

ST. NORBERT COLLEGE CHEMICAL HYGIENE PLAN

Facility Name: *St. Norbert College– DePere, WI*

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Prepared by Chemical Hygiene Officer: *Mark D. Musser*

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8/20/2017 – updated section 5.3.6.4 with new contact information, updated information links

11/17/2017 – updated section 5.0.3 with location of stock rooms for General Biology, General Chemistry, and Organic Chemistry, section 5.3.6 – removed pictures, formatting of 5.3.6.1, 5.3.6.2, and 5.3.6.3.

This Chemical Hygiene Plan was developed in response to the federal Occupational Health and Safety Administration (OSHA) regulation, [Occupational Exposures to Hazardous Chemicals in the Laboratory](#) (29 CFR 1910.1450), commonly referred to as the "Laboratory Standard".

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1.0 General Principles

1.1 Introduction and Purpose

This Chemical Hygiene Plan was developed in response to the federal Occupational Health and Safety Administration (OSHA) regulation, [Occupational Exposures to Hazardous Chemicals in the Laboratory](#) (29 CFR 1910.1450), commonly referred to as the "Laboratory Standard".

The purpose of the Chemical Hygiene Plan is to set forth procedures, equipment, personal protective equipment and carefully planned work practices for the laboratory use of chemicals, which are capable of protecting laboratory workers from the potential health hazards of the chemicals they encounter in the workplace.

Hazardous chemical means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

Physical hazard means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer pyrophoric, unstable (reactive) or water-reactive.

1.2 Avoid Underestimation of Risk.

Exposures for all substances should be minimized; for work with substances which present special hazards, special precautions should be taken. Any toxic mixture should be considered more toxic than its most toxic component, and that substances of unknown toxicity are toxic. **Always check the Safety Data Sheet (SDS) information before working with a chemical.**

All laboratory workers must be made aware of this plan. New employees should review the plan and receive safety training before beginning work with hazardous chemicals. The plan is available to all laboratory workers at all times.

1.3 Scope and Application

The Laboratory Standard covers employees who work with hazardous chemicals in laboratories. At Marian University, this program applies to all individuals working with hazardous chemicals in science and biology laboratories. Work with hazardous chemicals outside of laboratories is covered by the [Hazard Communication Standard \(29 CFR 1910.1200\)](#).

2.0 Roles and Responsibilities

2.1 Chemical Hygiene Officer (CHO) – Mark D. Musser

2.1.1 Assist Emergency Response Coordinator

2.1.2 Provide general training, and provide consultation for safe work practices for hazardous chemicals.

2.1.3 Provide safe working guidelines for laboratory workers through the CHO web page.

2.1.4 Inspect fume hoods annually.

2.1.5 Develop and maintain the Laboratory Safety Resource.

2.1.6 Conduct exposure monitoring, as needed.

2.1.7 Audit the departmental program periodically.

2.1.8 Review the Chemical Hygiene Plan at least annually.

2.1.9 Conduct laboratory safety inspections.

2.2 Professors/Laboratory Supervisors

2.2.1 Ensure laboratory workers attend general lab safety training given by the CHO.

2.2.2 Ensure laboratory workers understand how to work with chemicals safely. Provide chemical and procedure-specific training, as needed.

2.2.3 Provide laboratory workers with appropriate engineering controls and personal protective equipment needed to work safely with hazardous materials. Ensure such equipment is used correctly.

2.2.4 Ensure laboratory workers complete and submit [Particularly Hazardous Substance Use Approval forms](#) and submit them for approval before using any particularly hazardous substance.

2.2.5 Review and approve work with particularly hazardous substances.

2.3 Laboratory Worker

2.3.1 Attend laboratory safety training.

2.3.2 Review the Chemical Hygiene Plan.

2.3.3 Follow procedures and laboratory practices outlined in the Chemical Hygiene Plan and the Laboratory Safety Manual.

2.3.4 Adhere to all University and departmental safety policies and procedures and comply with safety directives issued by supervisors and the Chemical Hygiene Officer (CHO).

2.3.5 Use engineering controls and personal protective equipment, as appropriate.

2.3.6 Report all incidents, accidents and potential chemical exposures to the Professor and the CHO.

2.3.7 Document specific operating procedures for work with [particularly hazardous substances](#) , including carcinogens, reproductive toxins and chemicals with high acute toxicity.

3.0 Chemical and Hazard Identification

Chemical manufacturers or distributors perform an assessment of the physical and health hazards of each chemical they produce. This information is included in a [safety data sheet](#) (SDS) and, in part, on container labels.

3.1 The manufacturer's label should be kept intact. When a chemical is transferred to another container for storage, the new containers should be labeled with the name of the product, the chemical constituents and hazard warnings.

3.2 Safety data sheets (SDSs) received with chemical shipments must be maintained and readily accessible to laboratory workers. SDSs for stockroom chemicals withdrawn from the Biology Department or Chemistry Department stockrooms are available online. [\(Click here\)](#)

3.3 The 16 sections of a Safety Data Sheet (SDS) will provide the information needed to identify hazards and list any precautions that need to be followed to reduce risks and exposure. Descriptions of SDS Sections:

Section 1	Chemical Product and Company Identification
Section 2	Hazard Identification
Section 3	Composition/Information on Ingredients
Section 4	First Aid Measures
Section 5	Fire Fighting Measures
Section 6	Accidental Release Measures
Section 7	Handling and Storage
Section 8	Exposure Controls and Personal Protection
Section 9	Physical and Chemical Properties
Section 10	Stability and Reactivity
Section 11	Toxicological Information
Section 12	Ecological Information
Section 13	Disposal Considerations
Section 14	Transport Information
Section 15	Regulatory Information
Section 16	Other information


SDSs for most laboratory chemicals may be found through the [EHS web page](#).

