides, Azides, etc.
Manganates, Chromates, Permanganates, Borates	Acids, Anhydrides, Peracids, etc.
Chlorates, Chlorites, Perchlorates, Peroxides, Perchloric acid.	Miscellaneous
Acids, except nitric. (store acids in dedicated cabinets)	Miscellaneous (Nitric Acid)

Suggested Storage Time Limits for Common Peroxidizable Compounds
Most Dangerous: Discard after **3 months.** Peroxide formation hazard during storage.

- Isopropyl ether
- Divinyl acetylene
- Vinylidene chloride
- Potassium metal
- Sodium amide

Dangerous: Discard after **one year.** Peroxide formation hazard during storage and on concentration (i.e. distillation) of compound.

- Diethyl ether
- Dicyclopentadiene
- Tetrahydrofuran
- Diacetylene
- Dioxane
- Methyl acetylene
- Acetal
- Cumene
- Methyl isobutyl ketone

- Tetrahydronaphthalene
- Ethylene glycol dimethyl ether
- Cyclohexene
- Vinyl ethers
- Methylcyclopentane

Dangerous: Discard after **one year.** Peroxide formation causes initiation of hazardous polymerization.

- Acrylic acid
- Acrylonitrile
- Butadiene
- Chloroprene
- Chlorotrifluoroethylene
- Methyl methacrylate
- Styrene
- Tatrafluoroethylene
- Vinyl acetylene
- Vinyl acetate
- Vinyl chloride
- Vinyl pyridine

Safety Hints:

- Do not purchase these compounds in quantities greater than can be used in the specified storage time period.
- Ethers should be stored in the dark and under nitrogen if possible.
- Always check for the presence of peroxides before distilling any peroxide former.
- Consult safety references before working with peroxidizable compounds.

Chemical Incompatibility Matrix

	Acids, Inorganic	Acids, Oxidizing	Acids, Organic	Alkalis (Bases)	Oxidizers	Poisons, inorganic	Poisons, organic	Water reactives	Organic solvents
Acids, Inorganic			X	X		X	X	X	X
Acids, Oxidizing			X	X		X	X	X	X
Acids, Organic	X	X		X	X	X	X	X	
Alkalis (Bases)	X	X	X				X	X	X

Oxidizers			x				x	x	x
Poisons, inorganic	x	x	x				x	x	x
Poisons, organic	x	x	x	x	x	x			
Water reactives	x	x	x	x	x	x			
Organic solvents	x	x		x	x	x			

Short list of Incompatible Materials
DO NOT CONTACT:

ALKALI METALS Such as calcium, potassium, and sodium With: water, carbon dioxide, carbon tetrachloride, and other chlorinated hydrocarbons	***ACETIC ACID*** With: chromic acid, nitric acid, hydroxyl containing compounds, ethylene glycol, perchloric acid, peroxides, and permanganates
ACETONE With: concentrated sulfuric acid and nitric acid mixtures	***ACETYLENE*** With: copper (tubing), fluorine, bromine, chlorine, iodine, silver, mercury, or their compounds
ALUMINUM (powdered) With: chlorinated hydrocarbons, halogens, carbon dioxide, organic acids	***ARSENIC COMPOUNDS*** With: reducing agents
AMMONIA, ANHYDROUS With: mercury, halogens, calcium hypochlorite, iodine, bromine, hydrofluoric acid, or hydrogen fluoride	***AMMONIUM NITRATE*** With: acids, metal powders, flammable liquids, chlorates, nitrates, sulfur, and finely divided organics or other combustibles
ANILINE	***BROMINE***

With: nitric acid, hydrogen peroxide, or other strong oxidizing substances	With: ammonia, acetylene, butadiene, butane, hydrogen, sodium carbide, turpentine, other hydrocarbons, or finely divided metals
CALCIUM CARBIDE With: water, or alcohol	***CARBON ACTIVATED*** With: calcium hypochlorite, oxidizing agents
CHLORINE DIOXIDE With: ammonia, methane, phosphine, hydrogen sulphide	***COPPER*** With: acetylene, hydrogen peroxide
CHLORATES With: ammonium salts, acids, metal powders, sulfur, carbon, finely divided organics, or other compounds	***CHROMIC ACID*** With: acetic acid, naphthalene, camphor, alcohol, glycerine, turpentine, and other flammable liquids
CHLORINE With: ammonia, acetylene, butadiene, and other petroleum fractions, hydrogen, sodium carbides, turpentine, and finely divided metals	***CYANIDES*** With: acids
HYDROCYANIC ACID With: nitric acid, alkali	***HYDROFLUORIC ACID*** With: aqueous or anhydrous ammonia
HYDROGEN PEROXIDE With: copper, chromium, iron, most metals or their respective salts, flammable liquids and other combustible materials, aniline, and Nitromethane	***HYDROGEN SULFIDE*** With: nitric acid, oxidizing gases
HYDROCARBONS Generally, with: fluorine, bromine, chromic acid, or sodium peroxide	***IODINE*** With: acetylene or ammonia

MERCURY With: acetylene, fluminic acid, or hydrogen	***NITRIC ACID*** With: acetic, chromic, or hydrocyanic acids, aniline, carbon, hydrogen sulfide, flammable liquids or gases, or other substances which are readily nitrated
NITRATES With: sulfuric acid	***OXALIC ACID*** With: silver or mercury
OXYGEN With: oils, greases, hydrogen, flammable liquids, solids, or gases	***PEROXIDES (organic)*** With: acids, avoid friction or shock
PERCHLORIC ACID With: acetic anhydride, bismuth and its alloys, alcohols, paper, wood, and other organic materials	***PHOSPHOROUS PENTOXIDE*** With: water
PHOSPHORUS (white) With: air, alkalies, reducing agents, or oxygen	***POTASSIUM*** With: carbon tetrachloride, carbon dioxide, water
POTASSIUM PERMANGANATE With: glycerine, ethylene glycol, benzaldehyde, or sulfuric acid	***SODIUM PEROXIDE*** With: any oxidizable substances, for instance: methanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerine, ethylene glycol, ethyl acetate, furfural, etc.
SILVER With: acetylene, oxalic acid, tartaric acid, ammonium compounds, fluminic acid	***SODIUM*** With: carbon tetrachloride, carbon dioxide, water
SULFURIC ACID	***SODIUM PEROXIDE***

With: chlorates, perchlorates, permanganates, (or compounds with similar light metals, such as sodium, lithium) and water	With: ethanol, methanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulphide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural

NOTE: This list is not a complete list of incompatible materials. It contains some of the more common incompatible materials. Always research the material you work with in order to be safe. Ref: http://ehs.sc.edu/chemstorage.html

Containment to Prevent Hazards

Use the right container for the job to keep your chemicals safe. Use secondary containment whenever possible. Follow these general guidelines for safe containment of laboratory chemicals:

- Use containers that are compatible with their contents. The chemical should not react with the container material or cap liner. For example, do not store hydrofluoric acid in a glass container. Whenever possible, store chemicals in their original containers; transfer chemicals only to containers made of like materials.
- Buy smaller quantities. They make safe storage easier, and simultaneously encourages waste minimization. Smaller bottles are also less prone to breakage when accidentally dropped.
- Use safety cans for storage of flammable liquids.
- Whenever possible, purchase materials in coated bottles.
- Make sure that all containers are properly labeled.
- Inspect your chemical stocks periodically to make sure the containers are sound and labels are intact.
- Some chemicals require special devices such as vent caps for alleviating pressure buildup. Dibenzoyl peroxide, for example, requires a container that is non-rigid to prevent shock transfer, has a non-threaded cap to prevent friction when opening, and is resistant to static electricity buildup. All of these precautions may help to prevent an explosion.

Choose safer containers to reduce breakage

Buy chemicals in plastic-coated bottles which are coated with a thin layer of polymer to help absorb shock, prevent breakage and act as a secondary container in the event the bottle is broken. The safest container is a UL-approved safety can. The least safe is an uncoated glass container that will shatter if dropped on the floor.

Use secondary containment

For liquid and high hazard chemicals, secondary containers are effective tools to prevent reactions between incompatible chemicals. When storing reactive materials, secondary containment can prevent degradation and reactions that occur during storage (i.e., use a wide-mouthed jar to protect smaller bottles). For transporting bottles in hallways, place them in a specially designed carrier or a five-gallon plastic bucket to prevent spills. It is best to use secondary containers made of materials that are non-reactive, such as polyethylene.

Use designated cabinets and areas for high hazard chemicals

Flammable liquids: Large volumes of flammable liquids must be stored in an approved flammable liquid cabinet or safety can.

Acids: Bottles of acid should be stored in an acid cabinet. While acids and bases are both considered to be corrosive, do not store acids and bases in the same cabinet.

Store oxidizing acids, such as perchloric and nitric, separately in a secondary container within an acid cabinet. Glacial acetic acid is both corrosive and flammable; store it in secondary containment in a flammable cabinet.

Spatial Considerations

Do not store bottles of liquids above your containers of solids, and never above eye level.

Keep your bottles of liquids stored close to the floor to lessen the chance of breakage and prevent them from reacting with chemicals on lower shelves. This will also prevent injuries to laboratory personnel from liquids leaking at eye level.

Keep stored incompatible chemicals apart from each other.

Keep dissimilar materials apart by distance, shelf, shelving unit, drawer or cabinet.

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APPENDIX E
WASTE MINIMIZATION GUIDE

Disposal of waste and unwanted chemicals has become increasingly complicated. The U.S. Environmental Protection Agency (EPA) and the Montana Department of Environmental Quality (MDEQ) regulate the disposal and treatment of hazardous waste. We are all responsible for complying with the environmental laws and protecting human health.

Before seeking a disposal method for your chemical waste and when planning your work, consider the pollution prevention and waste minimization methods below.

Reduce Pollution at its Source

- *Modify laboratory processes*. Modern extraction techniques, such as those that use a solid phase or supercritical fluid, minimize waste by using much smaller volumes of organic solvents. Computer simulations and modeling eliminate all environmental impacts when they are substituted for wet laboratory experiments. In the classroom, computer and multimedia simulations often allow students to observe more complex procedures than would be available by a traditional laboratory exercise.
- *Reduce the scale of laboratory processes*. Innovative laboratory glassware and microscale techniques are now available that reduce quantities used to milligrams. Reducing the scale laboratory processes not only prevents pollution, but has many other benefits:
    - Small scale experiments cost less because they use less chemicals; valuable raw materials are also conserved.
    - Small scale experiments usually run more quickly
    - Heating and cooling are easier with smaller volumes
    - Your exposure to chemicals is reduced
    - The amount of fugitive emissions (evaporative losses) will be reduced
- *Improve laboratory operations.* Creative thinking can help you redesign laboratory procedures to use less chemicals, create less waste, prevent fugitive emissions and minimize unnecessary discharges to the sanitary sewer.
- Careful and neat operations reduce waste. Take care when weighing or transferring chemicals between containers to minimize spills. Don't take fume hood emissions, sewer effluents or chemical wastes for granted. They are all necessary to safely use laboratory chemicals, but chemical releases and disposal affect the environment, and should be minimized when practical. When it can be done safely, seal and contain processes to prevent the escape of fumes or leaks to the environment.

- *Buy Less*. Purchase only the chemicals and amounts you need in the immediate future. If you need only a small amount, ask another laboratory if you can borrow their stocks. A bulk quantity may appear to be economical, but the cost of disposing of the excess will negate any savings. Avoid end-of-budget-year buying sprees. Do not accept gifts or samples unless you plan to use them in the immediate future. Do not accept more than you need.
- *Store less*. Storing excess and duplicate chemicals risks a fire, spill or leak. Some chemicals become reactive or explosive with age. Storage of surplus takes up valuable laboratory space. Excess stored chemicals exacerbate a spill, leak or release and add risks when responding to a fire.
- *Reduce laboratory air emissions*. One potential source of pollution from laboratories is the emission of volatile chemicals into the air. To prevent chemical exposure to personnel, laboratories are designed to include fume hoods, local ventilation, ventilated cabinets, and room ventilation. The exhaust of these systems are not filtered or controlled for volatile chemicals, fumes or gases. As a result, you should use these ventilation systems to protect you from chemical exposure, but must use them prudently to prevent excessive emission of laboratory chemicals. Simple laboratory practices can minimize air emissions:
    - Keep containers of volatile chemicals capped; if a cap is not tight, replace the cap or transfer the contents to another container.
    - Minimize the amount of volatile chemicals in your lab; order and store only what you need in the immediate future.
    - Do not store chemicals in the fume hood; use a ventilated cabinet if possible.
    - Keep laboratory processes involving volatile chemicals as closed as safely possible.
    - Keep waste solvent collection carboys capped at all times, unless you are adding waste.
    - Do not dispose of any chemical by evaporation; it is illegal to evaporate hazardous chemical waste for the purpose of disposal.
- *Substitute with a safer chemical*. In a landmark study, the Division of Environmental Health and Safety of the University of Illinois at Urbana-Champaign, explored laboratory waste minimization opportunities. (Ashbrook, Peter C., Cynthia Klein-Banay and Chuck Maier, *Determination, Implementation and Evaluation of Laboratory Waste Minimization Opportunities,* 1992.) The following table includes some common chemical substitutes from that study:

Hazardous Chemical	**Safer Substitute**	**Used For**
Acetamide	Stearic Acid	Freezing point depression
Benzene	Xylene or hexane	Many solvent uses

Benzoyl Peroxide	Lauryl Peroxide	Some polymer catalysis
Carbon tetrachloride	Cyclohexane	Qualitative test for halides
Formaldehyde (formalin)	Ethanol	Specimen storage
Halogenated solvents	Non-halogenated solvents	Some extractions and other solvent uses
Sodium dichromate	Sodium hypochlorite	Some oxidation reactions
Sulfide ion	Hydroxide ion	Qualitative test for heavy metals
Toluene-based scintillation cocktail	Non-ignitable scintillation cocktail	Studies using radioactive materials

Substitution isn't always ideal; some procedures don't work as well, and some substitutes aren't as safe as you'd like. Substitution often requires successive trials and evaluations.

- *Stop using chromic acid solutions*. Chromic acid solution is a mixture of concentrated sulfuric acid and potassium dichromate, Chromerge (chromic acid), or chromium anhydride (chromium trioxide). It is used to clean laboratory glassware because it oxidizes most residues and eats away a very thin layer of the glass surface, leaving a new, clean surface.

- Chromic acid solution is a dangerous chemical. It is a strong corrosive and a strong oxidizer that has been known to react violently and explode when combined with oxidizable materials. It contains chromium (VI) as chromic or dichromic acid, which is a known human carcinogen. Chromium is toxic in other ways to humans, flora and fauna. These properties make it extremely difficult to handle safely.

Many commercially available alternatives are available for chromic acid solutions. They are listed below in groups of increasing hazards. This information is derived from the University of Illinois study.

Nonhazardous cleaning solutions: Safest – try these first.
- Ultrasonic baths
- Alconox or similar detergents
- Pierce RBS-35 or similar detergents
- Biodegradable surfactants

Strong corrosive solutions: Hazardous due to their corrosivity.
- Potassium hydroxide/ethanol solutions (also flammable)
- Dilute hydrochloric acid

Strong oxidizing acid solutions not containing chromium or other toxic metals. Very hazardous - least desirable alternative. Other solutions of strongly oxidizing acids work in the same way as chromic acid solution. Potassium permanganate/sulfuric acid baths are generally not recommended; they are very dangerous and potentially explosive if made incorrectly.

- Potassium persulfate/sulfuric acid (sold commercially as No-Chromix)
- Aqua regia (mixture of hydrochloric and nitric acids)

Chemically Treat Laboratory Wastes

Certain chemical wastes can be treated in your laboratory. In-lab chemical treatment reduces transport and handling risks, and reduces the cost of collecting and storing chemical waste. If you routinely generate wastes that can be treated, include waste treatment as the final step in your procedures. Appendix F includes some methods for deactivation, oxidation using bleach, precipitation and reduction to yield a less toxic waste. In some cases, the treatment product can be safely disposed of in the sanitary sewer. Other in-lab chemical treatment procedures can be found in the *Hazardous Laboratory Chemicals Disposal Guide* by Margaret A. Armour, CRC Press, 1991.

Keep Waste Types Separate

Do not mix hazardous and non-hazardous waste together; the entire volume then becomes hazardous waste. When wastes of different characteristics and compositions are mixed, treatment and disposal become much more difficult. For example, organic chemicals can be incinerated, but mercury waste that has been mixed with organic chemicals cannot be incinerated safely.

Other guides to follow:

- Do not place hazardous waste in the normal trash. Some chemicals can safely be disposed of in this manner.
- Do not put normal trash (or wastes that can be disposed of in the normal trash or sanitary sewer) in containers of laboratory chemicals or chemical wastes.

An Environmental Ethic

Scientists who value the environment bring a special zeal to pollution prevention. In the laboratory, an environmental ethic means taking responsibility for the by-products of research and teaching, and the waste that is generated. Scientists are creative by nature, and because they are most familiar with their work and the materials they use, they are the best source of new ideas to prevent pollution and minimize waste. Please share your ideas with EHS.

APPENDIX F
CHEMICAL DISPOSAL PROCEDURES

The U.S. Environmental Protection Agency (EPA) and the Montana Department of Environmental Quality (MDEQ) regulate the disposal and treatment of hazardous waste, including waste laboratory chemicals. By following the procedures in this part of the Chemical Hygiene Plan, you help Montana Tech comply with these environmental laws and protect health and the environment.

When planning your work and before seeking a disposal method for your chemical waste, consider the waste minimization methods in Appendix E. Some unwanted chemicals, if they are in their original containers and in good condition, can be used by another lab. If you have surplus chemicals, call EHS to assist in finding another laboratory that can use them.

There are two methods of dealing with chemical products and waste:

- In-lab chemical management. In-lab management includes simple disposal and treatment methods that can be done in your lab, such as bleach deactivation, flushing down the sanitary sewer, and neutralization. These disposal procedures are described in the following pages.
- EHS Hazardous Waste Management. For items that must be disposed of as hazardous waste and shipped off-site to a commercial hazardous waste treatment, storage and disposal facility, call EHS. EHS will provide you with a Montana Tech Hazardous Materials Manifest which must be completed. The following items apply to all hazardous waste containers.
    - The Resource Conservation and Recovery Act (EPA's hazardous waste law) requires that all waste containers be properly labeled as 'HAZARDOUS WASTE' or 'ACUTE HAZARDOUS WASTE' as appropriate.
    - A log must be kept for each hazardous waste container and should be attached to the container. Each time waste is added, the log must include the chemical(s) being added to the waste container, concentrations and amounts, the name of the person adding the waste, and the date it was added. A small notebook attached to the container is a good reminder to fill in the log.