3.4 Safety Data Sheets Pictograms (Click here for [.pdf version](#))

[Hazard Communication Standard Pictogram](#)

As of June 1, 2015, the Hazard Communication Standard (HCS) will require pictograms on labels to alert users of the chemical hazards to which they may be exposed. Each pictogram consists of a symbol on a white background framed within a red border and represents a distinct hazard(s). The pictogram on the label is determined by the chemical hazard classification.

HCS Pictograms and Hazards

<p style="text-align: center;">Health Hazard</p>  <ul style="list-style-type: none"> ▪ Carcinogen ▪ Mutagenicity ▪ Reproductive Toxicity ▪ Respiratory Sensitizer ▪ Target Organ Toxicity ▪ Aspiration Toxicity 	<p style="text-align: center;">Flame</p>  <ul style="list-style-type: none"> ▪ Flammables ▪ Pyrophorics ▪ Self-Heating ▪ Emits Flammable Gas ▪ Self-Reactives ▪ Organic Peroxides 	<p style="text-align: center;">Exclamation Mark</p>  <ul style="list-style-type: none"> ▪ Irritant (skin and eye) ▪ Skin Sensitizer ▪ Acute Toxicity ▪ Narcotic Effects ▪ Respiratory Tract Irritant ▪ Hazardous to Ozone Layer (Non-Mandatory)
<p style="text-align: center;">Gas Cylinder</p>  <ul style="list-style-type: none"> ▪ Gases Under Pressure 	<p style="text-align: center;">Corrosion</p>  <ul style="list-style-type: none"> ▪ Skin Corrosion/Burns ▪ Eye Damage ▪ Corrosive to Metals 	<p style="text-align: center;">Exploding Bomb</p>  <ul style="list-style-type: none"> ▪ Explosives ▪ Self-Reactives ▪ Organic Peroxides
<p style="text-align: center;">Flame Over Circle</p>  <ul style="list-style-type: none"> ▪ Oxidizers 	<p style="text-align: center;">Environment (Non-Mandatory)</p>  <ul style="list-style-type: none"> ▪ Aquatic Toxicity 	<p style="text-align: center;">Skull and Crossbones</p>  <ul style="list-style-type: none"> ▪ Acute Toxicity (fatal or toxic)

For more information:



Occupational
Safety and Health
Administration

U.S. Department of Labor
www.osha.gov (800) 321-OSHA (6742)

OSHA 3491-02 2012

3.5 Segregation of Chemicals

Incompatible chemicals should not be stored together. Storing chemicals alphabetically, without regard to compatibility, can increase the risk of a hazardous reaction, especially in the event of container breakage. In addition to the [Chemical Compatibility Chart](#) below, there are several resources available, both in print and on-line, including the National Oceanic and Atmospheric Administration [Chemical Reactivity Worksheet](#).

Use common sense when setting up chemical storage. Segregation that disrupts normal workflow can increase the potential for spills.

There are several possible storage plans for segregation. In general, dry reagents, liquids and compressed gases should be stored separately, then by hazard class, then alphabetically (if desired).

Segregate dry reagents as follows:

- Oxidizing salts
- Flammable solids
- Water-reactive solids
- All other solids

Segregate liquids as follows:

- [Acids](#)
 - Separate mineral acids (hydrochloric, sulfuric) from organic acids (picric, acetic)
- Bases
- Oxidizers
- Perchlorates
- [Flammable or combustible liquids](#)
- All other liquids

Segregate compressed gases as follows:

- Toxic gases
- Flammable gases

- Oxidizing and inert gases

Chemical Incompatibility Chart

Mixing these chemicals purposely or as a result of a spill can result in heat, fire, explosion, and/or toxic gases. This is a partial list.

Acetic Acid	Chromic Acid, nitric acid, hydroxyl-containing compounds, ethylene glycol, perchloric acid, peroxides, and permanganates.
Acetone	Bromine, chlorine, nitric acid, sulfuric acid, and hydrogen peroxide.
Acetylene	Bromine, chlorine, copper, mercury, fluorine, iodine, and silver.
Alkaline and Alkaline Earth Metals such as calcium, lithium, magnesium, sodium, potassium, powdered aluminum	Carbon dioxide, carbon tetrachloride and other chlorinated hydrocarbons, water, Bromine, chlorine, fluorine, and iodine. Do not use CO₂, water or dry chemical extinguishers. Use Class D extinguisher (e.g., Met-L-X) or dry sand.
Aluminum and its Alloys (especially powders)	Acid or alkaline solutions, ammonium persulfate and water, chlorates, chlorinated compounds, nitrates, and organic compounds in nitrate/nitrate salt baths.
Ammonia (anhydrous)	Bromine, chlorine, calcium hypochlorite, hydrofluoric acid, iodine, mercury, and silver.
Ammonium Nitrate	Acids, metal powders, flammable liquids, chlorates, nitrates, sulfur and finely divided organics or other combustibles.
Aniline	Hydrogen peroxide or nitric acid.
Bromine	Acetone, acetylene, ammonia, benzene, butadiene, butane and other petroleum gases, hydrogen, finely divided metals, sodium carbide, turpentine.
Calcium Oxide	Water
Carbon (activated)	Calcium hypochlorite, all oxidizing agents.
Caustic (soda)	Acids (organic and inorganic).
Chlorates or Perchlorates	Acids, aluminum, ammonium salts, cyanides, phosphorous, metal powders, oxidizable organics or other combustibles, sugar, sulfides, and sulfur.
Chlorine	Acetone, acetylene, ammonia, benzene, butadiene, butane and other petroleum gases, hydrogen, finely divided metals, sodium carbide, turpentine.

Chlorine Dioxide	Ammonia, methane, phosphine, hydrogen sulfide.
Chromic Acid	Acetic acid, naphthalene, camphor, alcohol, glycerine, turpentine and other flammable liquids.
Copper	Acetylene, hydrogen peroxide.
Cumene Hydroperoxide	Acids
Cyanides	Acids
Flammable Liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, bromine, chlorine, fluorine, iodine.
Fluorine	Isolate from everything.
Hydrazine	Hydrogen peroxide, nitric acid, and other oxidizing agents.
Hydrocarbons	Bromine, chlorine, chromic acid, fluorine, hydrogen peroxide, and sodium peroxide.
Hydrocyanic Acid	Nitric acid, alkali.
Hydrofluoric Acid	Ammonia, aqueous or anhydrous.
Hydrogen Peroxide (anhydrous)	Chromium, copper, iron, most metals or their salts, aniline, any flammable liquids, combustible materials, nitromethane, and all other organic material.
Hydrogen Sulfide	Fuming nitric acid, oxidizing gases.
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen.
Mercury	Acetylene, alkali metals, ammonia, fulminic acid, nitric acid with ethanol, hydrogen, oxalic acid.
Nitrates	Combustible materials, esters, phosphorous, sodium acetate, stannous chloride, water, zinc powder.
Nitric acid (concentrated)	Acetic acid, acetone, alcohol, aniline, chromic acid, flammable gases and liquids, hydrocyanic acid, hydrogen sulfide and nitratable substances.
Nitrites	Potassium or sodium cyanide.
Nitroparaffins	Inorganic bases, amines.
Oxalic acid	Silver, mercury, and their salts.
Oxygen (liquid or enriched air)	Flammable gases, liquids, or solids such as acetone, acetylene, grease, hydrogen, oils, phosphorous.
Perchloric Acid	Acetic anhydride, alcohols, bismuth and its alloys, paper, wood, grease, oils or any organic materials and reducing agents.
Peroxides (organic)	Acid (inorganic or organic). Also avoid friction and store cold.

Phosphorus (white)	Air, oxygen.
Phosphorus pentoxide	Alcohols, strong bases, water.
Potassium	Air (moisture and/or oxygen) or water, carbon tetrachloride, carbon dioxide.
Potassium Chlorate	Sulfuric and other acids.
Potassium Perchlorate	Acids.
Potassium Permanganate	Benzaldehyde, ethylene glycol, glycerol, sulfuric acid.
Silver and silver salts	Acetylene, oxalic acid, tartaric acid, fulminic acid, ammonium compounds.
Sodium	See Alkali Metals
Sodium Chlorate	Acids, ammonium salts, oxidizable materials and sulfur.
Sodium Nitrite	Ammonia compounds, ammonium nitrate, or other ammonium salts.
Sodium Peroxide	Any oxidizable substances, such as ethanol, methanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerol, ethylene glycol, ethyl acetate, methyl acetate, furfural, etc.
Sulfides	Acids.
Sulfur	Any oxidizing materials.
Sulfuric Acid	Chlorates, perchlorates, permanganates, compounds with light metals such as sodium, lithium, and potassium.
Water	Acetyl chloride, alkaline and alkaline earth metals, their hydrides and oxides, barium peroxide, carbides, chromic acid, phosphorous oxychloride, phosphorous pentachloride, phosphorous pentoxide, sulfuric acid, sulfur trioxide.

4.0 Components of the Chemical Hygiene Plan

4.0.1 General Rules for all Laboratory Work with Chemicals

The following rules should be used for all laboratory work with chemicals:

Every laboratory worker should observe the following rules:

1. Know the potential hazards and appropriate safety precautions before beginning work. Ask and be able to answer the following questions:
 - What are the hazards?
 - What are the worst things that could happen?

- What do I need to do to be prepared?
 - What work practices, facilities or personal protective equipment are needed to minimize the risk?
2. Know the location and how to use emergency equipment, including safety showers and eyewash stations.
 3. Never block safety equipment or doors and keep aisles clear and free from tripping hazards.
 4. Familiarize yourself with the emergency response procedures, facility alarms and building evacuation routes.
 5. Know the types of personal protective equipment available and how to use them for each procedure.
 6. Be alert to unsafe conditions and actions and bring them to the attention of your supervisor or lab manager immediately so that corrections can be made as soon as possible.
 7. Prevent pollution by following [waste disposal procedures](#). Chemical reactions may require traps or scrubbing devices to prevent the release of toxic substances to the laboratory or to the environment.
 8. Position and clamp reaction apparatus thoughtfully in order to permit manipulation without the need to move the apparatus until the entire reaction is completed. Combine reagents in the appropriate order and avoid adding solids to hot liquids.

4.0.2 Accidents, exposure emergencies, and spills:

- a. **Inhalation:** Move person to fresh air. If not breathing give artificial respiration. Obtain medical attention.
- b. **Skin Contact:** Immediately flush the affected area with water and remove any contaminated clothing. If symptoms persist after washing, obtain medical attention.
- c. **Eye Contact:** Immediately flush the eyes for at least 15 minutes, holding eyes open. Obtain medical attention.
- d. **Ingestion:** Encourage the victim to drink large amounts of water. Do Not Vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water, obtain medical attention.
- e. **Clean-up.** Promptly clean up small spills, using appropriate protective equipment and follow specific procedures.

4.0.3 Avoidance of “routine” exposure: Follow Standard Operating Procedures to avoid unnecessary exposure to chemicals by any route.

- a. **Do Not** smell or taste chemicals. Vent apparatus which may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) in Fume Hoods. Mouth suction: Do not use mouth suction for pipetting or starting a siphon.

- b. Inspect gloves before use.
- c. Do not allow release of toxic substances in cold rooms and warm rooms, since these have contained re-circulated atmospheres.

4.0.4 Personal protection: Assure that appropriate eye protection (goggles or safety glasses with side shields) is worn by all persons, including visitors, where chemicals are stored or handled.

- a. Wear appropriate gloves when the potential for contact with toxic materials exists; inspect the gloves before each use, wash them before removal, and replace them periodically. (A table of resistance to common glove materials)
- b. Use any other protective and emergency equipment as appropriate.
- c. Avoid use of contact lenses in the laboratory unless necessary; if they are used, inform supervisor so special precautions can be taken.
- d. Remove laboratory coats immediately on significant contamination.
- e. Personal apparel: Confine long hair and loose clothing. Wear shoes that protect the foot, no open toed shoes or sandals.