The following instructions address a broad scope of chemical disposal situations. Please call EHS if you have questions or are unsure about disposal methods.

In-Lab Chemical Management

Numerous chemicals are used at Montana Tech that are most appropriately disposed of by discharge into the sanitary sewer, by discharge into the sanitary sewer after neutralization, or other chemical treatment method, or directly into the normal trash. Deciding which disposal route is most appropriate for your material depends on the amount of waste, chemical and toxicological properties of the chemical, its environmental fate, and the capability of your facility.

This appendix contains the specific procedures for disposing of wastes. Please read them carefully before attempting any in-lab disposal of wastes.

Appendix G is an alphabetical list of chemicals and their appropriate disposal procedures. If your chemical is not suitable for reuse by another lab, look it up in Appendix G for its disposal procedure. If it is listed in Appendix G, you may dispose of the material in your laboratory via the designated procedure found in Appendix F.

Sometimes laboratories do not have the facilities for in-lab management, or the personnel are uncomfortable using the disposal procedures described here. If so, contact the department head, a supervisor, and EHS.

Alphabetical List of Procedures

The following is an alphabetical list of procedures, listed by chemical name, waste type and disposal method.

Acids
Look up chemical in Appendix G, then see ***Neutralization Procedures: Strong Acids and Bases***.

Acrylamide

- Dispose of solid acrylamide powder according to procedure ***On-Site Service***.
- Acrylamide and other electrophoresis gel solutions can be polymerized and discarded in the normal trash. Acrylamide solutions should be polymerized according to the procedure given by the supplier. Discard the gel in the normal trash following ***Normal Trash 2***. If gelling does not occur, discharge to the sanitary sewer according to ***Sanitary Sewer 7***.
- Dispose of empty acrylamide container according to procedure ***Normal Trash 4***.

- Alternatively, follow procedure ***On-Site Service*** for the disposal of acrylamide solutions.

Aerosol Cans
Refer to procedure ***Gas 1*** for disposal of aerosol cans.

Aqueous Solutions
Most aqueous solutions can be disposed of in the sanitary sewer.

- Aqueous solutions of water miscible flammable organic solvents: Solutions of less than 20% acetone, ethanol, methanol, and other water soluble and miscible solvents can be put down the drain followed by 10 volumes of water. See procedure ***Sanitary Sewer 8*** for more information.
- Aqueous solutions of more than 20% of the above solvents or more than 5 liters should be disposed of according to ***On-Site Service***.
- Aqueous solutions of inorganic chemicals: Check Appendix G for the appropriate disposal procedure. Aqueous solutions of chemicals for the normal trash should be disposed of according to ***Sanitary Sewer 6***.
- Aqueous solutions of organic chemicals. Check Appendix G for the appropriate disposal procedure. Aqueous solutions of chemicals for the normal trash should be disposed of according to ***Sanitary Sewer 7***.

Bases
Look up the chemical in Appendix G, then see ***Neutralization Procedures: Strong Acids and Bases***.

Batteries
There are four types of batteries used on campus: automotive, mercury and lithium containing, ordinary household (alkaline), and rechargeable (nickel-cadmium).

- Batteries containing mercury and large lithium batteries should be disposed of following ***On-Site Service***.
- Rechargeable (Ni-cad) batteries are regulated as Universal Waste and cannot go into the regular trash. Radio Shack will take these for recycling.
- Disposal of automotive (lead-acid) batteries involves recycling. When a new battery is purchased, the old one should be turned in to the distributor/store.
- Ordinary household batteries (alkaline) can be disposed of in the normal trash. No one locally recycles these.

Chemical Carcinogens and Mutagens
Chemical carcinogens or mutagens may be disposed of by following ***On-Site Service***.

Alternatively, you may treat certain carcinogens and mutagens, depending on the identity and quantity of waste. Treatment methods include:

- Alkylating agents and nitrosamides are readily destroyed by alkaline solutions.
  1. Working in a hood, dissolve the compound in a water-miscible solvent.
  2. Slowly add an excess of 5% sodium hydroxide or sodium thiosulfate.
  3. Allow to stir for 24 hours.
  4. Neutralize the solution if necessary (refer to ***Neutralization Procedures***) and rinse the solution down the sanitary sewer with large amounts of water.
- Ethidium bromide disposal procedures are addressed in a separate section below.
- Aromatic amines, polycyclic aromatic hydrocarbons and nitrosamines are best disposed of by incineration. Therefore, use ***On-Site Service***.
- Materials for which there are no treatment methods can be disposed of ***following On-Site Service.***

Cyanide Salts

Simple cyanide salts (e.g. NaCN) may generate deadly hydrogen cyanide gas when combined with acids. Large volumes of solutions, high concentrations and solid salts are best disposed of following procedure ***On-Site Service***.

For smaller quantities of less concentration, the following procedure may be used. It describes a method to verify the oxidation of cyanide ions to cyanate. The formation of a coordination compound in step 4 indicates further oxidation is necessary before the waste can safely be disposed into the sanitary sewer. For each chemical or solute, limit daily discharges to 100 grams per principal investigator.

1. Follow procedures described in ***Planning for Neutralization of Acids and Bases*** as listed in Neutralization procedures below. Procedures must be carried out in a fume hood.
2. Dilute the solution with water to a concentration not to exceed 2% w/v cyanide. Prepare a hot water bath in a fume hood.
3. For each 50 mL cyanide solution, slowly add 5 mL 10% (2.5 Molar) sodium hydroxide and 70 mL household bleach. Mix thoroughly.
4. Test the solution for residual cyanide as follows:
   - Place 1 mL reaction mixture in a test tube. Add 2 drops 5% ferrous sulfate solution.
   - Place in hot water bath and allow to boil for 30 seconds. Cool to room temperature.
   - Add 2 drops 1% ferric chloride solution. Add 6 Molar hydrochloric acid until the solution is acidic to litmus.

- If residual cyanide is present, a deep blue precipitate of sodium ferricferrocyanide (NaFe[Fe(CN)6]) will be formed.

5. If cyanide remains, add more bleach to the reaction mixture and repeat the test for residual cyanide.
6. If no precipitate is formed, wash the solution down the sanitary sewer with 20 volumes water per volume reaction mixture.

Ethidium Bromide

Ethidium bromide is a powerful mutagen widely used in biochemical research laboratories for visualizing DNA fragments. Ethidium bromide powder can be disposed following procedure ***On-Site Service***.

Ethidium Bromide 1: Aqueous solutions of ethidium bromide

- Dilute aqueous solutions less than 10 mg/L can be disposed of in the sanitary sewer. See procedure ***Sanitary Sewer 7***.
- Aqueous solutions of more than 10mg/L ethidium bromide can be disposed using ***On-Site Service***.
- Alternatively, you can use bleach to chemically treat ethidium bromide and dispose of the resulting mixture in the sanitary sewer. Contrary to older literature, recent findings of Margaret-Ann Armour of the University of Alberta show that waste ethidium bromide solutions can be safely treated with common household bleach to generate a non-mutagenic (according to the Ames test) solution of 2-carboxybenzophenone. Follow this procedure to treat ethidium bromide solutions:
    1. Carry out the following steps in a fume hood.
    2. Dilute solutions containing ethidium bromide to concentration ≤ 0.034% w/v (34 mg/100 mL).
    3. Add 10 mL fresh bleach for every 1 mg ethidium bromide (bleach can deteriorate upon exposure to air.)
    4. Stir at room temperature for 4 hours or overnight.
    5. Rinse the destroyed ethidium bromide solution down the sanitary sewer with 20 parts water.

Ethidium Bromide 2: Acrylamide gels containing ethidium bromide

Because of their ethidium bromide concentration, acrylamide gels containing ethidium bromide can be disposed of in the normal trash following procedure ***Normal Trash 2***.

Ethidium Bromide 3: Cesium chloride/ethidium bromide solutions

Waste aqueous solutions of cesium chloride and ethidium bromide sometimes are generated as a bi-phasic liquid with an alcohol layer. The following procedures are all appropriate for these wastes:

- Dilute aqueous solutions of less than 10 mg/L ethidium bromide can be disposed of in the sanitary sewer. See procedure ***Sanitary Sewer 1***.
- Aqueous solutions of more than 10 mg/L ethidium bromide are best treated by using bleach to chemically treat ethidium bromide. The resulting mixture should be disposed in the sanitary sewer. Follow this procedure to treat ethidium bromide solutions:
    1. Carry out the following steps in a fume hood.
    2. Dilute solutions containing ethidium bromide to concentration ≤ 0.034% w/v (34 mg/100 mL).
    3. Add 10 mL fresh bleach for every mg ethidium bromide (bleach can deteriorate upon exposure to air.)
    4. Stir at room temperature for 4 hours or overnight.
    5. Rinse the destroyed ethidium bromide solution down the sanitary sewer with 20 parts water.
- Alternatively, you can dispose of your liquid following ***On-Site Service***.

Ethidium Bromide 4: Alcohol solutions of ethidium bromide

Waste alcohol solutions of ethidium bromide commonly contain Butanol, *n*-Propanol or amyl alcohol. These alcohol solutions of ethidium bromide should be disposed following ***On-Site Service.***

Ethidium Bromide 5: Disposable labware contaminated with ethidium bromide

Contaminated labware includes disposable gloves, pipettes, test tubes, etc. that are contaminated with ethidium bromide. Follow the procedure below, depending on your waste type.

- Needles, spatulas and other sharps contaminated with ethidium bromide should be disposed of directly into a sharp's container.
- Pipettes and other disposable glassware contaminated with ethidium bromide should be disposed of in the waste container designated for glass disposal. Grossly contaminated glassware may be washed in bleach prior to disposal.
- Test tubes and centrifuge tubes contaminated with ethidium bromide should first be emptied, with the liquid disposed according to the appropriate procedure given above. Empty tubes can then be disposed in the normal trash, see ***Normal Trash 2***. Grossly contaminated glassware can be washed in bleach prior to disposal.
- Heat sealed tubes containing ethidium bromide should be disposed using ***On-Site Service***.

- Most other disposable labware contaminated with ethidium bromide can be safely disposed of in the normal trash according to ***Normal Trash 2***. If you think your labware contains an unusually high concentration of ethidium bromide, wash with bleach.

Explosives and Potential Explosives
Explosive and potentially explosive chemicals may require specific handling procedures to prevent detonation. Call EHS.

Gas in Aerosol Cans and Cylinders
As with most hazardous wastes, the best way to manage gas cylinders, canisters and cartridges is to keep surplus to a minimum. This can best be accomplished by buying only what you need, by using all you buy, by emptying cylinders completely through routine use, and by not purchasing duplicate cylinders for those that are partially full in your inventory.

Generally, two types of cylinders are used on campus:

- Cylinders containing gases such as argon, CO_2, He, N_2, O_2, air and other common gases. These usually come in 50-inch cylinders.
- Specialty gases, usually in lecture bottles, 12 inches long.

Gas 1: Aerosol cans
Empty aerosol cans be disposed of in the normal trash. Call EHS for instructions on aerosol cans with contents remaining. For solvent-based products or other hazardous substances, call EHS for disposal.

Gas 2: Return of gas cylinders to supplier
Most lecture bottles can be returned to their supplier or manufacturer.

1. Contact the manufacturer or vendor of the gas cylinder in question to see if it can be returned for reuse.
2. Follow the instructions given by the vendor to ship the cylinder.
3. If the manufacturer or vendor will not allow for return, follow procedure ***Gas 3*** for atmospheric gases and other gases.

Gas 3: Cylinders of atmospheric and inert gases
Consult with EHS for cylinders of atmospheric and inert gases that are not returnable or emptied.

Inorganic Chemicals
Look up chemical in Appendix G for specific disposal procedure.

Labware contaminated with chemicals

Contaminated labware includes disposable gloves, aprons, bench top coverings, centrifuge tubes, pipettes, pipette tips, test tubes, and unwanted glassware and other items that are contaminated with a chemical. Its hazard depends on the amount, toxicity and environmental fate of the contaminant.

Many of these items are typically cleaned and reused, and this is the best way to minimize this waste. The vast majority of waste labware that is not reused can safely be disposed of in the normal trash or the appropriate sharps or glass disposal container. To minimize the amount of waste contaminated labware that needs to be disposed commercially, decontaminate grossly contaminated labware whenever possible. Keep contaminated labware separate from non-contaminated labware whenever possible by using separate waste collection containers.

Toxicity Characteristic Rule

The U.S. Environmental Protection Agency regulates disposal of certain toxic chemicals under the Toxicity Characteristic Leaching Procedure (40 CFR 261). This method simulates the ability of a compound to leach out of a landfill into the groundwater. The following chemicals are currently listed by the U.S. EPA as having the characteristic of toxicity.

- Arsenic
- Barium
- Benzene
- Cadmium
- Carbon tetrachloride
- Chlordane
- Chlorobenzene
- Chloroform
- Chromium
- *m*-Cresol
- *o*-Cresol
- *p*-Cresol
- Cresol, total
- Endrin
- Heptachlor
- Hexachlorobenzene
- Hexachlorobutadiene
- Hexachloroethane
- Lead
- Lindane

- Mercury
- Methoxychlor
- Methyl ethyl ketone
- Nitrobenzene
- Pentachlorophenol
- Pyridine
- Selenium
- Silver
- Tetrachloroethylene
- Toxaphene
- Trichloroethylene
- 1,4-Dichlorobenzene
- 1,2-Dichloroethane
- 1,1-Dichloroethylene
- 2,4-Dinitrotoluene
- 2,4,5-Trichlorophenol
- 2,4,6-Trichlorophenol
- 2,4,5-TP Silvex
- Vinyl Chloride

Disposable material contaminated with these compounds must not be disposed of in the normal trash. They require treatment and disposal at a permitted hazardous waste facility. Follow procedure On-Site Service to dispose of these materials.

Labware 1: Decontamination and reuse of chemically contaminated labware

1. Wash, empty or otherwise decontaminate chemically contaminated labware to be reused with the appropriate detergent or solvent. Bleach is an excellent decontaminant for many oxidizable organic chemicals. An overnight soak is sufficient in most cases.
2. Dispose of the wash liquid appropriately. Most wash solutions can be disposed of in the sanitary sewer. Decant organic solvents into the proper waste container.

Labware 2: Decontamination and disposal of chemically contaminated labware

1. Wash, empty or otherwise decontaminate the chemically contaminated labware with the appropriate detergent or solvent. Bleach is an excellent decontaminant for many oxidizable organic chemicals. An overnight soak is sufficient in most cases.
2. Dispose of the wash liquid appropriately. Most wash solutions can be disposed of in the sanitary sewer. Decant organic solvents into the proper waste container.

3. Dispose of the decontaminated wet solids in the normal trash according to the procedure for ***Normal Trash 2***.

Labware 3: Chemically contaminated disposable items

Contaminated labware must be placed in a plastic bag. Liquids should be emptied into the appropriate liquid waste container. Add absorbent materials (e.g., paper towels or oil dry) to absorb any remaining liquids in the bag.

1. Toxicity characteristic chemicals. If the labware is contaminated with any amount of the TCLP chemicals listed above, give the waste to EH&S.
2. Normal trash chemicals. If the chemical contaminant is listed in Appendix G as having a disposal route of normal trash, the labware can safely be disposed of in the normal trash following procedure ***Normal Trash 3***.
3. Hazard determination. Most remaining contaminated labware can be disposed of in the normal trash by following procedure ***Normal Trash 3***. If decontamination of the labware is difficult, or your labware is contaminated with an extremely toxic chemical (i.e. Dioxin) or with gross amounts of a toxic chemical (i.e. gas chromatograph autosampler vials), use procedure ***On-Site Service***.

Mercury

Mercury compounds and metallic mercury are very hazardous. Mercury is especially difficult to safely handle because it is fluid and volatile. If spilled, mercury in the cracks of lab benches or floor tile may pose an exposure hazard for years until the mercury has evaporated. EHS first attempts to recycle free metallic mercury. Mercury and its compounds are very expensive to dispose of. Avoid using mercury by substituting red liquid thermometers and electronic devices to measure temperature and pressure.

Mercury 1: Recycling of free-flowing metallic mercury from thermometers and manometers

For free-flowing mercury from broken items, follow this procedure:

1. Follow Mercury Spill Clean-up procedure on page 24 of the Chemical Hygiene Plan.
2. If dealing with a broken thermometer, preserve all sections containing visible mercury, including the bulb. The capillary contains none of the metal; it can be discarded in the appropriate sharp's container.
3. Package the mercury securely in a small container and cover tightly.
4. Dispose of the material following ***On-Site Service***.

Mercury 2: Other mercury-containing materials such mercury-contaminated labware, mercury salts and spill clean-up products.

All compounds and materials containing mercury must be disposed following ***On-Site Service.***

Metals that are toxic

Toxic metals include beryllium and heavy metals such as arsenic, cadmium, chromium, lead, mercury, osmium, selenium and silver.

- Beryllium and beryllium dust must be given to EHS following ***On-Site Service***.
- Solid compounds containing toxic metals can be disposed following ***On-Site Service***.
- Some dilute solutions of toxic metals may be disposed of in the sanitary sewer. See procedure ***Sanitary Sewer 6***.
- Items contaminated with a toxic metal should be managed according to the procedures for ***Labware contaminated with chemicals***, above.

Neutralization Procedures: Strong Acids and Bases

Neutralization is the most efficient and least costly way of managing waste acids and bases. People who use strong acids and bases are responsible for their neutralization and disposal. This shares the burden for hazardous waste management with those people who generate the waste. Before you use acids, bases or any other chemical, your supervisor or principal investigator must train you to safely handle and dispose of these compounds.

This section addresses the neutralization of acids and bases listed in Appendix G. After neutralization, waste liquids can be disposed of in the sanitary sewer.

DO NOT NEUTRALIZE THESE ACIDS

The following acids are very reactive with water. Do not attempt to neutralize them unless you are an expert in handling and using these acids. Dispose of these waste acids following procedure ***On-Site Service***.

- Acid anhydrides and chlorides
- Chlorosulfonic acid
- Fuming Nitric acid
- Fuming Sulfuric acid
- Liquid halides of boron, silicon, tin, titanium and vanadium
- Liquid halides and oxyhalides of phosphorus, selenium and sulfur

Facilities, Personal Protection and Equipment for Neutralization

- Carry out neutralizations in a well-ventilated fume hood. Use the sash or a safety shield for protection against vigorous reactions.
- Wear an apron, splash-proof goggles ***and*** a full-face shield, and nitrile gloves (other glove material may not provide proper protection). Long gloves or gauntlets protect forearms from splashes.

- A five-gallon polyethylene bucket is recommended for neutralizing 1 to 10 liters. A large container is needed for addition of ice and base, and to safely stir the reaction.