4.0.5 Eating, drinking, smoking, etc.: Avoid eating, drinking, smoking, gum chewing, or application of cosmetics in areas where laboratory chemicals are present, wash hands before conducting these activities. Avoid the storage, handling, or consumption of food or beverages in storage areas, refrigerators, glassware or utensils which are also used for laboratory operations.

4.0.6 Choice of chemicals: Use only those chemicals for which the quality of the available ventilation system is appropriate.

4.0.7 Equipment and glassware: Handle and store laboratory glassware with care to avoid damage, do not use damaged glassware. Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur. Use equipment only for its designed purpose.

4.0.8 Planning: Seek information and advice on hazards, plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation.

4.0.9 Horseplay: Avoid practical jokes or other behavior which might confuse, startle or distract another worker.

4.1. Vigilance: Be alert to unsafe conditions and see that they are corrected when detected.

4.1.0 Personal housekeeping: Keep the work area clean and uncluttered, with chemicals and equipment being properly labeled and stored; clean up the work area on completion of an operation or at the end of each day.

4.1.1 Exiting: Wash areas of exposed skin well before leaving the laboratory. Always remember to wash hands as soon as possible, and any areas of exposed skin to prevent possible reactions on skin or an accidental exposure to eyes by contact with contaminated fingers.

4.2 Standard Operating Procedures

4.2.0 Use of hood: Use the hood for operations which might result in release of toxic chemical vapors or dust.

- a. **Use a hood when working with any volatile substance with a TLV of less than 50 ppm.**
- b. Confirm adequate hood performance before use; keep hood closed at all times except when adjustments within the hood are being made; keep materials stored in hoods to a minimum and do not allow them to block vents or air flow.
- c. Leave the hood “on” when it is not in active use if toxic substances are stored in it or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is “off”.

4.2.1 Waste Disposal: Assure that the plan for each laboratory operation includes plans and training for waste disposal.

4.2.1.1 Deposit chemical waste in appropriately labeled receptacles and follow other waste disposal procedures of the Chemical Hygiene Plan.

4.2.1.2 [Do not discharge to the sewer](#) concentrated acids or bases; highly toxic, malodorous, or lachrymatory substances; or any substances which might interfere with the biological activity of waste water treatment plants, create fire or explosion hazards, cause structural damage or obstruct flow.

4.2.2 Unattended operations: Leave lights on, place an appropriate sign on the door, and provide for containment of toxic substances in the event of failure of a utility service (such as cooling water) to an unattended operation. Must have prior approval by professor.

4.2.3 Working alone: Avoid working alone in a building; do not work alone in a laboratory if the procedures being conducted are hazardous.

4.2.4 Appendix A. [Particularly Hazardous Substances](#)

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4.2.7 Appendix D. Reserved

4.2.8 Appendix E. Reserved

The Laboratory Safety Manual on the Chemical Hygiene Officer web page provides general principles for working safely with hazardous chemicals. Professors and laboratory workers are encouraged to

develop and implement more detailed guidelines for specific operations and chemicals in their laboratories.

4.3 Training and Information

All laboratory workers must receive laboratory safety training when they are first assigned to a work area where hazardous chemicals are present and before assignments involving new exposure situations. General laboratory safety training is provided by the Chemical Hygiene Officer (CHO). More specific training for particular materials or operations in a particular work area is provided by the Principal Investigators, laboratory staff and teaching assistants.

The general training offered by the CHO covers the following topics:

4.3.1 An overview of the OSHA Laboratory Standard. Full text of the standard is available on the web at: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=10106

4.3.2 The content and availability of the Chemical Hygiene Plan and Laboratory Safety Resource.

4.3.3 The availability of material safety data sheets and how to use them.

4.3.4 An explanation of permissible exposure limits for chemicals.

4.3.5 An overview of methods to [recognize hazards, how to evaluate hazards](#), and common methods to prevent and control exposure.

4.3.6 The use, function and selection of personal protective equipment.

4.3.7 Emergency procedures for fire, injury, chemical exposure, and chemical spill situations.

4.3.8 Chemical waste disposal procedures at St. Norbert College.

Each laboratory worker must be made aware of the following information:

4.3.2.1 Location of the Chemical Hygiene Plan: The Chemical Hygiene Plan for the Biology and Science Departments is kept in Mark Musser's office (GMS 2055), in the individual laboratories, and on the CHO web page.

4.3.2.2 Nature and potential health and safety risks of specific hazardous substances used by the laboratory worker. Each Principal Investigator ensures that each individual working in his or her laboratory understands the hazards of and how to properly handle the materials in the laboratory. The PI maintains relevant files in the laboratory.

4.3.2.3 Proper handling, under all circumstances, of hazardous substances used in the laboratory.

4.3.2.4 Location and availability of reference materials, including safety data sheets (SDSs) for hazardous chemicals used or stored in the laboratory.

Training Records

4.3.9 The Chemical Hygiene Officer (CHO) maintains a database of attendance for training sessions given by the CHO. Records of in-laboratory training provided by individual laboratories are maintained in the laboratories.

4.4 Signs and Labels, Hazard Information

Prominent signs and labels of the following types should be posted:

4.4.1 Emergency telephone numbers of emergency personnel/ facilities, supervisors, and laboratory workers.

4.4.2 Identity labels, showing contents (including waste receptacles) and associated hazards. Hazardous Waste containers must be properly labeled with the full name of chemical and/or chemicals in the solution to be disposed of. Toxic wastes must remain separate to lower disposal costs (e.g. Mercury).

4.5 Personal Protective Equipment

The following items should be available in each laboratory:

4.5.1 Protective equipment compatible with the required degree of protection for substances being handled.

4.5.2 An easily accessible drench-type safety shower.

4.5.3 An eyewash fountain

4.5.4 A fire extinguisher

4.5.5 Telephone for emergency use

4.5.6 Other items designated by the laboratory supervisor.

4.6 Control Measures – Controlling Chemical Exposure

The following criteria are used to determine and implement control measures to reduce exposures to hazardous chemicals.