Strengths of Concentrated Acids

Concentrated Acid	Amount to furnish one mole of acid protons	Maximum volume per neutralization in 5-gallon bucket
Acetic Acid (glacial)	57.1 mL	1.50 L
Formic Acid (88%)	43.6 mL	1.20 L
Hydrochloric Acid	83 mL	2.20 L
Hydrofluoric Acid (50%)	34.6 mL	0.75 L
Nitric Acid	67 mL	1.00 L
Perchloric Acid	83 mL	1.00 L
Phosphoric Acid (85%)	45.6 mL	1.20 L
Sulfuric Acid	27.7 mL	0.75 L
Trichloroacetic Acid (20% solution)	817 mL	3.00 kg/L (30%)

Planning for Neutralization

- Before starting the procedure, calculate quantities of acid or base needed for neutralization. The relative strengths of commonly used acids and bases are summarized in the adjacent tables.
- Add the maximum amount of concentrated acid or base solution listed in the tables in this section to 10 L water in a 5-gallon bucket. A rule of thumb is to dilute up to 20 moles of acid protons per 10 liters of water.
- Try a small batch first. Measure a few milliliters of waste acid into a beaker and gradually add a measured amount of base while testing its pH and observing its reaction. Assess the amount of heat and fumes generated, and the amount of base needed. Use these observations for scaling up your neutralization. Remember that, when scaling up, the lower ratio of surface area to volume may make heat dissipation a problem. Using ice, going slow and stirring all help.

Strengths of Bases Used for Neutralizations

Base	Amount needed to furnish one mole of base protons	Notes
Ammonium hydroxide (15 Molar)	67 mL	Must be used in a fume hood
Calcium hydroxide	37 grams	Add as a powder to neutralize acids
Magnesium hydroxide	29 grams	Add as a powder to neutralize acids
Potassium hydroxide	56 grams	Dissolve 336 grams KOH per liter of water to make 6 N solution.
Sodium bicarbonate	84 grams	This is best used as spill neutralizer due to foaming.
Sodium carbonate	53 grams	This is best used as spill neutralizer due to foaming.
Sodium hydroxide	40 grams	Dissolve 240 grams NaOH per liter of water to make 6 N solution

Neutralize Acid 1: Non-oxidizing acids that may generate heat upon neutralization such as phosphoric and sulfuric acid

1. Follow ***Facilities, Personal Protection and Equipment for Neutralization*** and ***Planning for Neutralization***, above.
2. Pour amount of acid specified above slowly over cubed ice.
3. Neutralize by slowing adding 6 N sodium hydroxide solution, stirring continually.
4. As heat builds up, add more ice.
5. Monitor pH change with a suitable indicator or check periodically with pH paper.
6. When pH > 2 is reached, the solution may be washed down the sanitary sewer with 20 parts water.

Neutralize Acid 2: Concentrated acids such as formic, hydrochloric, hydrobromic, and lactic acids

1. Follow ***Facilities, Personal Protection and Equipment for Neutralization*** and ***Planning for Neutralization***, above.

2. Pour amount of acid specified above slowly into water.
3. Stir in 6 M sodium or potassium hydroxide solution (or other suitable base) while monitoring the pH change with Universal indicator or check periodically with pH paper.
4. Once a pH >2 is reached, the solution can be washed down the sanitary sewer using 20 parts water.

Neutralize Acid 3: Fluoride-containing acid solutions such as ammonium bifluoride, hydrofluoric, and tetrafluoroboric acids (Caution: Hydrofluoric acid is extremely dangerous on contact: avoid contact with eyes or skin.) (Do not use with glass! Use plastic.)

1. Follow ***Facilities, Personal Protection and Equipment for Neutralization*** and ***Planning for Neutralization***, above.
2. Pour amount of acid specified above slowly into water.
3. Stir in a slurry of calcium hydroxide.
4. Monitor pH changes with pH paper or a suitable indicator.
5. When a pH of >2 is reached, the solution can be washed down the sanitary sewer using 20 parts water to one-part acid solution.

A precipitate of calcium fluoride may appear. This precipitate may be disposed of in the sanitary sewer with the rest of the solution if no more than about 100 grams of calcium fluoride is formed. Larger amounts should be collected for disposal following procedure ***On-Site Service.***

Neutralize Acid 4: Oxidizing acids, such as nitric and perchloric acids

1. Follow ***Facilities, Personal Protection and Equipment for Neutralization*** and ***Planning for Neutralization***, above.
2. Dilute the acid with 10 parts water.
3. Neutralize with a 6 M solution of potassium or sodium hydroxide. The solution may turn yellow or brown as nitric oxide forms when neutralizing nitric acid. The nitric oxide is toxic and must be kept in the fume hood. If you use potassium hydroxide, a white precipitate of potassium perchlorate will form when neutralizing perchloric acid. The precipitate may be disposed of in the sanitary sewer with the rest of the solution.
4. Monitor pH with pH paper or another suitable indicator.
5. When a pH >2 is reached, wash solution down the sanitary sewer using 20 parts water.

Neutralize Acid 5: 57% Hydroiodic acid

1. Follow ***Facilities, Personal Protection and Equipment for Neutralization*** and ***Planning for Neutralizations***, above.
2. Dilute the dark orange/brown solution with 10 parts water.

3. Rinse bottle with water and add rinsate to rest of solution to be neutralized.
4. If crystallized iodine remains in the bottle, dispose following procedure ***On-Site Service***.
5. Add 6 M sodium hydroxide or another suitable base.
6. Monitor pH changes with pH paper, as the color of the solution will interfere with most indicators. The solution will become nearly colorless as pH 7 is approached.
7. When a pH >2 is reached, solution can be washed down the sanitary sewer using approximately 20 parts water.

Neutralize Acid 6: Chromic acid cleaning solutions and COD wastes

1. Follow ***Facilities, Personal Protection and Equipment for Neutralization*** and ***Planning for Neutralizations***, above. Limit this procedure to 20 L daily per principal investigator.
2. Pour the acid (approximately 0.75 L) into 10 L water.
3. Slowly pour 6 M sodium hydroxide into the solution (Caution: Hissing and spattering may occur).
4. Monitor pH change with pH paper.
5. When pH 4-5 is achieved, reduce the green Cr (VI) to blue Cr (III) by addition of saturated sodium sulfite solution. Caution: Hexavalent chromium [Cr (VI)] is a known carcinogen.
6. Once a homogenous blue color is achieved, the solution and precipitate can be washed down the sanitary sewer with approximately 20 parts water. See ***Sanitary Sewer 6*** for more details.

Example of Neutralization Calculation

Polly Purity just moved into the lab formerly used by Harry Hoarder and found the following items in the cabinets under the hood:

300 mL of ammonium hydroxide
1.5 L of hydrochloric acid
250 mL of sulfuric acid
400 mL 20% trichloroacetic acid solution

Polly was horrified by the thought that Harry may have stuck his grungy pipettes into these reagents, and decided that these items had to go. How many grams of sodium hydroxide would she need to neutralize all of these items?

Step One: Calculate how many moles of acid protons you have.

Hydrochloric acid: 1500 mL ÷ 83.0 mL/mole = 18 moles
Sulfuric acid: 250 mL ÷ 27.2 mL/mole = 9 moles
Trichloroacetic acid: 400 mL ÷ 871 mL/mole = 0.5 moles
28 moles acid

Step Two: Calculate how many moles of base you have:
Ammonium hydroxide: 300 mL ÷ 67 mL/mole = 5 moles base
Step Three: Subtract moles of base from moles of acid:
28 moles acid – 5 moles base = 23 moles base needed
Step Four: Calculate the grams of sodium hydroxide you would need to complete the neutralization:
23 moles base x 40 g/mole NaOH = 920 grams NaOH
Therefore, an additional 920 grams of sodium hydroxide are needed to complete the neutralization.

Neutralize Base 1: General base neutralization such as solutions of potassium and sodium hydroxides and alcoholic sodium or potassium hydroxide cleaning solutions.

1. Follow ***Facilities, Personal Protection and Equipment for Neutralization*** and ***Planning for Neutralization***, above.
2. Note that effervescence is common with older base solutions due to carbon dioxide absorption.
3. Add up to 2 L hydroxide solution to 10 liters water.
4. Slowly add 6 N hydrochloric or other suitable acid.
5. Monitor pH changes with pH paper. (Note: Liquid indicators can oxidize rapidly in basic solutions and give false color change.)
6. When pH <10 is reached, solution can be washed down sanitary sewer with 20 parts water.

Neutralize Base 2: Amine solutions such as ammonium hydroxide, methylamine, dimethyl amine, ethylamine, and trimethyl amine

1. Follow ***Facilities, Personal Protection and Equipment for Neutralization*** and ***Planning for Neutralization***, above.
2. Add up to 1.5 liters of amine with 10 liters water.
3. Slowly add 6 N hydrochloric or other suitable acid. (Do not use nitric or perchloric acids on amine bases.)
4. Monitor pH changes with pH paper. (Note: Liquid indicators can oxidize rapidly in basic solutions and give false color change.)
5. When pH <10 is reached, solution can be washed down sanitary sewer with 20 parts water.

Neutralize Base 3: Volatile low molecular weight amines such as allyl amine, butyl amine, diethyl amine, ethylenediamine, morpholine, pyrrolidine and tetramethylethylenediamine

1. Follow ***Facilities, Personal Protection and Equipment for Neutralization*** and ***Planning for Neutralization***, above.
2. Add up to 1.5 liters of amine with 10 liters water.
3. Slowly add 6 N hydrochloric or other suitable acid.

4. Monitor pH changes with pH paper. (Note: Liquid indicators can oxidize rapidly in basic solutions and give false color change.)
5. When pH <10 is reached, solution can be washed down sanitary sewer with 20 parts water.

Normal Trash Procedures

Although certain laboratory wastes can safely be disposed of in the normal trash, great care must be taken to protect custodians, handlers, haulers and the environment. This section describes the necessary precautions for disposing of laboratory chemical waste in the normal trash.

Safe and Legal Use of the Normal Trash

Where does it go? When you dispose of any waste in a normal trash wastebasket on the Montana Tech campus, your waste is collected with other waste from the building and then picked up to go in a normal trash dumpster. When the dumpster is emptied, the trash is mixed with other campus trash, refuse and garbage, and transported to the Butte-Silver Bow landfill.

Do not discard any chemical in normal trash unless Appendix G specifically lists that as a method of disposal. You may not dispose of any regulated hazardous waste in the normal trash. Hazardous waste includes chemicals that are:

- Ignitable or oxidizers
- Corrosive
- Reactive, potentially explosive, or capable of generating cyanide or sulfide gas
- Contain a Toxic Characteristic Chemical (see list in section ***Labware Contaminated with Chemicals*** above)
- Listed as an Acute Hazardous Waste (P-list), a Toxic Waste (D or U-list), or appear on the F or K-lists.

Only certain wastes (specified in this section) may be disposed of in the normal trash. To prevent risks to those who empty wastebaskets, you may not dispose of any uncontained chemical in the normal trash. To keep things neat, any liquids and wet wastes need to be absorbed and securely bagged, and dry wastes need to be in containers with secure lids.

Normal Trash 1: Non-hazardous solid chemicals

Use this procedure for non-hazardous solid chemicals that are listed as ***Normal Trash 1*** in Appendix G, such as talc, silica, sulfur and carbon. Do not dispose of liquids or solutions in the normal trash.

- Normal trash is handled roughly. To prevent exposing handlers to powders, all waste solids should be contained in a tightly closed bag, box or bottle that is packed inside a second box or bag (i.e., an overpack). A box overpack is preferred, especially to prevent breakage if glass is used as an inside container. Mark the overpack with the waste's identity so that handlers can be assured that the waste is safe for the normal trash.
- To further minimize the chance of breakage from handling, place more than one kilogram of non-hazardous chemical for the normal trash directly in your building's dumpster.

Normal Trash 2: Non-hazardous waste that is wet

Use this procedure for non-hazardous waste that is listed as ***Normal Trash 2*** in Appendix G and for other wastes that refer to this procedure, such as gels, precipitates and semi-solids. This procedure can also be used for wet, emptied vials.

- Any waste contaminated with a Toxic Characteristic Chemical must be given to EHS following procedure ***On-Site Service***.
- Minimize liquids in the waste by emptying vials, decanting any excess liquids, filtering the waste or allowing the aqueous waste to evaporate in a fume hood. Dispose of liquids in the sanitary sewer or in an organic solvent waste container, as appropriate. Absorb any remaining liquids by adding absorbent (e.g., oil dry or absorbent paper) to the waste or in the container.
- Normal trash is handled roughly. To keep the waste contained, all waste for the normal trash should be in a tightly closed bag, box or bottle that is packed inside a second box or bag (i.e. an overpack). A box overpack is preferred, especially to prevent breakage if glass is used as an inside container. Mark the overpack with the waste's identity so that handlers can be assured that the waste is safe for the normal trash.
- To further minimize the chance of breakage from handling, place more than one kilogram of waste for the normal trash directly in your building's dumpster.

Normal Trash 3. Labware contaminated with chemicals

Use this procedure for chemically-contaminated labware that can be safely disposed of in the normal trash, as referenced in ***Labware 3***.

- Any waste contaminated with a Toxicity Characteristic Chemical must be given to EHS for disposal. See section ***Labware Contaminated with Chemicals*** for a list of Toxic Characteristic Chemicals.
- Sharps and glass must be disposed of in a sharp's container. An ordinary cardboard box may be used to dispose of glassware contaminated with chemicals provided it is strong and sturdy. The box should be no larger than 12" x 12" bottom and weigh no

more than 20 pounds when full. The box should be lined with plastic to contain any splinters and moisture.

- Minimize liquids in the waste by emptying vials, decanting any excess liquids, filtering the waste or allowing the aqueous waste to evaporate in a fume hood. Dispose of the liquids in the sanitary sewer or in an organic solvent waste container, as appropriate. Absorb any remaining liquids by adding absorbent (e.g. oil dry or absorbent paper).
- Normal trash is handled roughly. To keep the waste contained, all waste for the normal trash should be in a tightly closed bag, box or bottle that is packed inside a second box or bag (i.e. an overpack). A box overpack is preferred, especially to prevent breakage if glass is used as an inside container. Mark the overpack with the waste's identity so that handlers can be assured that the waste is safe for the normal trash.
- To further minimize the chance of breakage from handling, place more than one kilogram of waste for the normal trash directly in your building's dumpster.

Normal Trash 4: Disposal of empty containers

To dispose of an empty container that contained a liquid or solid chemical:

- Remove all remaining chemical from the container by normal means (e.g. pouring, draining, aspirating, etc.)
- Rinse the container three times using a small amount of water or an alcohol or acetone rinse, which can be disposed of in the sanitary sewer. Waster is preferred for rinsing, even if the chemical is only slightly soluble; try running warm water in the container while it is in a sink. If an organic solvent that is not miscible with water is used, dispose of the rinsate in an organic waste container.
- Dispose of the container in the normal trash, a glass collection container, or a sharps container, depending on what type of container you have.

Oils

Petroleum-based oils used for lubrication of engines and machinery are recycled through Physical Facilities. This includes centrifuges, diffusion pumps and vacuum pumps used in laboratories. Do not allow cleaning solvents or other materials to be combined with used oils. Uncontaminated instrument and machine oils such as centrifuge, diffusion pump and vacuum pump oils can be disposed of by the following procedure:

1. Refer to Appendix G.
2. Package oil in one-gallon containers and label the contents. (Five-gallon containers can be used if necessary.) Do NOT mix with other chemicals.
3. Refer to procedure ***On-Site Service*** for disposal.
4. If the oil might contain PCBs (polychlorinated biphenyls), refer to method ***PCB 1***.

On-Site Service

Surplus chemicals, waste organic solvents, most waste chemicals and some contaminated labware can be removed from your laboratory and brought to EHS. Prior to removal, the owner of the chemical must complete a Montana Tech Hazardous Materials Manifest provided by EHS. The owner will label the containers as hazardous waste or surplus chemicals, whichever is appropriate. The chemicals removed from the area, are stored in the Hazardous Waste Storage Room. "Good" chemicals are re-distributed if possible, and the rest are stored until they are shipped as hazardous waste to a commercial treatment, storage and disposal facility.

Other guidelines:

- All containers must be marked legibly with the chemical's identity.
- Chemical mixtures, aqueous solutions, other liquids and reaction products must be placed in suitable containers that are tightly closed and contain the material. Leaking or highly soiled containers will not be accepted.
    - Glass bottles with screw caps work well. Open beakers or flasks are not suitable, nor are milk jugs or pop bottles.
    - A suitable container for contaminated labware is a tightly closed plastic bag inside a cardboard box. Clearly mark the outside with its contents.
    - Suitable containers for wet solids include (for small amounts) glass bottles with screw caps and (for larger amounts) tightly closed plastic bags inside cardboard boxes. Clearly mark the outside of the box with its contents. No free liquid should be present with wet solid wastes; absorb any free liquid with absorbent paper or oil dry (do not use vermiculite for an absorbent.)

Organic Chemicals

- Refer to Appendix G for the proper disposal procedure for your chemical.
- For solids and reusable solids in their original containers, see ***On-Site Service***.
- For organic solvents, see
- For gases, see ***Gases in Aerosol Cans*** and ***Cylinders.***
- For a solute in aqueous solutions, refer to Appendix G for the proper disposal
- For a contaminant on disposable labware, see ***Labware 3***.

Organic Solvent Collection

- If you generate a substantial amount of organic solvent waste, the preferred method for accumulation is to use a DOT-approved 15-gallon polyethylene drum. The solvents can then be shipped directly without having to bulk them into another container. Use procedure ***On-Site Service***.

- For smaller amounts, use no larger than 4-liter containers that are compatible with your waste, and use ***On-Site Service***.

Adding Waste Solvents to Waste Containers:

1. Organic solvents are toxic, so wear goggles, gloves and a lab coat when handling the waste.
2. When in use, keep the waste containers in a well-ventilated area.
3. Keep the waste container securely capped at all times except when adding waste. Four good reasons to do this include:
4. Volatile solvents are toxic and evaporation into the room threatens your health.
    a. If an open waste container is accidentally tipped over, the solvent spill risks a fire and the health of you and your colleagues.
    b. Evaporation of organic solvents causes air pollution and is an illegal disposal method.
    c. The law (RCRA) states that all waste containers must be capped at all times!
5. A funnel may help prevent spills, but never leave a funnel in a waste container when you are not adding waste.
6. Do not fill waste containers to the top. For 4-liter containers, leave a minimum of a 2-inch headspace. For 15-gallon drums, leave a 5-inch headspace. This will allow sufficient room for expansion and will help to prevent leaks.

Required Recordkeeping

- To dispose of waste properly, the contents must be known. As stated on page 1 of this appendix, logs must be kept for each hazardous waste container.
- When a waste container is full, call EHS for a Montana Tech Hazardous Materials Manifest and for pick-up or to drop off.

Osmium Tetroxide

Osmium tetroxide solutions can be converted to a less volatile and safer form in a variety of ways, all of them involving the reduction of tetroxide to a non-volatile dioxide or the cyclic osmium (VI) ester.

- Add corn oil to the solution and shake. This method takes advantage of the double bonds of the unsaturated oil to form a cyclic osmic ester. The reaction may be slow as corn oil is not really mixable with water, but it is easy and it works. Ethanol and other alcohols will also reduce osmium tetroxide to dioxide. The solution will become dark and a suspension will form; this is its own indication of efficiency.
- Alternatively, add sodium sulfite solution (prepared fresh as it slowly oxidizes to sulfate on prolonged storage) to a solution containing osmium tetroxide. A black or purple turbidity will indicate the reduction of the tetroxide to dioxide.

Polychlorinated Biphenyls (PCBs)
The U.S. Environmental Protection Agency, under the Toxic Substances Control Act (TSCA), regulates PCB-containing materials at concentrations over 50 ppm. The following guidelines should be followed to properly dispose of PCBs:

PCB 1: Liquids containing PCBs
These include PCBs mixed with organic solvents, PCB solutions mixed with polymers, stock solutions, concentrated PCBs, and rinsate from equipment.

1. Store in a glass container, preferably 1 gallon or less, with a good cap that does not leak.
2. Clearly label that the contents are PCBs.
3. Keep track of all solvents and approximate PCB concentrations in the container. (e.g., 100 mL 100 ppm Aroclor 1254 in hexane.)
4. When the container is ¾ full, arrange for disposal following procedure ***On-Site Service***.

PCB 2: PCB contaminated equipment such as gloves and labware

1. Keep contaminated materials separated from liquid PCBs.
2. Place the contaminated materials in a heavy plastic bag and seal. Place the bag inside another bag (double bag), seal with tape and place inside a box.
3. Identify PCB concentration of contaminant on the waste label.
4. Arrange for disposal following procedure ***On-Site Service***.

PCB 3: Electrical equipment containing PCB (or suspected PCB) oil such as fluid-filled capacitors, transformers and voltage regulators

1. Fluid-filled electrical equipment over 9 pounds may contain significant amounts of PCB oil. Suspect electrical items should be stored in plastic trays or buckets containing an absorbent to contain and absorb any spills or leaks.
2. Electrical items containing PCB oil must be carefully handled and stored in leakproof, containment areas. Oil leaking from these items will cause serious contamination necessitating enormous clean-up costs.
3. The U.S. EPA strictly regulates disposal of PCB electrical equipment.

Sanitary Sewer Procedures
As noted in Appendix G, many chemicals can be safely disposed of in the sanitary sewer when flushed down a sink drain with copious amounts of water.

Chemicals NOT safe for drain disposal
The following materials are prohibited from drain disposal:

- Halogenated hydrocarbons
- Nitro compounds
- Mercaptans
- Flammables (immiscible in water)
- Explosives such as azides and peroxides
- Water soluble polymers that could form gels in the sewer system
- Water reactive materials
- Malodorous chemicals
- Toxic chemicals such as carcinogens, mutagens, teratogens
- Substances that boil below 50° C

Safe and Legal Use of the Sanitary Sewer

Where does it go? When you dispose of any material or wastewater in a laboratory sink on the Montana Tech campus, your laboratory effluent is mixed with other sanitary sewage and wastewater and enters the sewage collection system of Butte-Silver Bow Metro Sewer. In the collection system, Montana Tech's wastewater is mixed with sewage and wastewater from area households and businesses. The sewage and wastewater are conducted to Metro Sewer's treatment plant south of the campus.

What happens to it? Solutes that are in wastewater are subject to physical degradation in the sewage system. For example, a small quantity of most organophosphate pesticides is quickly hydrolyzed in the sewer. At the treatment plant, the waste is subjected to bacterial degradation. For example, small amounts of sodium nitrate (an oxidizer) disposed of in the sanitary sewer will be used as a bacterial nutrient. There is also a tremendous degree of dilution that occurs in the system, which facilitates both of these processes.

What is the law? Only certain liquids and wastes (specified in this appendix) may be disposed of in your laboratory sink. To prevent damage to the plumbing, you may not dispose of any undiluted corrosive chemicals in your sink; corrosives must first be neutralized. To prevent explosions in the sewer system, you may not dispose of any undiluted or nonmiscible flammable liquid in a laboratory sink. Polychlorinated biphenyls must not be disposed of in the sanitary sewer. Because they do not degrade, sewer disposal of toxic metals such as mercury and cadmium are limited to small amounts of very dilute solutions.

Prudent and safe use of the sanitary sewer: Accounting for these concerns and restrictions, the sanitary sewage system is capable of safely handling and treating a wide variety of laboratory waste. Appendix G lists those chemicals that are appropriate for the sanitary sewer, and this part describes the proper procedures to use. This appendix has been approved by Butte-Silver Bow Metro Sewer.

Guidelines for Sanitary Sewer Disposal

Discharge compounds to the sewer only if:

1. You are certain of its identity,
2. Appendix G lists the disposal procedure as Sanitary Sewer, or
3. You have received special permission from Metro Sewer.

Some chemicals that may be disposed of in the sanitary sewer are, nonetheless, toxic to humans. Follow these steps when discharging compounds to the sanitary sewer:

1. Don't dispose of chemicals in the sanitary sewer unless you are confident that your laboratory's sewer can handle large volumes of water and chemicals. Most laboratory sinks can be used for sanitary sewer disposal, but avoid those sinks with a history of plugging problems.
2. Refer to Appendix G for the specific procedure for your material. Remember that concentrated acids and bases must first be neutralized.
3. For each chemical or solute, each procedure has a daily limit per principal investigator or supervisor. Coordinate your sewer disposal activities with others in your group or lab to stay within these limits.
4. Wear a lab coat, safety goggles, appropriate gloves, and avoid potential contact.
5. Use a hood sink where available. For procedure ***Sanitary Sewer 3***, use of a hood is mandatory.
6. Dispose of a small amount of the material first, noting reactivity and solubility. To increase solubility, try warm water. Do not flush materials that are insoluble.
7. Dispose of small quantities at a time.
8. Flush the chemicals with large quantities of water (usually at least 20 times the amount).
9. Rinse out the sink to remove any residual debris and to clear the trap.

Sanitary Sewer 1: Readily soluble solids, solutions and non-volatile liquids

Soluble organic salts, sugars, amino acids, nucleotides, nucleosides, vitamins, acids, amines, surfactants and many metabolic intermediates can be disposed of in the sanitary sewer. In addition, soluble salt combinations of these ions can be discharged to the sanitary sewer system:

Cations	**Anions**
Aluminum	Acetate
Ammonium	Bicarbonate
Bismuth	Bisulfite
Calcium	Borate

Cerium	Bromate
Cesium	Bromide
Cobalt	Carbonate
Gold	Chlorate
Iron	Chloride
Lithium	Cyanate
Magnesium	Iodate
Manganese	Iodide
Potassium	Nitrate
Rubidium	Nitrite
Sodium	Perchlorate
Strontium	Periodate
Tin	Permanganate
	Phosphate
	Silicate
	Stannate
	Sulfate
	Sulfite
	Thiocyanate
	Thiosulfate
	Titanate
	Tungstate
	Vanadate

1. Follow ***Guidelines for Sanitary Sewer Disposal***, above. For each chemical or solute, limit discharges to 1000 grams per day per principal investigator.
2. Look at the label to see if it is an anhydrous aluminum or magnesium salt (***see Sanitary Sewer 3***).
3. Slowly pour into stream of running water down drain.
4. Dispose of the rinsed empty bottle following ***Normal Trash 4***.

Sanitary Sewer 2: Slowly soluble solids

This procedure is optional. You may not have the time or facilities for this. If this is the case, dispose of the material following ***On-Site Service***.

1. Follow ***Guidelines for Sanitary Sewer Disposal***, above. For each chemical or solute, limit discharges to 100 grams per day per principal investigator.
2. Dissolve as much as possible in a bucket of water, decant and try to dissolve the remainder. Alternatively, with water running through a colander or strainer, pour in a little of the solid (powder, crystals, etc.) at a time. Use a hood and go slowly with

light, fluffy powders that tend to be airborne. Allow a stream of water to run over any undissolved material in the strainer.
3. Dispose of the rinsed, empty bottle following ***Normal Trash 4***.

Sanitary Sewer 3: Water reactive but suitable if dissolved

1. Follow ***Guidelines for Sanitary Sewer Disposal***, above. For each chemical or solute, limit discharges to 100 grams per day per principal investigator.
2. Always sewer these materials in a hood sink. If a hood sink is not available, dispose of the material following ***On-Site Service***.
3. Pour slowly in a bucket of water or stream of running water. Anhydrous halogen salts of Mg, Al, Ca or Fe may hiss and generate heat as they dissolve in water.
4. Allow the chemical to dissolve completely. Slowly pour into stream of running water.
5. Dispose of the rinsed, empty bottle following ***Normal Trash 4***.

Sanitary Sewer 4: Pretreatment prior to sewer disposal

This appendix describes chemical treatment procedures for acrylamide, cyanide solutions, ethidium bromide, and strong acids and bases. Many simple chemical treatment procedures exist that can be performed in the laboratory to make the chemicals suitable for discharge to the sanitary sewer. If you generate small amounts of waste that can be readily detoxified, neutralized, oxidized, precipitated or reduced by laboratory methods, and you have the facilities to perform these methods, do so.

For all chemical treatment procedures, follow ***Guidelines for Sanitary Sewer Disposal***.

Sanitary Sewer 5: Malodorous but suitable for sewer disposal

This procedure is suitable for aqueous solutions of acetaldehyde, formaldehyde, glutaraldehyde, mercaptoethanol, low molecular weight amines, and sulfide solutions. In general, this procedure is for neat liquids as well as solutions addressed in ***Sanitary Sewer 8***.

1. Follow ***Guidelines for Sanitary Sewer Disposal***, above. For each chemical or solute, limit discharges to 100 grams per day per principal investigator.
2. The sink should be in a hood that is performing well. Pour directly into drain with water running. Don't allow the solution to spread in sink. Flush with large volumes of water afterwards.
3. Dispose of the rinsed, empty bottle following Normal Trash 4.

Sanitary Sewer 6: Aqueous solutions of inorganic chemicals

Use this procedure only if you have been referred her from Appendix G or another section of this part.

Follow ***Guidelines for Sanitary Sewer Disposal***, above. The concentrations of the following toxic metals are regulated in the sanitary sewer. Do not exceed these daily limits for discharge per principal investigator.

- Arsenic 1000 g
- Barium 1000 g
- Cadmium 250 g
- Chromium (III) 1000 g
- Chromium (VI) 500 g
- Copper 1000 g
- Lead 1000 g
- Mercury 2 g
- Molybdenum 2 g
- Nickel 1000 g
- Selenium 300 g
- Silver 300 g
- Zinc 1000 g

Concentrated solutions of these metals should be treated to precipitate and remove metals before discharge to the sanitary sewer. Adjust pH to basic side of neutrality and collect any precipitate that occurs. This will work well with mercury (II), silver, lead and cadmium. Chromates and dichromates can be treated with sodium bisulfite or dithionite to reduce them to Cr (III). Copper, zinc, nickel, arsenic (cacodylate buffers) and barium solutions can be sewered directly. Dispose of the precipitate via ***On-Site Service***. Any silver solutions can be put through the silver recovery unit in the Metallurgical Engineering Department. Contact EHS to make arrangements.

Sanitary Sewer 7: Aqueous solutions of organic chemicals

Use this procedure only if you have been referred here from Appendix G or another section of this part.

Follow ***Guidelines for Sanitary Sewer Disposal***, above. Aqueous solutions or biodegradable concentrations of 10% or less can be disposed of in the sanitary sewer with copious amounts of water. Degradable organic chemicals include hydrazine, acrylamide, nicotine, diaminobenzidine, phenol, sodium fluoroacetate, and picric acid, as well as others listed in Appendix G.

Sanitary Sewer 8: Aqueous solutions of organic solvents

Solutions of these biodegradable organic chemicals used as dilute, homogenous aqueous solutions (or as aqueous extract wastes from reaction workups) may be safely disposed of in the sanitary sewer. These include low molecular weight alcohols, aldehydes, ketones, amines, ethers, cellosolves, nitriles, esters and nitroalkanes such as:

- Methanol to pentanol
- Formaldehyde to butyraldehyde
- Acetone, methyl ethyl ketone
- Propyl amine to piperidine
- Propylene oxide, tetrahydrofuran, dioxane and diethyl ether
- Methyl cellosolve and ethyl cellosolve
- Acetonitrile
- Methyl formate and methyl acetate
- Nitroethane and nitromethane
- Dimethylformamide (DMF), hexamethylphosphoramide (HMPA) and dimethylsulfoxide (DMSO)

1. Follow ***Guidelines for Sanitary Sewer Disposal***, above.
2. Limit sewer disposal of dilute aqueous solutions of these solvents to 10 liters daily per principal investigator.
3. Follow the solution with approximately 10 volumes of water.
4. Dispose of the rinsed, empty bottle following ***Normal Trash 4***.
5. If the material is malodorous, follow procedure ***Sanitary Sewer 5***.

Solids

Refer to Appendix G for disposal procedure for solid chemicals. Solids and reusable solids in their original container can be disposed following procedure ***On-Site Service***.

Solids that are wet: gels, precipitates and semi-solids

Use this procedure for solids that are wet, such as gels, precipitates, semi-solids, etc. This procedure can also be used for wet, emptied vials.

- Minimize liquids in the waste by emptying vials, decanting excess liquids, filtering the waste or allowing the aqueous waste to evaporate in a fume hood. Dispose of liquids in the sanitary sewer or in an organic solvent waste container, as appropriate. Absorb any remaining liquids by adding absorbent (e.g. oil dry or absorbent paper.)
- Any waste contaminated with a Toxicity Characteristic chemical must be given to EHS following procedure ***On-Site Service***. See ***Labware Contaminated with Chemicals*** for a list of the Toxicity Characteristic chemicals.
- For all other wet wastes or chemicals, call EHS or dispose of the waste following procedure ***On-Site Service***.

Unknowns

Analysis and disposal of material for which the identity is not known is very expensive, ranging from about $50 to $1500 per unknown. To prevent the creation of unknowns, label everything – even beakers, test tubes, etc.- with the name of the chemical, the owner, and the date. If you do find unknowns in your department or lab, consider the following:

1. Consult other workers in the area who may have an idea as to the identity of the material. Even a general chemical classification (such as aromatic sulfur compound) can be helpful.
2. A phone call to a colleague who has left will pay for itself if they can identify the material.
3. When a professor or scientist plans to leave Montana Tech, contact EHS so no unknowns are left behind. A laboratory checkout is required.
4. All graduate students are required to report to EHS before graduating. If lab work was performed during their graduate work, a walk-through of the lab area(s) is required, with the student, the advisor, and the EHS Director present.
5. Departments are responsible for the cost of analysis for unknowns.

APPENDIX G
DISPOSAL PROCEDURES BY CHEMICAL

For each waste laboratory chemical, use this list to direct you to the appropriate disposal procedure in Appendix F. For materials not included in this list, follow procedure **On Site Service** in Appendix F for disposal.

Chemical Name	Disposal Procedure in Appendix F
Acacia powder, gum arabic	Normal Trash 1
Acetaldehyde	Sanitary Sewer 5
Acetaldehyde, aqueous solution	Sanitary Sewer 5
Acetaldoxime	On Site Service
Acetamide	Sanitary Sewer 1
Acetamidophenol, 4-	Sanitary Sewer 2
Acetaminophen (Tylenol®)	Sanitary Sewer 2
Acetate/barbitol buffer solution (aqueous)	Sanitary Sewer 1
Acetic Acid	Neutralize Acid 2
Acetic Acid, aqueous solution	Sanitary Sewer 1
Acetoacetic Acid, lithium salt	Sanitary Sewer 1
Acetone	On Site Service
Acetoneoxime	Sanitary Sewer 1
Actetonitrile	On Site Service
Acetonylacetone (2,5-hexanedione)	On Site Service
Acetophenone	On Site Service
Acetyl acetone (2,4-pentanedione)	On Site Service
Acetyl-DL-tryptophane, N-	Sanitary Sewer 2
Acetyl-D-glucosamine, N-	Sanitary Sewer 1
Acetylglucosaminidase, N-	Sanitary Sewer 1

Chemical Name	Disposal Procedure in Appendix F
Acid and base indicator solutions	Sanitary Sewer 1
Acid fuchsin (dye) solution in alcohol	On Site Service
Acrylamide, aqueous solution	*Acrylamide*
ACS II® (toluene based)	On Site Service
Activated carbon, unused	Normal Trash 1
Adenine	Sanitary Sewer 1
Adenine sulfate	Sanitary Sewer 1
Adipic Acid	Sanitary Sewer 2
Adrenaline	Sanitary Sewer 1
Adrenaline chloride	Sanitary Sewer 1
Aerothene (1,1,1-trichloroethane)	On Site Service
Agfa rapid concentrate (developer)	Sanitary Sewer 1
Alanine, beta-	Sanitary Sewer 1
Alanine, D-, L-, or DL-	Sanitary Sewer 1
Alanine hydroxamic acid	Sanitary Sewer 1
Allantoin	Sanitary Sewer 1
Alletrin (pyrethrin)	On Site Service
Allo cystathione, DL-	Sanitary Sewer 2
Allopurinol	Sanitary Sewer 1
Alloxan	Sanitary Sewer 1
Allyl alcohol	On Site Service
Allyl amine	Sanitary Sewer 5
Allyl bromide	On Site Service
Allyl chloride	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Allyl cyanide	On Site Service
Allyl formate	On Site Service
Alumina	Normal Trash 1
Aluminum ammonium sulfate	Sanitary Sewer 1
Aluminum chloride-$6H_2O$ (hydrated)	Sanitary Sewer 1
Aluminum chloride, anhydrous	Sanitary Sewer 3
Aluminum nitrate	Sanitary Sewer 1
Aluminum oxide	Normal Trash 1
Aluminum potassium sulfate	Sanitary Sewer 1
Aluminum sulfate, anhydrous	Sanitary Sewer 3
Amberlite®	Normal Trash 1
Amidazole	Sanitary Sewer 1
Aminoacetic acid (glycine)	Sanitary Sewer 1
Amino acetonitrile hydrochloride	Sanitary Sewer 1
Amino acid calibration mixture, (aqueous)	Sanitary Sewer 1
Aminobenzoic acid, m-	Sanitary Sewer 2
Aminobenzoic acid, p-	Sanitary Sewer 2
Aminobephenyl, 4-, aqueous solution	Sanitary Sewer 7
Amino- n-, or iso-butyric acid, D, L or DL, alpha, beta, or gamma	Sanitary Sewer 1
Amino-n-caproic acid, e-	Sanitary Sewer 1
Aminoethanol, 2-	Sanitary Sewer 1
Aminoguanidine	Sanitary Sewer 1
Aminoguanidine bicarbonate	Sanitary Sewer 1