4.6.1 Engineering Controls, are the primary means of control for exposure to hazardous chemicals. Local ventilation, including fume hoods, ducted biosafety cabinets, are the most common types of engineering controls.

4.6.2 Administrative Controls, It may be necessary to supplement engineering controls and protective equipment with administrative controls, such as restricting access to an area, restricting use of particular chemicals to a limited group of people, or limiting the length of exposure.

4.6.3 Personal Protective Equipment (PPE), including gloves, face shields, safety glasses with side shields, safety goggles, lab coats and aprons, are used when engineering controls are not sufficient to adequately control exposure. Specifically, this equipment is used to prevent exposure to the skin or eyes. Personal protective equipment is carefully selected to ensure that it is compatible with the chemicals used. Information about selection of appropriate protective equipment is available in the [Laboratory Safety Resource](#).

4.6.4 Exposure Monitoring

Exposure monitoring is conducted by the Chemical Hygiene Officer (CHO) upon request, if there is reason to believe that exposure levels for a particular substance may routinely exceed either the action level or the [permissible exposure limit](#) set forth by OSHA. Individuals may contact the CHO directly at x4019. The Results of the monitoring will be made available by the CHO to the individual(s) monitored, their supervisors within 15 working days of the receipt of analytical results.

Based on the monitoring results, periodic monitoring may be scheduled at the discretion of the CHO, in accordance with applicable federal, state and local regulations.

4.7 Medical Program

4.7.1 First Aid. Personnel trained in first aid should be available during working hours and an emergency room with medical personnel should be nearby.

4.7.2 Compliance with regulations. Regular medical surveillance should be established to the extent required by regulations.

4.7.3 Routine Surveillance. Anyone whose work involves regular and frequent handling of toxicologically significant quantities of a chemical should consult a qualified physician to determine on an individual basis whether a regular schedule of medical surveillance is desirable.

4.8 Recordkeeping

4.8.1 Accident records. Detailed records should be written and retained. These records will be reviewed to reduce future incidents and risks.

4.8.2 Inventory and usage records. Accurate records of substances used, substitute lower-risk substances for higher-risk substances whenever possible.

4.8.3 Medical Records. All medical records shall be retained by the institution for 30 years.

4.9 Housekeeping, Maintenance, and Inspections

4.9.1 Cleaning. Floors should be cleaned regularly.

4.9.2 Passageways. Stairwells and hallways should not be used as storage areas. Access to exits, emergency equipment, and utility controls should never be blocked.

4.9.3 Maintenance. Eyewash fountains are weekly, and emergency showers are tested monthly. Other safety equipment should be inspected regularly. (e.g. every 3-6 months). Procedures to prevent restarting of out-of-service equipment should be established.

4.9.4 Inspections. Formal housekeeping and chemical hygiene inspections should be held at least quarterly for units which have frequent personnel changes and semiannually for others; informal inspections should be continual.

5.0 Chemical Procurement, Distribution, and Storage

5.0.1 Procurement. Before a substance is received, information on proper handling, storage, and disposal should be known to those who will be involved. No container should be accepted without an adequate identifying label. Preferable, all substances should be received in a central location. Items will be added to the chemical inventory and used for reports as needed.

5.0.2 Bulk Storage Room. (GMS 1078) Flammable and Corrosive Substances are segregated in a separate well-identified designated cabinets. Chemicals which are highly toxic or other chemicals must be transported in rubber unbreakable secondary containers. Stored chemicals are examined periodically (at least quarterly) for replacement, deterioration, and container integrity (e.g. Dents, Rust). Chemicals used from the bulk storage room should be reported to the Chemical Hygiene Officer, who will adjust the amount in the chemical inventory.

5.0.3 Stockrooms. There are located next to the General Chemistry Laboratories (GMS 2054), General Biology Laboratories (GMS 2043) and Organic Chemistry Laboratory (GMS 3042), they are properly ventilated, and can be used as preparation or repackaging areas, are secured, and student TAs, Professors, and the Chemical Hygiene Officer has access.

5.0.4 Distribution. When chemicals are hand carried, the container should be placed in an outside container or bucket. If an elevator is used to transfer chemicals between floors, secondary containment must be used.

5.0.5 Laboratory storage. Amounts permitted should be as small as practical. Storage on bench tops and in hoods is inadvisable. Use the Flammable and Corrosive cabinets located under the Fume Hoods to store extra chemical reagents that are routinely used. Exposure to heat or direct light should be avoided.

5.1 All Emergencies including Leaks, Spills, and Releases to the Environment

All Emergencies call 911 and state the type of emergency

Provide as much detailed information as possible (e.g. location, type, amount, or volume)

Examples: Spill of hazardous substance (Flammable, Corrosive) spills over 4 L or 5 Gallons
 Cylinder leak releasing fumes and vapors
 Large spill of substance that is not contained and is threatening the water supply
 Natural gas leak, fumes, vapors

5.1.0 Steps to take after calling emergency services at 911

1. Persons should be evacuated from the affected area at once.
2. Close doors to seal off the contaminated area to prevent further contamination until the arrival of a trained responder.
3. Persons who may have been contaminated should seek medical attention immediately.
4. Call Senior Director of Campus Safety – Steve Jakups – 920.403.1346
5. Call Director of Facilities – Patrick Wrenn – 920.403.3176
6. Call Chemical Hygiene Officer - Mark Musser 920.850.7261 (cell)

5.1.1 Small leak or Spill less than 3.785L or 1 Gallon (contained inside building – no drains)

1. Small spills should be cleaned up immediately. Absorbent materials are located in Chemical Stock room. A Spill control Cart with absorbent material is located in the Gehl-Mulva Science Center in room 1078.
2. Always use the safety glasses with side shields or goggles and gloves provided in the spill kits.
3. Report the spill and any items used during clean-up to CHO Mark Musser at 920.850.7261 (24/7)

5.1.2 Reporting a Spill into the City Sewer: 1.920.322.3660 (24/7)

REPORTING OF OPERATING UPSETS, SPILLS, SLUGS OR OTHER EMERGENCIES. (1) Users shall immediately notify the City of an upset, spill, or other slug that has a reasonable potential to cause a violation of any applicable pretreatment standard or requirement.