Chemical Name	Disposal Procedure in Appendix F
Amino-2-hydroxymethyl-1,3-propanediol, 2- (TRIZMA)	Sanitary Sewer 1
Amino-6-hydroxy purine (guanine), 2-	Sanitary Sewer 1
Amino-2-methyl-1,3-propanediol, 2-	Sanitary Sewer 1
Amino-2-methylpropanol, 2-	Sanitary Sewer 1
Aminomethyl pyridine, 4-	Sanitary Sewer 1
Aminophylline	Sanitary Sewer 1
Aminopropanol, 3-	Sanitary Sewer 3
Aminopropyl-N-3-morpholine	Sanitary Sewer 1
Aminopropyl triethoxysilane, 3-	On Site Service
Aminosalicylic acid, p-	Sanitary Sewer 1
Ammonia solution, aqueous	Neutralize Base 2
Ammonium acetate	Sanitary Sewer 1
Ammonium bicarbonate	Sanitary Sewer 1
Ammonium bromide	Sanitary Sewer 1
Ammonium carbonate	Sanitary Sewer 1
Ammonium chloride	Sanitary Sewer 1
Ammonium citrate	Sanitary Sewer 1
Ammonium formate	Sanitary Sewer 1
Ammonium hydroxide	Neutralize Base 2
Ammonium iodide	Sanitary Sewer 1
Ammonium iron (III) sulfate	Sanitary Sewer 1
Ammonium nitrate	Sanitary Sewer 1
Ammonium oxalate	Sanitary Sewer 1
Ammonium perchlorate	Sanitary Sewer 1

Chemical Name	Disposal Procedure in Appendix F
Ammonium peroxydisulfate	Sanitary Sewer 2
Ammonium phosphate	Sanitary Sewer 1
Ammonium phosphate dibasic	Sanitary Sewer 1
Ammonium phosphate monobasic	Sanitary Sewer 1
Ammonium sulfamate	Sanitary Sewer 1
Ammonium sulfate	Sanitary Sewer 1
Ammonium thiocyanate	Sanitary Sewer 1
Ammonium thiosulfate	Sanitary Sewer 1
Amyl acetate, n-	On Site Service
Amyl alcohol, n-	On Site Service
Amyl alcohol, tert-	On Site Service
Amylamine, n-	Sanitary Sewer 5
Anethole	On Site Service
Anhydrone (anhydrous magnesium perchlorate)	Sanitary Sewer 3
Aniline	On Site Service
Aninosalicylic acid, p-	Sanitary Sewer 1
Anisaldehyde, m-	On Site Service
Anisaldehyde, p-	On Site Service
Anisole	On Site Service
Anisyl alcohol	On Site Service
Ansidine, o-	On Site Service
Anthranilic acid	Sanitary Sewer 2
Antiblaze (freon)	On Site Service
Antifoam	Sanitary Sewer 2

Chemical Name	Disposal Procedure in Appendix F
Antimony potassium tartrate	Sanitary Sewer 1
Antimony sodium tartrate	Sanitary Sewer 1
Aquasol, (toluene)	On Site Service
Aquassure (mostly toluene)	On Site Service
Arabic gum, tears	Normal Trash 1
Arabinose, L-	Sanitary Sewer 1
Arginine, L-	Sanitary Sewer 1
Arginine monohydrochloride, L-	Sanitary Sewer 1
Aromatic petroleum derivatives	On Site Service
Ascorbic acid	Sanitary Sewer 1
Asparagine	Sanitary Sewer 1
Aspartic acid, DL-	Sanitary Sewer 1
Aspirin	Sanitary Sewer 2
Bacto-lactose	Sanitary Sewer 1
Baking Soda	Sanitary Sewer 1
Balsam fir resin	Normal Trash 1
Barbiruric acid/pyridine solution	On Site Service
Battery acid (dilute sulfuric acid)	Neutralize Acid 2
Beef extract	Normal Trash 1
Behenic acid	Normal Trash 1
Bentonite	Normal Trash 1
Benzaldehyde	On Site Service
Benzene	On Site Service
Benzidine dihydrochloride, aqueous soln	Sanitary Sewer 7

Chemical Name	Disposal Procedure in Appendix F
Benzonitrile	On Site Service
Benzyl acetate	On Site Service
Benzyl alcohol	On Site Service
Benzylamine	On Site Service
Benzyl benzoate	On Site Service
Benzyl chloride	On Site Service
Benzyl dimethylamine	On Site Service
Betaine	Sanitary Sewer 1
Bicine	Sanitary Sewer 1
Bilirubin standard	Sanitary Sewer 1
Biosolve 3® , aqueous	Sanitary Sewer 1
Biosolve® (triton X-100)	Sanitary Sewer 1
Biotin	Sanitary Sewer 2
Bis(dimethylamine)-2-propanol, 1,3-	Sanitary Sewer 1
Bis(trimethylsilyl)acetamide	Sanitary Sewer 1
Bis(trimethylsilyl)trifluoroacetamide	Sanitary Sewer 1
Blanket wash (primarily mineral spirits)	On Site Service
Bleach, aqueous solution	Sanitary Sewer 1
Boileezers®	Normal Trash 1
Borax	Sanitary Sewer 2
Boric acid	Sanitary Sewer 2
Borneol, l-	On Site Service
Bornyl acetate, l-	On Site Service
Boron acetate	Sanitary Sewer 1

Chemical Name	Disposal Procedure in Appendix F
Bovine serum	Sanitary Sewer 1
Brilliant blue solution	On Site Service
Bromcresol green, indicator soln	Sanitary Sewer 1
Bromide standard solution, aqueous	Sanitary Sewer 1
Bromobenzene	On Site Service
Bromobutane, 1-	On Site Service
Bromobutane, 2-	On Site Service
Bromo-n-caproic acid, a-	On Site Service
Bromo-2-chloroethane, 1-	On Site Service
Bromochloromethane	On Site Service
Bromo-3-chloropropane, 1-	On Site Service
Bromocresol, indicator solution	Sanitary Sewer 1
Bromodecane, 1-	On Site Service
Bromoethane	On Site Service
Bromofluorobenzene	On Site Service
Bromoform	On Site Service
Bromonaphthalene	On Site Service
Bromopropane	On Site Service
Bromo-1-propene, 1-	On Site Service
Bromopropene, 2-	On Site Service
Bromopyridine, 2-	On Site Service
Bromopyridine, 3-	On Site Service
Bromotoluene, a-	On Site Service
Bromotrichlormethane	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Bromthymol blue, indicator solution	Sanitary Sewer 1
BSTFA (Bis-(trimethylsilyl)trifluoroacetimide)	Sanitary Sewer 1
Budget solve® (xylene)	On Site Service
Buffer pH-4 solution, aqueous	Sanitary Sewer 1
Buffer pH-7 solution, aqueous	Sanitary Sewer 1
Buffer pH-10 solution , aqueous	Sanitary Sewer 1
Butanediol, 1,4-	On Site Service
Butanedione, 2,3-	On Site Service
Butanol, n-	On Site Service
Butanol, sec-	On Site Service
Butanol, tert-	On Site Service
Butanone, 2-	On Site Service
Butyl acetate, n-	On Site Service
Butyl alcohol, n-	On Site Service
Butyl alcohol, t-	On Site Service
Butyl alcohol, sec-	On Site Service
Butyl amine, n-	Sanitary Sewer 5
Butyl amine, t-	Sanitary Sewer 5
Butyl ammonium chloride salt, t-	Sanitary Sewer 1
Butyl benzyl phthalate	On Site Service
Butyl butyrate	On Site Service
Butyl cellosolve	On Site Service
Butyl chloride, n-	On Site Service
Butyl ether, n-	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Butyl nitrite, n-	On Site Service
Butyl phenol, 2-tert-	On Site Service
Butyl phthalate	On Site Service
Butyl trifluoroacetate	On Site Service
Butyraldehyde	On Site Service
Butyric acid, n-	Sanitary Sewer 5
Butyronitrile, n-	On Site Service
Caccotheline	Sanitary Sewer 2
Cadaverine	Sanitary Sewer 1
Cadaverine, di-HCL	Sanitary Sewer 1
Caffeic acid	Sanitary Sewer 1
Calamus oil european	On Site Service
Calcium acetate	Sanitary Sewer 1
Calcium bromde	Sanitary Sewer 1
Calcium carbonate	Normal Trash 1
Calcium chloride, anhydrous powder	Sanitary Sewer 3
Calcium chloride, dihydrate	Sanitary Sewer 1
Calcium disodium versenate	Sanitary Sewer 1
Calcium hypochlorite	Sanitary Sewer 2
Calcium lactate	Sanitary Sewer 2
Calcium oxalate	Normal Trash 1
Calcium pantothenate, dl-	Sanitary Sewer 1
Calcium phosphate	Sanitary Sewer 1
Calcium phosphate, dibasic	Sanitary Sewer 2

Chemical Name	Disposal Procedure in Appendix F
Calcium phosphate, monobasic	Sanitary Sewer 2
Calcium silicate	Normal Trash 1
Calcium sulfate	Sanitary Sewer 2
Calcium thiocyanate	Sanitary Sewer 1
Canadian balsam	Normal Trash 1
Caproic acid	On Site Service
Caprylic acid	On Site Service
Captan/benomyl solution	On Site Service
Carbamylcholine chloride	Sanitary Sewer 1
Carbamyl phosphate	Sanitary Sewer 1
Carbolic acid (liquefied phenol)	On Site Service
Carbon black	Normal Trash 1
Carbon, (granular), unused	Normal Trash 1
Carbon tetrachloride	On Site Service
Carborundum grit	Normal Trash 1
Carbo-sorb (2-methoxyethyl amine)	Sanitary Sewer 5
Carbowax 1540 (PEG)	Normal Trash 1
Carnitine HCl, dl-	Sanitary Sewer 1
Carnoy's solution (Chloroform, acetic acid)	On Site Service
Carvone, d-	On Site Service
Castor oil	On Site Service
Cation exchange resin	Normal Trash 1
Cedarwood oil	On Site Service
Celite	Normal Trash 1

Chemical Name	Disposal Procedure in Appendix F
Cellex-D (anion exchange)	Normal Trash 1
Cellulose powder	Normal Trash 1
Ceric ammonium sulfate	Sanitary Sewer 1
Ceric sulfate	Sanitary Sewer 1
Cesium acetate	Sanitary Sewer 1
Cesium chloride	Sanitary Sewer 1
Charcoal, unused	Normal Trash 1
Chloral hydrate	Sanitary Sewer 1
Chloralose	Sanitary Sewer 1
Chlordane (in solvent)	On Site Service
Chloroacetonitrile	On Site Service
Chloroacetophenone, p-	On Site Service
Chloroaniline, m-	On Site Service
Chloroaniline, o-	On Site Service
Chlorobenzaldehyde, 2-	On Site Service
Chlorobenzene	On Site Service
Chlorobutane, 1-	On Site Service
Chlorodibromomethane	On Site Service
Chloro-2,3-epoxypropane, 1- (epichlorohydrin)	On Site Service
Chloroethanol, 2-	On Site Service
Chloroform	On Site Service
Chlorogenic acid	Sanitary Sewer 1
Chloro-3-methyl-2-butene, 1-	On Site Service
Chloromethyl methyl ether	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Chloromethylnaphthalene	On Site Service
Chloro-2-methyl propane, 2-	On Site Service
Chloro-N,N-diallyacetamide, 2-	On Site Service
Chlorophenol, o-	On Site Service
Chloro-1,2-propanediol, 3-	On Site Service
Chlorox® Bleach	Sanitary Sewer 1
Choline chloride	Sanitary Sewer 1
Chromic acid and sulfuric acid	Neutralize Acid 6
Chromium oxide, sulfuric acid	Neutralize Acid 6
Chromosorb®	Normal Trash 1
Cinnamaldehyde, trans-	On Site Service
Circuit board etching compound	Sanitary Sewer 1
Citric acid	Sanitary Sewer 1
Clearium® (toluene)	On Site Service
Clove oil	On Site Service
Cobalt chloride	Sanitary Sewer 1
Cobalt nitrate	Sanitary Sewer 1
Cobaltous acetate	Sanitary Sewer 1
Cobaltous chloride	Sanitary Sewer 1
Cobaltous sulfate	Sanitary Sewer 1
Cobalt sodium nitrite	Sanitary Sewer 1
Cobalt sulfate	Sanitary Sewer 1
Cobe's solution, aqueous	Sanitary Sewer 1
Collidine, s-	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Collidine, (trimethylpyridine, 2,4,6-)	On Site Service
Congo red solution	On Site Service
Copier dispersant (mineral spirits)	On Site Service
Correx solution (Benzamidazole carbamate)	On Site Service
Cotton blue, aqueous lactic acid solution	Sanitary Sewer 1
Creatine	Sanitary Sewer 1
Creatine phosphate dipotassium	Sanitary Sewer 1
Cresol, m-	On Site Service
Cresol, o-	On Site Service
Cresyl acetate, o-	On Site Service
Crotonaldehyde	On Site Service
Croton oil	On Site Service
Crown-5, 15-	Sanitary Sewer 1
Crown-6, 18-	Sanitary Sewer 1
Crystal violet, methanol solution	On Site Service
Crystal violet solution	On Site Service
Cumene	On Site Service
Cyanamide	Sanitary Sewer 1
Cyanamide, aqueous solution	Sanitary Sewer 1
Cyanocobalamin (B-12)	On Site Service
Cyclohexane	On Site Service
Cyclohexanol	On Site Service
Cyclohexanone	On Site Service
Cyclohexene	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Cyclohexene-1-caronitrile, 3-	On Site Service
Cyclohexylamine	On Site Service
Cyclopentane	On Site Service
Cyclopentene	On Site Service
Cyclophosphamide, aqueous solution	Sanitary Sewer 7
Cysteic acid, L-	Sanitary Sewer 1
Cysteine, L-	Sanitary Sewer 1
Cysteine HCl, L-	Sanitary Sewer 1
Cystine, L-	Sanitary Sewer 1
Cytidine	Sanitary Sewer 1
Cytosine	Sanitary Sewer 1
DEAE-dextran	Sanitary Sewer 1
Decahydronapthalene, (Decalin)	On Site Service
Decane, n-	On Site Service
Decyl alcohol	On Site Service
Decylamine, n-	On Site Service
Defoamer	Normal Trash 1
Deoxyadenosine	Sanitary Sewer 1
Deoxyguanosine	Sanitary Sewer 1
Desoxypyridoxine	Sanitary Sewer 1
Developer, aqueous solution	Sanitary Sewer 1
Dextran	Sanitary Sewer 1
Dextran, sulfate	Sanitary Sewer 1
Dextrin	Normal Trash 1

Chemical Name	Disposal Procedure in Appendix F
Dextrose	Sanitary Sewer 1
Diacetone alcohol	On Site Service
Diacetyl monoxime	Sanitary Sewer 2
Diallyl phthalate	On Site Service
Diaminobenzidine, aqueous solution	Sanitary Sewer 7
Diaminobenzoic acid, 3,5-, di-HCl,	Sanitary Sewer 1
Diaminobutane dihydrochloride, 1,4-	Sanitary Sewer 1
Diamino dipropyl amine, 3,3'-	Sanitary Sewer 1
Diamino-2-hydroxypropane, 1,3-	Sanitary Sewer 1
Diamino-2-methyl propane, 1,2-	Sanitary Sewer 1
Diaminopentane	Sanitary Sewer 1
Diaminopimelic acid, DL-a-e-	Sanitary Sewer 1
Dianisidine hydrochloride, o- solution	Sanitary Sewer 7
Diatomaceous earth	Normal Trash 1
Diazabicyclooctane (DABCO)	Sanitary Sewer 1
Diazabicycloundec-5-ene, 1,5-	On Site Service
Dibromoacetophenone, a,a-	On Site Service
Dibromo-2-butene, 1,4-	On Site Service
Dibromo-3-chloropropane, 1,2-	On Site Service
Dibromoethane, 1,2-	On Site Service
Dibromomethane	On Site Service
Dibutyl amine	On Site Service
Di-n-butyl ether	On Site Service
Dibutyl maleate	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Dibutyl phthalate	On Site Service
Dibutyl tin dilaurate (liquid)	On Site Service
Dicalcium phosphate	Sanitary Sewer 2
Dicarnaba (banvil), emulsifiable concentrate	On Site Service
Dichloroacetic acid	Neutralize Acid 2
Dichlorobenzene, o-	On Site Service
Dichlorobutane, 1,4-	On Site Service
Dichloroethane, 1,1-	On Site Service
Dichloroethaen, 1,2-	On Site Service
Dichloroethylene, (cis or trans), 1,2-	On Site Service
Dichlorohexaflouropropane, 1,2-	On Site Service
Dichloromethane	On Site Service
Dichloro-2-propanol, 1,3-	On Site Service
Dichromate cleaning solution	Neutralize Acid 6
Dicyclohexyl amine	On Site Service
Dicyclohexyl-18-crown-6-ether	On Site Service
Dicyclopentadiene	On Site Service
Diethanol amine	Sanitary Sewer 1
Diethoxyethane	On Site Service
Diethyl amine	Sanitary Sewer 5
Diethyl amino-3-butanone, 1-	Sanitary Sewer 1
Diethylaminoethanol, 2-	Sanitary Sewer 1
Diethyl aminoithyl cellulose (DEAE Cellulose)	Sanitary Sewer 1
Diethylamino-3-pentanone, 1-	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Diethyl aniline, N,N-	On Site Service
Diethyl carbonate	On Site Service
Diethyl cellosolve (1,2-Diethoxyethane)	On Site Service
Diethylenetriamino pentacetic acid	Sanitary Sewer 1
Diethyl ether	On Site Service
Diethyl ethylmalonate	On Site Service
Diethyl ketal (aceophenone)	On Site Service
Diethyl maleate	On Site Service
Diethyl malonate	On Site Service
Diethyl phosphoric acid ester	Neutralize Acid 2
Diethyl phthalate	On Site Service
Diethyl succinate	On Site Service
Diethyl-d-tartrate	On Site Service
Diethyl-m-toluamide (DEET)	On Site Service
Diffusion pump oil (siloxane)	On Site Service
Difurfurlidene acetone	On Site Service
Difurylmethane	On Site Service
Dihydro-2-methoxy-2H-pyran, 3,4-	On Site Service
Dihydro-2H-pyran-2-methanol, 3,4-	On Site Service
Dihydroxy benzaldehyde, 3,4-	Sanitary Sewer 1
Dihydroxy benzoic acid, 2,5-	Sanitary Sewer 1
Diisobutyl ketone	On Site Service
Diisodecyl phthalate	On Site Service
Diisopropyl amine	Sanitary Sewer 5

Chemical Name	Disposal Procedure in Appendix F
Diisopropyl ethylamine	On Site Service
Diisopropyl naphthalene	On Site Service
Dimercaptopropanol, 2,3-	Sanitary Sewer 5
Dimethoxybenzidine, aqueous solution	Sanitary Sewer 7
Dimethoxymethylphenyl silane	On Site Service
Dimethoxypropane, 2,2-	On Site Service
Dimethoxy-4-propenylbenzene, 1,2-	On Site Service
Dimethoxytoluene,2,5-	On Site Service
Dimethylacetamide, N,N-	On Site Service
Dimethylacetamide, N,N-, aqueous soln	Sanitary Sewer 1
Dimethylallyaminopurine riboside	Sanitary Sewer 1
Dimethylallylamine: TFA buffer	Sanitary Sewer 1
Dimethyl amine, aqueous soln	Sanitary Sewer 5
Dimethylamino ethanol	Sanitary Sewer 1
Dimethylaminoethyl phenol, 4-	Sanitary Sewer 1
Dimethylaminoethyl propionate, 2-	On Site Service
Dimethylaminomethyl phenol, 2,4,6-tris	On Site Service
Dimethylamino propionitrile, 3-	Sanitary Sewer 5
Dimethylaminopropylamine	Sanitary Sewer 1
Dimethylaminopyridine, 4-	Sanitary Sewer 1
Dimethyl aniline, N,N-	On Site Service
Dimethylbenzidine, aqueous solution	Sanitary Sewer 7
Dimethylbenzylamine, N,N-	On Site Service
Dimethyl caprylamide	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Dimethylcyclohexane, 1,2-	On Site Service
Dimethyldodecylamine-N-oxide	On Site Service
Dimethylformamide dibutyl acetal, N,N-	On Site Service
Dimethylformamide dicyclohexyl acetal, N,N-	On Site Service
Dimethylformamide diethyl acetal, N,N-	On Site Service
Dimethylformamide diisopropyl acetal, N,N-	On Site Service
Dimethylformamide dipropylacetal	On Site Service
Dimethylformamide , N,N-	On Site Service
Dimethylglycine HCl, N,N-	Sanitary Sewer 1
Dimethyl glyoxime (2,3-butanedione dioxime)	Sanitary Sewer 1
Dimethyl-4-heptanone, 2,6-	On Site Service
Dimethylhexanoamide	On Site Service
Dimethyl phenol, 2,4-	On Site Service
Dimethyl phthalate	On Site Service
Dimethyl siloxane (silicone oil)	On Site Service
Dimethyl suberate	On Site Service
Dimethyl succinate	On Site Service
Dimethyl sulfide	On Site Service
Dimethyl sulfoxide	On Site Service
Dimethyl urea, 1,3-	Sanitary Sewer 1
Dimethyl urea, N,N'-	Sanitary Sewer 1
Dinitrofluorobenzene, 2,4-	On Site Service
Dinitrofluorobenzene, 2,4-dilute aqueous solution	Sanitary Sewer 7

Chemical Name	Disposal Procedure in Appendix F
Diotol® scintillation cocktail	On Site Service
Dioxane, 1,4-	On Site Service
Dioxane, p-	On Site Service
Dipentene	On Site Service
Diphenylithylene, 1,1-	On Site Service
Diphenyloxazole, 2,5-, DMSO solution	On Site Service
Dipropyl amine	Sanitary Sewer 5
Disodium EDTA	Sanitary Sewer 1
Disodium phosphate	Sanitary Sewer 2
Dithiothreitol	Sanitary Sewer 1
DMF	On Site Service
DMP-30	On Site Service
DMSO (dimethyl sulfoxide)	On Site Service
Docosanoic acid	Normal Trash 1
Dodecane	On Site Service
Dodecenyl succinic anhydride (DDSA)	On Site Service
Dodecyl alcohol	On Site Service
Dow Corning 550®	On Site Service
Dow Corning 3-6060® (MIBK)	On Site Service
Dowex® resin	Normal Trash 1
Dowtherm A®	On Site Service
Dricote (trimethylsilylacetate in Dichloromethane)	On Site Service
Drierite (anhydrous calcium sulfate)	Normal Trash 1
Dulcitol	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Dye solutions	On Site Service
Eccostrip 94 (Formic acid in Dichloromethane)	On Site Service
Econofluor®	Sanitary Sewer 1
EDTA	Sanitary Sewer 1
EDTA (disodium)	Sanitary Sewer 1
EDTA (tetrasodium salt)	Sanitary Sewer 1
EDTA (trisodium, monohydrate)	Sanitary Sewer 2
EGTA	Sanitary Sewer 2
Electron microscopy resins (solidified)	Normal Trash 1
Emulphogen (liquid polyoxyethylene)	On Site Service
Enflurane	On Site Service
Eosin Y, alcoholic solution	On Site Service
Epichlorohydrin	On Site Service
Epoxy-3,3,3-trichloropropane, 1,2-	On Site Service
Erythritol, meso	Sanitary Sewer 1
Esteron Ten-Ten® (2,4-D) solution	On Site Service
Ethanol	On Site Service
Ethanolamine	Sanitary Sewer 1
Ethidium bromide, butanol solution	On Site Service
Ethidium bromide, aqueous solution	*Ethidium Bromide 2*
Ethoxybenzaldehyde, o-	On Site Service
Ethyoxy ethanol, 2- (ethyl cellosolve)	On Site Service
Ethoxyquin	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Ethrane	On Site Service
Ethyl acetate	On Site Service
Ethyl acetonacetate	On Site Service
Ethyl acetonedicarboxylate	On Site Service
Ethyl alcohol	Sanitary Sewer 5
Ethyl amine, 70% aqueous solution	On Site Service
Ethyl anthranilate	On Site Service
Ethyl benzoate	On Site Service
Ethyl benzoylacetate	On Site Service
Ethyl bromide	On Site Service
Ethyl bromoacetate	On Site Service
Ethyl butyrate	On Site Service
Ethyl-n-butyrate	On Site Service
Ethylbutyric acid, 2-	On Site Service
Ethyl chloroacetate	On Site Service
Ethyl cyanoacetate	On Site Service
Ethylenediamine triacetic acid	Sanitary Sewer 1
Ethylenediamine	Sanitary Sewer 5
Ethylenediamine-N,N-diacetic acid	Sanitary Sewer 1
Ethylenediamine tetraacetic acid (EDTA)	Sanitary Sewer 1
Ethylene dichloride	On Site Service
Ethylenedinitrilo tetraacetic acid	Sanitary Sewer 1
Ethylene glycol	On Site Service
Ethylene glycol dimethyl ether	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Ethylene glycol monobutyl ether	On Site Service
Ethylene glycol monoethyl ether	On Site Service
Ethylene glycol monomethyl ether	On Site Service
Ethyl ether	On Site Service
Ethyl formate	On Site Service
Ethyl hexanediol	On Site Service
Ethyl-1,3-hexanediol, 2-	On Site Service
Ethylhexoic acid, 2-	On Site Service
Ethyl iodide	On Site Service
Ethylmethane sulfonate, aqueous solution	Sanitary Sewer 7
Ethyl morpholine, n-	On Site Service
Ethyl oxylate	On Site Service
Ethyl phenol	On Site Service
Ethylphenol, 2-	On Site Service
Ethylphenol, 3-	On Site Service
Ethyl silicate	On Site Service
Ethyl succinate	On Site Service
Ethyltrimethylammonium bromide	Sanitary Sewer 1
Eucalyptus oil	On Site Service
Eugenol	On Site Service
Eupharol	On Site Service
Ferric acetate	Sanitary Sewer 1
Ferric ammonium citrate	Sanitary Sewer 1
Ferric ammonium sulfate	Sanitary Sewer 1

Chemical Name	Disposal Procedure in Appendix F
Ferric chloride, anhydrous	Sanitary Sewer 3
Ferric chloride, hexahydrate	Sanitary Sewer 2
Ferric chloride, aqueous solution	Sanitary Sewer 1
Ferric citrate	Sanitary Sewer 1
Ferric oxide	Normal Trash 1
Ferric phosphate	Normal Trash 1
Ferric pyrophosphate	Normal Trash 1
Ferric sodium pyrophosphate	Sanitary Sewer 1
Ferric sulfate	Sanitary Sewer 2
Ferrous ammonium sulfate	Sanitary Sewer 1
Ferrous chloride	Sanitary Sewer 2
Ferrous sulfate	Sanitary Sewer 2
Fixer, Kodak®	Sanitary Sewer 1
Florisil	Normal Trash 1
Fluoroaniline, o-	On Site Service
Fluorocitrate, aqueous solution	Sanitary Sewer 1
Fluorodeoxyuridine, 5'-	Sanitary Sewer 1
Fluorophenyl alanine HCl, o-	Sanitary Sewer 1
Fluorosilicone oil	On Site Service
Fluothane	On Site Service
Folin & Ciocalteau's phenol reagent	Neutralize Acid 2
Formalin (aqueous formaldehyde solution, 40% or less	Sanitary Sewer 5
Formamide	On Site Service
Formic acid	Neutralize Acid 2

Chemical Name	Disposal Procedure in Appendix F
Fremy's salt	Sanitary Sewer 1
Freon 11®	On Site Service
Freon 113® (trichlorotrifluoroethane)	On Site Service
Frucose, L-	Sanitary Sewer 1
Fuel oil	On Site Service
Fumaric acid	Sanitary Sewer 1
Furaldehyde, 2-	On Site Service
Furfural	On Site Service
Furfuryl alcohol	On Site Service
Galatose, D-	Sanitary Sewer 1
Galacturonic acid, alpha, D-	Sanitary Sewer 1
Gallic acid	Sanitary Sewer 1
Gels, acrylamide polymer	Normal Trash 1
Ghatti gum	Normal Trash 1
Glacial acetic acid	Neutralize Acid 2
Glucosamine, D-	Sanitary Sewer 1
Glucosamine hydrochloride, D(+)-	Sanitary Sewer 1
Glucose	Sanitary Sewer 1
Glucose oxidase	Sanitary Sewer 1
Glucose standard solution, aqueous	Sanitary Sewer 1
Glucuronic acid	Sanitary Sewer 1
Glutamic acid, L-(+)-	Sanitary Sewer 1
Glutamic acid-g-hydrazide, L-	Sanitary Sewer 1
Glutamic acid hydrochloride, L-	Sanitary Sewer 1

Chemical Name	Disposal Procedure in Appendix F
Glutamine, L-	Sanitary Sewer 1
Glutaraldehyde solution, aqueous	Sanitary Sewer 5
Glycerine	Sanitary Sewer 1
Glycerol	Sanitary Sewer 1
Glycerophosphate	Sanitary Sewer 1
Glycine	Sanitary Sewer 1
Glycoaldehyde	Sanitary Sewer 1
Glycolic acid	Sanitary Sewer 1
Glyoxylic acid	Sanitary Sewer 1
Gram's iodine stain	Sanitary Sewer 1
Graphite	Normal Trash 1
Guaiacol	On Site Service
Guaic gum, powder	Normal Trash 1
Guanidine hydrochloride	Sanitary Sewer 1
Gum arabic	Normal Trash 1
Gum ghatti	Normal Trash 1
Halothane	On Site Service
HCl solution, aqueous	Neutralize Acid 2
Heat transfer fluid (non-PCB)	On Site Service
HEPES (4-(2-Hydroxyethyl)-1-poperanzineethane-sulfonic acid)	Sanitary Sewer 1
Heptaldehyde	On Site Service
Heptane, n-	On Site Service
Heptylamine	On Site Service
Hexachlorobutadiene	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Hexachloropentadiene	On Site Service
Hexadecane	On Site Service
Hexadecanol, 1-	Normal Trash 1
Hexafluorobenzene	On Site Service
Hexaldehyde, n-	On Site Service
Hexamethyldisilane	On Site Service
Hexamethyldisilane in toluene	On Site Service
Hexamethyldisilazane, 1,1,1,3,3,3-	On Site Service
Hexamethyl phosphoramide	On Site Service
Hexamethyl phosphoramide, aqueous soln.	Sanitary Sewer 1
Hexamethylphosphoroustirmide	On Site Service
Hexanal	On Site Service
Hexane	On Site Service
Hexanedione, 2,5-	On Site Service
Hexanes	On Site Service
Hexanoic acid	On Site Service
Hexanol	On Site Service
Hexanone, 2-	On Site Service
Hexyl alcohol	On Site Service
Hexylamine	On Site Service
Hexyl-4-chloropenol, 2-n-	On Site Service
Hippuric acid	Sanitary Sewer 1
Hippuric acid, sodium salt	Sanitary Sewer 1

Chemical Name	Disposal Procedure in Appendix F
Histamine dihydrochloride	Sanitary Sewer 1
Histidine, L-	Sanitary Sewer 1
Histoclad (xylene)	On Site Service
Homocysteine, DL-	Sanitary Sewer 1
Homoserine, DL-	Sanitary Sewer 1
Homotryptamine hydrochloride	Sanitary Sewer 1
Hyamine (Quaternary alkyl ammonium hydroxide solution in methanol)	On Site Service
Hydriodic acid 50%	Neutralize Acid 5
Hydrobromic acid	Neutralize Acid 2
Hydrochloric acid	Neutralize Acid 2
Hydrofluor (Xylene)	On Site Service
Hydrogen iodide solution	Neutralize Acid 5
Hydrogen peroxide, aqueous solution (30 % or less)	Sanitary Sewer 1
Hydroiodic acid	Neutralize Acid 5
Hydroquinone (Kodak first developer)	Sanitary Sewer 1
Hydroquinone/quinone	Sanitary Sewer 2
Hydroquinone, aqueous solution (Kodak first developer)	Sanitary Sewer 1
Hydroxy benzaldehyde, 2-	On Site Service
Hydroxybenzoic acid, p	Sanitary Sewer 1
Hydroxyethyl ether, bis-2-	On Site Service
Hydroxyethyloimino diacetic acid, 2-	Sanitary Sewer 1
Hydroxylamine	Sanitary Sewer 1

Chemical Name	Disposal Procedure in Appendix F
Hydroxylamine hydrochloride	Sanitary Sewer 1
Hydroxylamine sulfate	Sanitary Sewer 1
Hydroxylamine sulfate, aqueous solution	Sanitary Sewer 1
Hydroxylammonium chloride	Sanitary Sewer 1
Hydroxy-L-proline	Sanitary Sewer 1
Hydroxymethylaminomethane, tris-	Sanitary Sewer 1
Hydroxyphenylpyruvic acid	Sanitary Sewer 1
Hydroxypiperdine, 3-	Sanitary Sewer 1
Hydroxypropionic acid (lactic acid)	Sanitary Sewer 1
Hydroxypyrazolo-(3,4-d)-pyramidine	Sanitary Sewer 1
Hydroxytryptophan	Sanitary Sewer 2
Hydroxanthine	Sanitary Sewer 1
Imidazole	Sanitary Sewer 1
Iminodiacetic acid, disodium salt	Sanitary Sewer 1
Immersion oil, (non-PCB)	On Site Service
Indicator solutions	Sanitary Sewer 1
Indole	Sanitary Sewer 2
Indole-3-acetic acid	Sanitary Sewer 1
Indolebutyric acid	Sanitary Sewer 1
Indole-3-carboxylic acid	Sanitary Sewer 1
Inositol, l-	Sanitary Sewer 1
Inositol, myo-	Sanitary Sewer 1
Insta-fluor®	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Insta-gel® cocktail	On Site Service
Iodine, aqueous solution	Sanitary Sewer 1
Iodine tincture	Sanitary Sewer 1
Iodoacetic acid, sodium salt, aqueous soln	Sanitary Sewer 7
Iodobutane	On Site Service
Iodoethene	On Site Service
Iodomethane	On Site Service
Iodonaphthalene	On Site Service
Ionone b-	On Site Service
Iron (II) chloride	Sanitary Sewer 2
Iron (II) chloride dihydrate	Sanitary Sewer 1
Iron (II) chloride tetrahydrate	Sanitary Sewer 1
Iron (III) chloride, anhydrous	Sanitary Sewer 3
Iron (III) chloride, hexahydrate	Sanitary Sewer 1
Iron citrate	Sanitary Sewer 1
Iron dextran	Sanitary Sewer 1
Iron filings	Normal Trash 1
Iron oxalate	Sanitary Sewer 1
Iron oxide	Normal Trash 1
Iron phosphate	Normal Trash 1
Iron pyrophosphate	Normal Trash 1
Iron wire	Normal Trash 1
Isoamyl acetate	On Site Service
Isoamyl alcohol	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Isoamyl ether	On Site Service
Isoamyl nitrite	On Site Service
Isobutanol	On Site Service
Isobutyl alcohol	On Site Service
Isobutyraldehyde	On Site Service
Isobutyric acid	Sanitary Sewer 5
Isoeugenol	On Site Service
Isoglutamine, L-	Sanitary Sewer 1
Isoleucine, L-	Sanitary Sewer 2
Isonicotinamide	Sanitary Sewer 1
Isonicotinic acid	Sanitary Sewer 1
Isooctane	On Site Service
Isopentane	On Site Service
Isopentyl acetate	On Site Service
Isopentyl alcohol	On Site Service
Isoprene	On Site Service
Isopropyl alcohol (Isopropanol)	On Site Service
Isopropyl amine	Sanitary Sewer 5
Isopropyl ammonium chloride	Sanitary Sewer 1
Isopropylbenzaldehyde, p-	On Site Service
Isopropyl benzene (cumene)	On Site Service
Isopropylcyclohexylamine	On Site Service
Itek® mega developer (KOH, NaOH)	Sanitary Sewer 1
Juniper tar	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Kainite	Sanitary Sewer 1
Kaolin	Normal Trash 1
Karl Fischer reagent (Pyridine, Iodine, Sulfur dioxide)	Sanitary Sewer 5
Kelthane® (DDT in fuel oil)	On Site Service
Kerosene	On Site Service
Keto-1,4-dioxane	On Site Service
Ketoglutaric acid, alpha-	Sanitary Sewer 1
Keycut oil in water, 10% or greater	On Site Service
Kodak® hardener (sulfuric acid 25%)	Neutralize Acid 2
Kodak® photo-flo	Sanitary Sewer 1
Kodak® rapid fixer	Sanitary Sewer 1
K oil (a natural oil)	On Site Service
Kojic acid	Sanitary Sewer 1
Lacmoid (resorcin blue)	Sanitary Sewer 1
Lacquer (solidified)	Normal Trash 1
Lactalbumin hydrolysate	Sanitary Sewer 1
Lactic acid, L-	Sanitary Sewer 1
Lactose	Sanitary Sewer 1
Lamott purple, solution	On Site Service
Lanolin	Normal Trash 1
Laser dyes in alcohol	On Site Service
Lauric acid	Normal Trash 1
Lethane-60	On Site Service
Leucine, L-	Sanitary Sewer 2