(2) The report required by subsection (1) shall include:

(a) The location, date and time of the discharge;

(b) The character (e.g. oil, hydraulic fluid, used cooking oil) and volume of the discharged material; and

(c) Containment or other corrective action taken by the user.

Note: After reporting the above information (1) (a),(b),(c) forward it to the Chemical Hygiene Officer Mark D. Musser at mark.musser@snc.edu or call 920.850.7261(cell) who will complete and submit subparts (3) and (4).

(3) Within five (5) days after the report required by subsection (1), the user shall submit to the City a written report describing the cause of the discharge, the duration of the discharge, and the measures to be taken by the user to prevent similar discharges in the future.

(4) The report required by subsection (3) shall contain the certification set forth in § 13.50.14 and be signed according to § 13.50.15.

(5) Users shall immediately notify the City at 1.920.322.3660 (24 hours per day/7 days per week) of any emergency that may affect the sewerage system.

5.1.3 Releases to the Environment (Air Emissions)

NR 445.03 General limitations. No person may cause, allow or permit emissions into the ambient air of any hazardous substance in a quantity or concentration or for a duration that is injurious to human health, plant or animal life unless the purpose of that emission is for the control of plant or animal life. Hazardous substances include but are not limited to the hazardous air contaminants listed in [Tables A to C of s. NR 445.07](#).

5.2 Waste Management Plan

The Waste Management Plan will be followed when disposing of wastes on campus. All regulatory requirements will be followed to ensure compliance with all Federal, State and Local laws and ordinances.

5.2.1 Generator Status. According to Federal guidelines, St. Norbert College is currently following a Small Quantity Generator (SQGs).

All Hazardous Waste Manifests are retained by the Chemical Hygiene Officer (CHO).

Here are the following requirements from the US EPA Generator Summary Chart:

Quantity Limits: 100 kg – 1,000 kg/mo (220 -2,004 lbs.) of hazardous wastes in a month;

On-Site Accumulation Quantity: Not to exceed 6000 kg (13,200 lbs) at any one time

Accumulation Time Limits: Less than or equal to 180 days

EPA ID: Required – WID 010241867

Note:

I am currently doing research to see if we can become a Conditionally Exempt Small Quantity Generator. In Wisconsin, this term has been changed to a Very Small Quantity Generator.

Our Goal is to meet the following requirements from the USA EPA Generator Summary Chart:

Quantity Limits: Do not generate more than or equal to 100 kg (220 lbs.) of hazardous wastes in a month;

On-Site Accumulation Quantity: Less than or equal to 1000 kg (2,200 lbs); and less than or equal to 1 kg (2.2 lbs) of acute hazardous waste; less than or equal to 100 kg (220 lbs) of acute spill residue or soil.

Accumulation Time Limits: None

EPA ID: Not Required, For site identification purposes we would continue to use our EPA ID number on shipping manifests and on all correspondence and reports; it is WID 010241867

Storage Requirements: None

5.2.2 Waste Streams. A waste stream characterization for each experiment or process waste will be available based on generator knowledge, or on a chemical analysis of suspect waste streams or experiments. These records are maintained by the CHO and are available in the Waste Management Plan.

5.2.2.1 Art Department

5.2.2.2 Biology Department - (Biohazardous waste, Flammable waste)

5.2.2.3 Chemistry Department – (Flammable waste, Toxic waste)

5.2.2.4 Facilities – Universal Waste – (Batteries, Fluorescent lamps, Used oil)

5.2.2.5 IT Department – Universal Waste (Batteries) and Recycling Electronic Waste (discarded computers, laptops, small office equipment)

5.2.2.6 Offices – Universal Waste (Batteries)

5.2.2.7 Physics Department – Universal Waste (Batteries)

5.2.2.8 Reserved

5.2.2.9 Reserved

5.2.3 Indiscriminate disposal. Pouring waste chemicals down the drain or adding them to mixed refuse for landfill burial is unacceptable. Established procedures for proper waste disposal must be followed at all times to protect people and the environment from harm due to improper hazardous waste disposal.

5.2.4 Emissions. Hoods should not be used as a means of disposal for volatile chemicals. Proper lids that seal the waste container must be used. **Containers must be closed except when adding more solution, or transferring solution to another container.**

5.2.4.1 BTU emissions. The Wisconsin NR 419.03 limits organic compound emissions. St. Norbert falls under the following category of direct sources, and is exempt from the requirement to obtain a construction permit, NR406.04 Direct sources exempt from construction permit requirements.

5.2.4.2 Furnaces. (1)(a) One or more external combustion furnaces at a source which will not burn any hazardous waste identified under ch. NR605, or which have been issued a license or licenses under ch. NR 680, and if no individual furnace is designed to burn the following fuels at more than the maximum rates indicated: **5. Gaseous fossil fuel at a heat rate input of not more than 25 million Btu per hour.**

5.2.4.3 Laboratories. (j) **A laboratory which emits volatile compounds, sulfur dioxide, carbon monoxide, nitrogen oxides or particulate matter or a combination thereof at a rate of less than 5.7 pounds per hour unless the emissions of any single hazardous air pollutant listed under section 112(b) of the act equal or to exceed 10 tons per year or the cumulative emissions of hazardous air pollutants listed under section 112 (b) of the act equal or exceed 25 tons per year.**

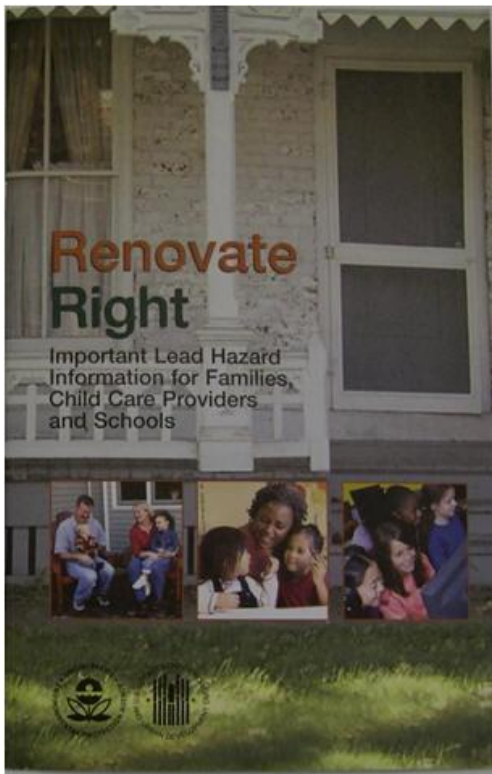
5.2.4.4 Chlorofluorocarbons (CFCs). A log of the CFCs recovered by certified vendors, including the amounts recovered, and the person conducting the work. 40 CFR 82.156 Persons who take the final step in the disposal of a small appliance must (2) Verify that the refrigerant has been evacuated from the appliance. Such verification must include a signed statement from whom the appliance is obtained that all refrigerant that had not leaked previously has been recovered from the appliance or shipment of appliances in accordance with paragraph (g) or (h) of this section, as applicable. This statement must include the name and address of the person who recovered the refrigerant and the date the refrigerant was recovered or a contract that refrigerant will be removed prior to delivery.

5.2.5 Hazardous Medical Wastes.

5.2.5.1 Epipens and other contaminated items. Biohazardous waste includes: Contaminated Sharps, Bulk Blood or blood products, bulk human body fluids (including semen, vaginal secretions, any body fluid containing visible blood, saliva in dental settings, amniotic fluid, cerebrospinal fluid, peritoneal fluid, pleural fluid, and synovial fluid. Microbiological waste, pathological waste, and animal waste (from infectious animals). Ensure appropriate secondary containment is provided for all non DOT hazardous waste containers. These containers will be provided by the Chemical Hygiene Officer (CHO). Also any hazardous materials that have potential access to the sanitary sewer must be provided secondary containment to prevent unintended releases.

5.2.6 Hazardous Waste and Renovation Projects. Projects are subject to a required protocol that identifies potential hazardous wastes.

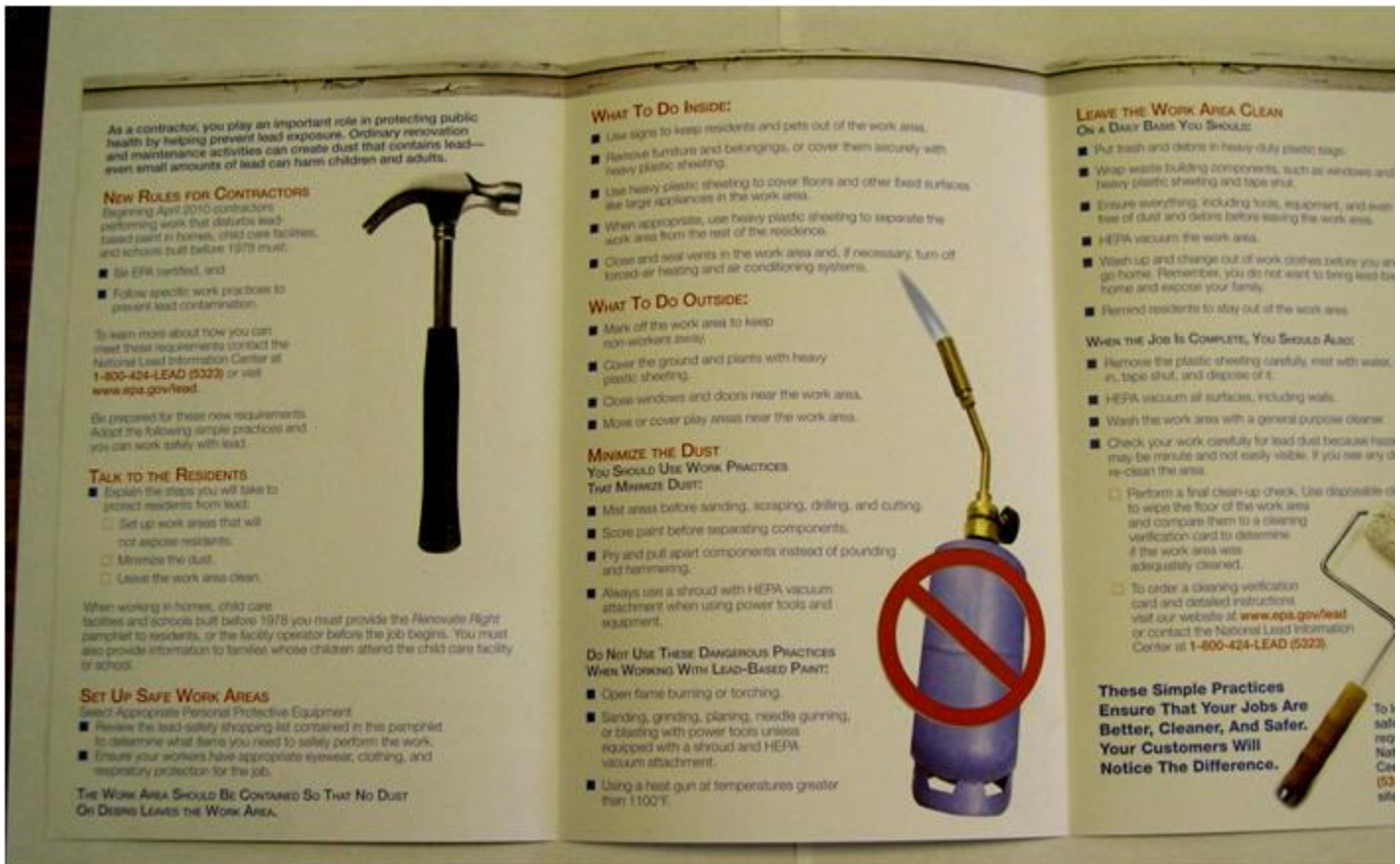
5.2.6.1 Lead Based Paint. Suspicious paint must be tested for before removal. Federal Law requires that individuals receive certain information before renovating 6 square feet or more of painted surfaces in a room for interior projects or more than 20 square feet of painted surfaces for exterior projects in housing, child care facilities and schools built before 1978. Starting in April 2010, Federal law requires contractors that disturb lead-based paint in homes, child care facilities and schools, built before 1978 to be certified and follow specific work practices to prevent lead contamination.