Chemical Name	Disposal Procedure in Appendix F
Levulinic acid	Sanitary Sewer 1
Levulose, D-(-)-	Sanitary Sewer 1
Ligroin, (VM&P naptha)	On Site Service
Lime, unslaked (calcium oxide)	Sanitary Sewer 2
Lime, slaked (hydrated lime or calcium hydroxide)	Normal Trash 1
Limonene, D-	On Site Service
Lindane, emulsifiable concentrate, 20% solution	On Site Service
Linoleic acid	On Site Service
Linseed oil	On Site Service
Liquiflour®	On Site Service
Lithium acetate	Sanitary Sewer 1
Lithium bromide	Sanitary Sewer 1
Lithium carbonate	Sanitary Sewer 1
Lithium chloride	Sanitary Sewer 1
Lithium hydroxide	Neutralize Base 1
Lithium hypoacetate	Sanitary Sewer 1
Lithium iodide	Sanitary Sewer 1
Lithium lactate	Sanitary Sewer 1
Lithium nitrate	Sanitary Sewer 1
Lithium pyruvate hydrate	Sanitary Sewer 1
Lithium sulfate	Sanitary Sewer 1
Lugols solution, aqueous (Formalin, Iodine)	Sanitary Sewer 5
Lutidine	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Lutine,2,6-	On Site Service
Lye	Neutralize Base 1
Lyphogel (polyacrylamide gel)	Normal Trash 1
Lysine, D-	Sanitary Sewer 2
Lysine dihydrochloride, L-	Sanitary Sewer 1
Lysine monohydrochloride, L-	Sanitary Sewer 1
Magnesia	Sanitary Sewer 2
Magnesium acetate	Sanitary Sewer 1
Magnesium bromide	Sanitary Sewer 1
Magnesium carbonate	Sanitary Sewer 2
Magnesium chloride, hexahydrate	Sanitary Sewer 1
Magnesium chloride, anhydrous	Sanitary Sewer 3
Magnesium hydroxide	Sanitary Sewer 1
Magnesium metal, lump, turnings or ribbon	Normal Trash 1
Magnesium oxide (magnesia)	Sanitary Sewer 2
Magnesium perchlorate, anhydrous	Sanitary Sewer 3
Magnesium perchlorate, hexahydrate	Sanitary Sewer 1
Magnesium phosphate, monobasic	Sanitary Sewer 1
Magnesium phosphate, dibasic	Sanitary Sewer 2
Magnesium phosphate, tribasic	Normal Trash 1
Magnesium silicate	Normal Trash 1
Magnesium stearate	Normal Trash 1
Magnesium sulfate	Sanitary Sewer 2
Magnesium sulfate anhydrous	Sanitary Sewer 3

Chemical Name	Disposal Procedure in Appendix F
Magnesium turnings	Normal Trash 1
Malathion solution	On Site Service
Maleic acid	Sanitary Sewer 1
Malic acid, L-	Sanitary Sewer 1
Malonic acid	Sanitary Sewer 1
Maltose	Sanitary Sewer 1
Mandelic acid, DL-	Sanitary Sewer 1
Manganese acetate	Sanitary Sewer 1
Manganese chloride	Sanitary Sewer 1
Manganese sulfate	Sanitary Sewer 1
Manganous sulfate	Sanitary Sewer 1
Mannitol, D-	Sanitary Sewer 1
Mannosamine, D-	Sanitary Sewer 1
Mannose, D-(+)-	Sanitary Sewer 1
Mega developer® (NaOH, KOH)	Sanitary Sewer 1
Melamine	Sanitary Sewer 2
Mercaptoacetic acid	Sanitary Sewer 5
Mercaptoethanol	Sanitary Sewer 5
Mercaptosuccinic acid	Sanitary Sewer 5
Methanol	On Site Service
Methionine, L-	Sanitary Sewer 1
Methocel (5% methylcellulose aqueous solution)	Sanitary Sewer 1
Methocel (methyl cellulose)	Normal Trash 1
Methoxy ethanol, 2-	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Methoxyethyl ether, 2-	On Site Service
Methylacetamide, N-	On Site Service
Methyl acetate	On Site Service
Methyl alcohol	On Site Service
Methyl amine (40% solution)	Neutralize Base 2
Methylaniline, N-	On Site Service
Methyl benzoate	On Site Service
Methyl benzyl alcohol, dl-	On Site Service
Methyl benzyl amine, alpha-	On Site Service
Methylbutyrate	On Site Service
Methyl caproate	On Site Service
Methyl cellosolve	On Site Service
Methyl Cellulose	Normal Trash 1
Methyl chloromethyl ether	On Site Service
Methylcyclohexanol, 2-	On Site Service
Methylcyclopentadiene dimer	On Site Service
Methylcytosine hemihydrate, 5-	Sanitary Sewer 1
Methyl-a-D-mannopyranoside	Sanitary Sewer 2
Methylene blue solution	On Site Service
Methylene chloride (Dichloromethane)	On Site Service
Methylene dichloride	On Site Service
Methylenedioxy-4-propenylbenzene, 1,2- (saffrole)	On Site Service
Methylene iodide	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Methyl ethyl ketone	On Site Service
Methyl furan	On Site Service
Methyl-D-glucopyranoside	Sanitary Sewer 1
Methyl-D-glucoside, a-	Sanitary Sewer 1
Methyl-D-gluropyranose, 3-o-	Sanitary Sewer 1
Methyl iodide	On Site Service
Methyl isobutyl ketone	On Site Service
Methyl isonicotinate	On Site Service
Methyl laurate	On Site Service
Methyl-L-lysine, N-	Sanitary Sewer 2
Methyl morpholine, N-	Sanitary Sewer 5
Methyl napthalene, 1-	On Site Service
Methylnitrosourea solution in alcohol or acetone	Sanitary Sewer 5
Methylnitrosourea, dilute aqueous solution	Sanitary Sewer 7
Methyl oleate	On Site Service
Methyl-2,2-pentanediol, 2-	On Site Service
Methylphosphoramide	On Site Service
Methyl-1-propanol, 2-	On Site Service
Methyl propionate	On Site Service
Methyl purple, indicator solution	Sanitary Sewer 1
Methyl pyridine, 2- (picoline, 2-)	On Site Service
Methyl red, indicator solution	Sanitary Sewer 1
Methyl salicylate	On Site Service
Methyl stearate	Normal Trash 1

Chemical Name	Disposal Procedure in Appendix F
Methyl sulfide	On Site Service
Methyl sulfoxide	On Site Service
Methyl-2-thienyl ketone	On Site Service
Methyltrimethylsilyltrifluoroacetamide	Sanitary Sewer 1
Methylurea	Sanitary Sewer 1
Methyl valerate	On Site Service
MIBK (Methyl isobutyl ketone)	On Site Service
Mini solve (xylene)	On Site Service
MitraMycin solution (plicamycin, aureolic acid)	Sanitary Sewer 7
Mix bed resin (AG501-X8) 20-50	Normal Trash 1
Monoacetylglycerol	Sanitary Sewer 1
Monobromobenzene	On Site Service
Monochloroacetic acid solution	Neutralize Acid 2
Monochlorobenzene	On Site Service
Monoethanol amine	Sanitary Sewer 1
Monofluor	On Site Service
MOPS, (3-(N-Morpholino)propanesulfonic acid)	Sanitary Sewer 2
Mop treatment oil	On Site Service
Morpholine	Sanitary Sewer 5
3(N-Morpholino)propane sulfonic acid, MOPS	Sanitary Sewer 2
Multilith® blanket solvent (fuel oil and perchloroethylene)	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Muriate of potash	Sanitary Sewer 2
Myoinositol	Sanitary Sewer 2
Nadic methyl anhydride	On Site Service
Nanonic acid	On Site Service
Naptha, (benzene, toluene)	On Site Service
Naphthylethylenediamine di-HCl	Sanitary Sewer 1
Neatan	Sanitary Sewer 2
NE260 liquid scintillation cocktail	On Site Service
Nerol	On Site Service
Niacin	Sanitary Sewer 1
Niacinamide	Sanitary Sewer 1
Niacinamide hydrochloride	Sanitary Sewer 1
Nicotine (free base)	Sanitary Sewer 1
Nicotine sulphate (black leaf 40), aqueous solution	Sanitary Sewer 1
Nicotinic acid	Sanitary Sewer 1
Nicotinic acid hydrazide	Sanitary Sewer 1
Nigrisine solution	On Site Service
Ninhydrin	Sanitary Sewer 1
Nin-sol (ninhydrin and dimethylsulfoxide)	On Site Service
Nitric acid	Neutralize Acid 4
Nitriloethanol, 2,2′,2″-(triethanolamine)	Sanitary Sewer 1
Nitrilotriacetic acid	Sanitary Sewer 1
Nitroacetophenone, o-	On Site Service
Nitrobenzene	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Nitrocatechol, 4-	On Site Service
Nitroethane	On Site Service
Nitrofurazine, aqueous solution	Sanitary Sewer 7
Nitromethane	On Site Service
Nitrophenol, m-	Sanitary Sewer 1
Nitrophenol, m-, aqueous solution	Sanitary Sewer 1
Nitrophenol, o-, aqueous solution	Sanitary Sewer 1
Nitrophenol, p-, aqueous solution	Sanitary Sewer 1
Nitrophenol, 4- (in benzene)	On Site Service
Nitrophenyl disodium phosphate	Sanitary Sewer 1
Nitroprusside, aqueous solution	Sanitary Sewer 1
Nitrotoluene, o-	On Site Service
Nonenyl succinic anhydride	On Site Service
Nonyl aldehyde	On Site Service
Nonylaminoethanol	On Site Service
Nonyl phenol	On Site Service
Norbornadiene	On Site Service
Norbornylbromide, exo-	On Site Service
Norit® (charcoal), unused	Normal Trash 1
Norleucine, L-	Sanitary Sewer 2
Nutrient agar	Normal Trash 1
Nutrient broth	Sanitary Sewer 1
Octacosane	Normal Trash 1
Octadecane, n-	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Octadiene, 1,7-	On Site Service
Octane	On Site Service
Octanol, 1-	On Site Service
Octanol, 2-	On Site Service
Octyl aldehyde	On Site Service
Octylamine, N-	On Site Service
Oleic acid	On Site Service
Olive oil	On Site Service
Omnifluor®	On Site Service
Ornithine, DL-	Sanitary Sewer 1
Ornithine hydrochloride, L-	Sanitary Sewer 1
Orotic acid	Sanitary Sewer 1
Oxalic acid	Sanitary Sewer 1
Oxalic acid, ammonium, potassium or sodium salt	Sanitary Sewer 1
Paint residues, non-heavy metal, (solidified)	Normal Trash 1
Palmitic acid	Normal Trash 1
Palmitoleic acid	On Site Service
Pancreatin, aqueous solution	Sanitary Sewer 1
Papain suspension	Sanitary Sewer 1
Papanicolaou hematoxylin solution (Harris type staining	On Site Service
Paraffin oil	On Site Service
Paraformaldehyde, aqueous solution	Sanitary Sewer 5
Paraldehyde	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Paraquat, aqueous solution	Sanitary Sewer 7
Parlodioin strips	Normal Trash 1
PCS solubilizer (toluene)	On Site Service
Peanut oil	On Site Service
PEG 6000	On Site Service
Pentane, n-	On Site Service
Pentanedione, 2,4-	On Site Service
Pentanol, 2-	On Site Service
Pentanone, 2-	On Site Service
Pentanone, 3-	On Site Service
Pentene	On Site Service
Pentyl acetate	On Site Service
Pentyl alcohol	On Site Service
Pepsin	Sanitary Sewer 1
Peptone	Sanitary Sewer 1
Perchloroethylene (Tetrachloroethylene)	On Site Service
Perchloric acid	Neutralize Acid 4
Perfection SAPP (sodium pyrophosphate)	Sanitary Sewer 1
Permount®	On Site Service
Permutit ion exchange resin	Normal Trash 1
Petroleum ether	On Site Service
Petroleum jelly	Normal Trash 1
Phenanthroline/iron solution, aqueous	Sanitary Sewer 1
Phenethyl alcohol	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Phenethylamine	On Site Service
Phenetidine, o-	On Site Service
Phenetole	On Site Service
Phenol –liquid	On Site Service
Phenol reagent, 2N HCl	Neutralize Acid 2
Phenol, dilute aqueous solution	Sanitary Sewer 7
Phenyl acetaldehyde	On Site Service
Phenyl acetate	On Site Service
Phenylalanine, L-	Sanitary Sewer 2
Phenyl chloroacetate	On Site Service
Phenyl ether	On Site Service
Phenyl ethyl ether (phenetole)	On Site Service
Phenylpropanol, 3-	On Site Service
Phenyl propyl amine	On Site Service
Phenyl-1-propylamine, 3-	On Site Service
Phloroglucin	Sanitary Sewer 1
Phloroglucinol	Sanitary Sewer 1
Phloroglucinol hydrate	Sanitary Sewer 1
Phloxine B solution	On Site Service
Phosphate buffer solution, aqueous	Sanitary Sewer 1
Phosphatidylethanolamine	Sanitary Sewer 1
Phosphoric acid, 85%	Neutralize Acid 1
Phosphorwolframsaure (phosphotungstic acid)	Sanitary Sewer 1
Phosphotungstic acid	Sanitary Sewer 1

Chemical Name	Disposal Procedure in Appendix F
Photo-flo 200®	Sanitary Sewer 1
pH reference buffer	Sanitary Sewer 1
Phytol	On Site Service
Picoline, 2-	On Site Service
Picoline, 3-	On Site Service
Picoline, 4-	On Site Service
Picoline-N-oxide, 2-	On Site Service
Picolinic acid hydrochloride, a-	Sanitary Sewer 1
Picric acid (aqueous solutions only)	Sanitary Sewer 1
Pinacalone (t-butyl methyl ketone)	On Site Service
Pinene	On Site Service
Pine resin,solidified	Normal Trash 1
Piperidine	Sanitary Sewer 5
Piperonyl butoxide	On Site Service
Pivaldehyde	On Site Service
Pivalic acid (trimetylacetic acid)	Sanitary Sewer 1
Plaster of Paris (calcium sulfate, anhydrous)	Sanitary Sewer 2
Polyethylene glycol (liquid)	On Site Service
Polyethylene glycol oligomer	On Site Service
Polyethylene glycol (solid)	Normal Trash 1
Polyethylene imine, aqueous solution	Sanitary Sewer 1
Polyethylene, solid	Normal Trash 1
Polyethylene sorbitan monostearate, liquid	On Site Service
Polyoxyethylene sorbitan-mono-oleate, liquid	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Polyoxyethylated vegetable oil, liquid	On Site Service
Polyoxyethylene lauryl ether, liquid	On Site Service
Polyoxyethylene sorbitan, liquid	On Site Service
Polyphosphoric acid	Neutralize Acid 1
Polypropylene glycol, liquid	On Site Service
Polystyrene	Normal Trash 1
Polyvinyl alcohol, powder	Normal Trash 1
Polyvinyl alcohol, aqueous solution	Sanitary Sewer 1
Polyvinyl chloride	Normal Trash 1
Polyvinyl pyrrolidone	Normal Trash 1
Polyvinyl pyrrolidone (PVP-40)	Normal Trash 1
Polyvinyl sulfate	Sanitary Sewer 1
Potash, (potassium carbonate)	Sanitary Sewer 2
Potash sulfurated	Sanitary Sewer 5
Potassium acetate	Sanitary Sewer 1
Potassium acid phthalate	Sanitary Sewer 1
Potassium alum	Sanitary Sewer 1
Potassium aluminum sulfate	Sanitary Sewer 1
Potassium bicarbonate	Sanitary Sewer 1
Potassium biiodate	Sanitary Sewer 1
Potassium biphthalate	Sanitary Sewer 1
Potassium bisulfite, m-	Sanitary Sewer 5
Potassium bitartrate	Sanitary Sewer 1
Potassium borate	Sanitary Sewer 1

Chemical Name	Disposal Procedure in Appendix F
Potassium bromide	Sanitary Sewer 1
Potassium carbonate	Sanitary Sewer 2
Potassium chlorate	Sanitary Sewer 2
Potassium chloride	Sanitary Sewer 1
Potassium citrate	Sanitary Sewer 1
Potassium cyanate	Sanitary Sewer 1
Potassium dichromate in sulfuric acid	Neutralize Acid 6
Potassium ferricyanide	Sanitary Sewer 1
Potassium ferrocyanide	Sanitary Sewer 2
Potassium hydrogen phthalate	Sanitary Sewer 1
Potassium hydroxide	Neutralize Base 1
Potassium iodate	Sanitary Sewer 1
Potassium iodide	Sanitary Sewer 1
Potassium nitrite	Sanitary Sewer 1
Potassium nitroferricyanide	Sanitary Sewer 1
Potassium nitroprusside	Sanitary Sewer 1
Potassium oxalate	Sanitary Sewer 1
Potassium phosphate	Sanitary Sewer 2
Potassium phosphate dibasic	Sanitary Sewer 2
Potassium phosphate monobasic	Sanitary Sewer 1
Potassium phosphate tribasic	Sanitary Sewer 2
Potassium polysulfide/thiosulfate	Sanitary Sewer 5
Potassium silicate, aqueous solution	Sanitary Sewer 1
Potassium sodium tartrate	Sanitary Sewer 1

Chemical Name	Disposal Procedure in Appendix F
Potassium sorbate	Sanitary Sewer 1
Potassium sulfate	Sanitary Sewer 2
Potassium sulfite	Sanitary Sewer 1
Potassium tetraoxalate	Sanitary Sewer 1
Potassium thioacetic acid	Sanitary Sewer 1
Potassium thiocyanate	Sanitary Sewer 1
Potassium thioglycollate	Sanitary Sewer 1
Proline, L-	Sanitary Sewer 1
Propanediamine, 1,3-	Sanitary Sewer 5
Propanediol, 1,2-	On Site Service
Propanol, 1-	On Site Service
Propanol, 2-	On Site Service
Propanol, n-	On Site Service
Propargyl amine	Sanitary Sewer 5
Propargyl alcohol	On Site Service
Propargyl bromide	On Site Service
Propargyl chloride	On Site Service
Propidium iodide, aqueous solution	*Ethidium Bromide 2*
Propionaldehyde	On Site Service
Propiophenone	On Site Service
Propionic acid	Sanitary Sewer 5
Propyl acetate, n-	On Site Service
Propyl alcohol, n-	On Site Service
Propyl amine, n-	Sanitary Sewer 5

Chemical Name	Disposal Procedure in Appendix F
Propyl-n-butyrate, n-	On Site Service
Propylene glycol	On Site Service
Propylene oxide	On Site Service
Propyl ether	On Site Service
Propyl formate,n-	On Site Service
Protamine	Sanitary Sewer 1
Protamine sulfate (salmon)	Sanitary Sewer 1
Protease	Sanitary Sewer 1
Protease peptone	Sanitary Sewer 1
Protosol® (toluene stabilizer)	On Site Service
Pseudoionone	On Site Service
Pumice	Normal Trash 1
Putrescine	Sanitary Sewer 1
Pyran-2H-2-one	On Site Service
Pyran-4H-4-one	On Site Service
Pyrazole	Sanitary Sewer 1
Pyridine	On Site Service
Pyridine, aqueous solution	Sanitary Sewer 5
Pyridine aldoxime methiodide, 2-	Sanitary Sewer 1
Pyridinecarboxaldehyde, 3-	Sanitary Sewer 1
Pyridine dicarboxylic acid, 2,6-	Sanitary Sewer 1
Pyridinedicarboxylic acid, 3,5-	Sanitary Sewer 1
Pyridoxal	Sanitary Sewer 2
Pyridoxal phosphate, 5-	Sanitary Sewer 1

Chemical Name	Disposal Procedure in Appendix F
Pyridoxine hydrochloride	Sanitary Sewer 1
Pyridylcarbinol, 4-	Sanitary Sewer 1
Pyrrole	Sanitary Sewer 5
Pyrrolidine	Sanitary Sewer 5
Pyrrolidinone, 2-	On Site Service
Pyrrolidinol, 3-	Sanitary Sewer 1
Pyruvate kinase	Sanitary Sewer 1
Pyruvic acid	Sanitary Sewer 1
Pyruvic acid, lithium salt	Sanitary Sewer 1
Pyruvic aldehyde, aqueous solution	Sanitary Sewer 1
Quinaldine (2-methylquinoline)	On Site Service
Quinoline	On Site Service
Ready solv® (psuedocumene)	On Site Service
Resorcinol	Sanitary Sewer 1
Rhamnose, L-	Sanitary Sewer 2
Rhodamine B, alcoholic solution	On Site Service
Ribitol	Sanitary Sewer 1
Riboflavin	Sanitary Sewer 1
Ribonucleic acid	Sanitary Sewer 1
Ribose, D-	Sanitary Sewer 1
Rodinal (p-aminophenol)	Sanitary Sewer 1
Rosin, (lumps)	Normal Trash 1
RPI scint® (toluene)	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Rubidium chloride	Sanitary Sewer 1
Safety-count®	On Site Service
Safranine staining solution	Sanitary Sewer 1
Safrole	On Site Service
Sage oil	On Site Service
Salicylaldehyde	On Site Service
Salicylic acid	Sanitary Sewer 1
Sand (washed & ignited), unused	Normal Trash 1
Sarkosyl I®	Sanitary Sewer 1
Scintillation cocktail, 3a70b-® (xylene)	On Site Service
Scintillation cocktail, 3a40® (xylene)	On Site Service
Scintillation fluid, (toluene)	On Site Service
Scintisol® (toluene)	On Site Service
Sedoheptulose anhydride	Sanitary Sewer 1
Sequestrene® (EDTA)	Sanitary Sewer 1
Serine, L-	Sanitary Sewer 1
Shellac gum	On Site Service
Shell flex 210® (parafinic oils)	On Site Service
Sigmacote, (heptane)	On Site Service
Silanizing reagent, 5% in toluene	On Site Service
Silicone based oils	On Site Service
Silica	Normal Trash 1
Silica gel, chromatography, unused	Normal Trash 1
Silica gel, desicant, unused	Normal Trash 1

Chemical Name	Disposal Procedure in Appendix F
Silica sand, unused	Normal Trash 1
Silicic acid	Normal Trash 1
Siliclad: silicone compound	Sanitary Sewer 1
Silicon carbide	Normal Trash 1
Silicone defoamer	Normal Trash 1
Silicone oil	On Site Service
Siliconized glass wool	Normal Trash 1
Silicon oil	On Site Service
Silicon surfactant	On Site Service
Silicotungstic acid, hydrated	Sanitary Sewer 2
Skelly B® (hexane)	On Site Service
Skelly "V" ® mineral spirit	On Site Service
Skellysolv®	On Site Service
Soap, aqueous solution	Sanitary Sewer 1
Soda ash (sodium carbonate)	Sanitary Sewer 1
Soda lime (calcium oxide and sodium hydroxide)	Sanitary Sewer 2
Sodium acetate	Sanitary Sewer 1
Sodium benzoate	Sanitary Sewer 2
Sodium bicarbonate	Sanitary Sewer 1
Sodium biphosphate	Sanitary Sewer 1
Sodium bisulfite	Sanitary Sewer 5
Sodium borate	Sanitary Sewer 1
Sodium bromate	Sanitary Sewer 2
Sodium bromide	Sanitary Sewer 1

Chemical Name	Disposal Procedure in Appendix F
Sodium carbamate, aqueous solution	Sanitary Sewer 1
Sodium carbonate	Sanitary Sewer 1
Sodium chlorate	Sanitary Sewer 2
Sodium chloride	Sanitary Sewer 1
Sodium citrate	Sanitary Sewer 1
Sodium cobalt nitrate	Sanitary Sewer 1
Sodium dextran sulfate	Sanitary Sewer 1
Sodium dichloropropionate, aqueous solution	Sanitary Sewer 1
Sodium EDTA	Sanitary Sewer 1
Sodium formaldehyde sulfoxylate	Sanitary Sewer 1
Sodium formate	Sanitary Sewer 1
Sodium-b-glycerophosphate	Sanitary Sewer 1
Sodium glyoxylate	Sanitary Sewer 1
Sodium hippurate	Sanitary Sewer 1
Sodium hydroxide	Neutralize Base 1
Sodium hydroxide, in methanol, ethanol, or t-butanol	Neutralize Base 1
Sodium hypochlorite, aqueous solution	Sanitary Sewer 1
Sodium iodate	Sanitary Sewer 1
Sodium iodide	Sanitary Sewer 1
Sodium lactate	Sanitary Sewer 1
Sodium meta-bisulfite	Sanitary Sewer 5
Sodium metaborate	Sanitary Sewer 2
Sodium metasilicate	Sanitary Sewer 2

Chemical Name	Disposal Procedure in Appendix F
Sodium nitroferricyanide	Sanitary Sewer 1
Sodium nitroprusside	Sanitary Sewer 1
Sodium oleate	Sanitary Sewer 2
Sodium oxalate	Sanitary Sewer 1
Sodium perchlorate	Sanitary Sewer 1
Sodium periodate	Sanitary Sewer 2
Sodium-m-periodate	Sanitary Sewer 2
Sodium phenolate	Sanitary Sewer 1
Sodium phenylpyruvate	Sanitary Sewer 1
Sodium phosphate	Sanitary Sewer 1
Sodium phosphate dibasic	Sanitary Sewer 1
Sodium phosphate monobasic	Sanitary Sewer 1
Sodium phosphate tribasic	Sanitary Sewer 1
Sodium picrate, aqueous solution	Sanitary Sewer 1
Sodium potassium tartrate	Sanitary Sewer 1
Sodium pyrophosphate	Sanitary Sewer 1
Sodium pyruvate	Sanitary Sewer 1
Sodium saccharine	Sanitary Sewer 1
Sodium salicylate	Sanitary Sewer 1
Sodium silicate, aqueous solution	Sanitary Sewer 1
Sodium stearate	Normal Trash 1
Sodium sulfate	Sanitary Sewer 2
Sodium sulfate, anhydrous	Sanitary Sewer 2
Sodium sulfite	Sanitary Sewer 1

Chemical Name	Disposal Procedure in Appendix F
Sodium sulfocyanate	Sanitary Sewer 1
Sodium sulphacetamide	Sanitary Sewer 1
Sodium sulphate	Sanitary Sewer 2
Sodium tartrate	Sanitary Sewer 1
Sodium tetraborate	Sanitary Sewer 2
Sodium tetrathionate	Sanitary Sewer 1
Sodium thiocyanate	Sanitary Sewer 1
Sodium thiosulfate	Sanitary Sewer 1
Sodium tungstate	Sanitary Sewer 1
Solubilizer (Quaternary alkyl ammonium hydroxide in toluene)	On Site Service
Sorbitan trioleate	On Site Service
Sorbitol	Sanitary Sewer 1
Sorbitol and oxypropylene ether, liquid	On Site Service
Spermine tetrahydrochloride	Sanitary Sewer 1
Stain solutions	On Site Service
Stannous chloride	Sanitary Sewer 2
Stannous octoate	On Site Service
Stannous sulfate	Sanitary Sewer 1
Starch	Normal Trash 1
Starch phosphate	Sanitary Sewer 1
Stearic acid	Normal Trash 1
Stearyl alcohol	Normal Trash 1
Stearylamine, solid	Normal Trash 1
Stilbene, cis-	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Stop bath, aqueous solution	Sanitary Sewer 1
Stopcock grease	Normal Trash 1
Strontium chloride	Sanitary Sewer 1
Styrene oxide	On Site Service
Succinic acid	Sanitary Sewer 1
Sucrose	Sanitary Sewer 1
Sugar standard, aqueous solution	Sanitary Sewer 1
Sulfonated resin, salt	Normal Trash 1
Sulfur	Normal Trash 1
Sulfurated potash	Sanitary Sewer 5
Sulfur, flowers	Normal Trash 1
Sulfuric acid	Neutralize Acid 1
Sulfuric acid w/ sodium dichromate	Neutralize Acid 6
Talc	Normal Trash 1
Tartaric acid	Sanitary Sewer 1
TEMED (tetramethyl ethylenediamine, N,N,N,N)	Sanitary Sewer 5
Tergitol	Sanitary Sewer 1
Tergitol-nonionic NPX	On Site Service
Terpineol	On Site Service
TES (2{[tris(hydroxymethyl)methyl]amino}-1-)	Sanitary Sewer 1
Tetrabromoethane, 1,1,2,2-	On Site Service
Tetrabromoethane, s-	On Site Service
Tetrabutyl ammonium bromide	Sanitary Sewer 1
Tetrabutyl ammonium chloride	Sanitary Sewer 1

Chemical Name	Disposal Procedure in Appendix F
Tetrabutyl ammonium fluoride	Sanitary Sewer 1
Tetrabutylammonium hexafluorophospate	Sanitary Sewer 2
Tetrabutylammonium hydrogen sulfate	Sanitary Sewer 1
Tetrabutylammonium hydroxide, solution in methanol	On Site Service
Tetrabutylammonium hydroxide, aqueous solution	Sanitary Sewer 1
Tetrabutylammonium iodide	Sanitary Sewer 1
Tetrabutylammonium phosphate	Sanitary Sewer 1
Tetrabutyl ammonium tetrafluoroborate	Sanitary Sewer 1
Tetrachloroacetone, 1,1,3,3-	On Site Service
Tetrachloroethane, 1,1,1,2- or 1,1,2,2-	On Site Service
Tetrachloroethylene	On Site Service
Tetraethylammonium bromide	Sanitary Sewer 1
Tetraethylammonium hydroxide solution, in methanol	On Site Service
Tetraethylammonium hydroxide, aqueous solution	Sanitary Sewer 1
Tetraehtylammonium-p-toluenesulfonate	Sanitary Sewer 1
Tetraethylene glycol	On Site Service
Tetrahydrofuran	On Site Service
Tetrahydrofurfuryl palmitate	Normal Trash 1
Tetrahydronaphthalene (tetraline)	On Site Service
Tetrahydrothiophene	On Site Service

Chemical Name	Disposal Procedure in Appendix F
Tetramethyl ammonium chloride	Sanitary Sewer 1
Tetramethylammonium tetrafluoroborate	Sanitary Sewer 1
Teetramethylene sulfone	On Site Service
Tetramethylethylenediamine, N,N,N',N'-	Sanitary Sewer 5
Tetramethylethylene diamine, aqueous solution	Sanitary Sewer 1
Tetramethylpentadecane, 2,6,10,14-	On Site Service
Tetramethylsilane	On Site Service
Tetramethylsuccinamide	Sanitary Sewer 2
Tetrapropylammonium hydroxide, solution in methanol	On Site Service
Tetrapropylammonium hydroxide, aqueous solution	Sanitary Sewer 1
Tetra sodium pyrophosphate, TSP	Sanitary Sewer 1
Texaco 59® oil	On Site Service
Theophylline	Sanitary Sewer 2
Thiamine hydrochloride	Sanitary Sewer 1
Thioacetic acid, sodium salt	Sanitary Sewer 5
Thiodan® (cottonseed oil)	On Site Service
Thiodiglycol	Sanitary Sewer 1
Thiodiglycolic acid	Sanitary Sewer 1
Thiodipropionitrile, 3,3-	On Site Service
Thioglycolic acid	Sanitary Sewer 5
Thiophene	On Site Service
Thiothymine	Sanitary Sewer 1

Chemical Name	Disposal Procedure in Appendix F
Threonine, L-	Sanitary Sewer 1
Thymidine	Sanitary Sewer 1
Thymine	Sanitary Sewer 1
Thyroxin, L-	Sanitary Sewer 2
Tiglic acid	Sanitary Sewer 1
Tin (granular)	Normal Trash 1
Tin (mossy)	Normal Trash 1
Tin chloride	Sanitary Sewer 2
Tin (II) chloride	Sanitary Sewer 2
Tin plating solution, aqueous	Sanitary Sewer 1
Tin sticks	Normal Trash 1
Tin sulfate	Sanitary Sewer 2
Tissue solubilizer, toluene	On Site Service
Titanous chloride, aqueous solution	Sanitary Sewer 1
Tocopherol, do-a-	On Site Service
Toilet bowl cleaner (8M HCl solution)	Neutralize Acid 2
Toilet soap	Sanitary Sewer 1
Tolualdehyde	On Site Service
Toluene	On Site Service
Toluene, PPO, AND POPOP	On Site Service
Toluene-based scintillation fluid	On Site Service
Toluidine, o-	On Site Service
Toluidine, o-, aqueous solution	Sanitary Sewer 1
Toxaclean-e	Sanitary Sewer 1

Chemical Name	Disposal Procedure in Appendix F
Tributyl amine	On Site Service
Trichloroacetic acid solution	Neutralize Acid 2
Trichloroacetonitrile	On Site Service
Trichlorobenzene, 1,2,4-	On Site Service
Trichloroethane, 1,1,1-	On Site Service
Trichoroethanol, 2,2,2-	On Site Service
Trichloroethylene	On Site Service
Tricine	Sanitary Sewer 1
Tricresyl phosphate	On Site Service
Trideuterioacetonitrile	On Site Service
Tri(Dimethylaminomethyl)-2,4,6-phenol (DMP30®)	On Site Service
Triethanol amine (nitrilotriethanol)	Sanitary Sewer 1
Triethyl amine	On Site Service
Triethylene glycol	Sanitary Sewer 1
Triethylene glycol dimethylether	On Site Service
Trifluoroacetic acid	Neutralize Acid 2
Trifluoromethane sulfonic acid	Neutralize Acid 2
Trifluorotrichloroethane	On Site Service
Trihexylamine	On Site Service
Triisopentylamine	On Site Service
Triisopropyl benzene	On Site Service
Triketohydrindene hydrate (ninhydrin)	Sanitary Sewer 1
Trimethoxypropenylbenzene, 2,4,5-	On Site Service
Trimethylamine, 25% aqueous solution	Sanitary Sewer 5

Chemical Name	Disposal Procedure in Appendix F
Trimethyl borate	On Site Service
Trimethyl pentane	On Site Service
Trimethylpentane, 2,2,4-	On Site Service
Trimethyl pyridine (collidine)	On Site Service
Trimethylpyridine, 2,4,6- (s-collidine)	On Site Service
Trimethylsilylacetamide	Sanitary Sewer 1
Trimethylsilyl trifluoroacetimede	Sanitary Sewer 1
Tri-n-octylamine	On Site Service
Trioctyl amine	On Site Service
Triolein	On Site Service
Trioxane, s-	Sanitary Sewer 5
Trioxane, aqueous solution	Sanitary Sewer 5
Tripentylamine	On Site Service
Tris (ethylene diamine) cobalt chloride	Sanitary Sewer 1
TRIS hydrochloride	Sanitary Sewer 1
Tris(hydroxymethyl)aminomethane, THAM	Sanitary Sewer 1
Tris(hydroxymethyl)methyl glycine, N-	Sanitary Sewer 1
Trisodium pentacyanoaminoferrate	Sanitary Sewer 1
Tristearin	Normal Trash 1
Tri-o-tolyphosphate	On Site Service
Triton®	On Site Service
Triton X-100®	On Site Service
Triton X-114®	On Site Service
Trizma base, aqueous solution	Sanitary Sewer 1

Chemical Name	Disposal Procedure in Appendix F
Trypan blue stain solution	On Site Service
Trypsin	Sanitary Sewer 1
Tryptophan, 1-	Sanitary Sewer 2
Tungstic acid	Sanitary Sewer 1
Turbidity standard	Sanitary Sewer 1
Truco W.D. #1®	On Site Service
Turk blood diluting fluid	On Site Service
Turpentine (or paint thinner mixture)	On Site Service
Tween 40®	On Site Service
Tween 60® (liquid)	On Site Service
Tween 80® (liquid)	On Site Service
Tween 80® (polyoxyethylene sorb)	On Site Service
Tween 60® (solid)	Normal Trash 1
Tween 80® (solid)	Normal Trash 1
Tyrosine, L-	Sanitary Sewer 2
Uracil	Sanitary Sewer 1
Urea	Sanitary Sewer 1
Uric acid	Sanitary Sewer 1
Uridine	Sanitary Sewer 1
Valeric acid	On Site Service
Valine, DL-	Sanitary Sewer 2
Veratrole (1,2-dimethoxybenzene)	On Site Service
Vinyl acetonitrile (allyl cyanide)	On Site Service
Vinyl cyclohexene	On Site Service

Chemical Name	Disposal Procedure in Appendix F
White oil (No. 3)	On Site Service
White petrolatum	Normal Trash 1
Wright's stain solution	On Site Service
Xanthine	Sanitary Sewer 2
Xanthosine	Sanitary Sewer 1
Xerox® fusing fluid	On Site Service
Xylene	On Site Service
Xylose, D-	Sanitary Sewer 2
Zeolite®	Normal Trash 1
Zirconyl perchlorate, aqueous solution	Sanitary Sewer 1