*Renovators must provide the following pamphlet: “Renovate Right: Important Lead Hazard Information for Families, Child Care Providers and Schools”. There is a Pre-Renovation Form that must be filled out, documenting the receipt of this pamphlet.

*Starting in April 2010, Federal law requires contractors that disturb lead-based paint in homes, child care facilities and schools, built before 1978 to be certified and follow specific work practices to prevent lead contamination. They must follow a 3-step plan:

1. Talk to the residents; explain the steps that will be taken to protect residents from lead.
2. Set up safe work areas – minimize the dust.
3. Leave the work area clean – perform a final clean-up check.



Sample Contractor's Guide

5.2.6.2 Asbestos. Proper notifications must be completed prior to the demolition of a facility containing known Asbestos Containing Materials (ACM). Records of test results and any other documents pertaining to the removal process are maintained by the Chemical Hygiene Officer (CHO).

5.2.6.3 Polychlorinated Biphenyls (PCB's.)

PCBs belong to a broad family of man-made organic chemicals known as chlorinated hydrocarbons. PCBs were domestically manufactured from 1929 until their manufacture was banned in 1979. They have a range of toxicity and vary in consistency from thin, light-colored liquids to yellow or black waxy solids. **Due to their non-flammability, chemical stability, high boiling point, and electrical insulating properties, PCBs were used in hundreds of industrial and commercial applications including electrical, heat transfer, and hydraulic equipment; as plasticizers in paints, plastics, and rubber products; in pigments, dyes, and carbonless copy paper; and many other industrial applications.**

But, most fluorescent light ballasts manufactured before 1979 used capacitors containing PCBs. Sealed inside the capacitor is about a teaspoon of concentrated PCBs. Potting material surrounds the capacitor, which is encased in a ballast box. Magnetic ballasts containing PCBs must be disposed of in accordance with formal hazardous waste procedures. **Contact Mark Musser at 920.850.7261 to setup a disposal of items containing PCB's. Documents related to any disposal of PCB's are maintained by the CHO**

5.2.6.4 Secondary Containment. Ensure appropriate secondary containment is provided for all non DOT hazardous waste containers. These containers will be provided by the EHS Specialist. **Also any hazardous materials that have potential access to the sanitary sewer must be provided secondary containment to prevent unintended releases.**

5.2.7 Non-Hazardous and Universal Waste. Some wastes are not hazardous but require special handling when disposed of.

5.2.7.1 Used Batteries. Environmental Hazards of Batteries

People are using more and more household batteries. The average person owns about two button batteries, ten normal (A, AA, AAA, C, D, 9V, etc.) batteries, and throws out about eight household batteries per year. About three billion batteries are sold annually in the U.S. averaging about 32 per family or ten per person.

A battery is an electrochemical device with the ability to convert chemical energy to electrical energy to provide power to electronic devices. **Batteries contain heavy metals such as mercury, lead, cadmium, and nickel, which can contaminate the environment when batteries are improperly disposed of. When incinerated, certain metals might be released into the air or can concentrate in the ash produced by the combustion process.**

☐ Typical Types of Household Batteries

☐ Primary Cells (Non-rechargeable) Common Uses

☐ Alkaline* Cassettes players, radios, appliances Carbon-zinc Flashlights, toys, etc. Lithium Cameras, calculators, watches, computers, etc. Mercury Hearing aids, pacemakers, cameras, calculators, watches, etc. Silver Hearing aids, watches, cameras, calculators Zinc Hearing aids, pagers

☐ Secondary Cells (Rechargeable) Common Uses

☒ **Nickel-cadmium Cameras, rechargeable appliances such as portable power tools, hand held vacuums, etc. Small sealed lead-acid Camcorders, computers, portable radios and tape players, cellular phones, lawn mower starters, etc.**

Used batteries containing hazardous materials (e.g. mercury, cadmium, lead, and silver) are classified as universal waste rather than hazardous waste. This allows St. Norbert College to recycle the batteries, while continuing to ensure that the batteries are handled in an environmentally sound manner. Lead-acid batteries are also recycled. Packaging for disposal instructions should be followed to guard against possible short circuiting. The rechargeable Battery Recycling Corporation recommends you do at least one of the following to prepare batteries for recycling. **Terminal Protection: Cover the terminals of each battery with non-conductive tape. Place batteries in a separate plastic bag so the terminals will not come in contact with other batteries or metal during storage and transport.**

5.2.7.2 Used oil. Label containers holding used oil as “USED OIL”. Used oil can be recycled by local vendors. Documents stating the vendor’s name, date, and amount of material (e.g. one 20 gallon drum) to be recycled should be forwarded to the Chemical Hygiene Officer to maintain.

5.2.7.3 Spent Fluorescent Bulbs. These bulbs require special handling to prevent breakage, during storage and transfer to a certified recycler. Mercury is a toxin that does not dissipate in the environment. It is a bio-accumulative toxin that builds up in the human body, adversely impacting health.

Fluorescent lamps contain small amounts of mercury. In 1976, the Federal Resource Conservation and Recovery Act regulated that mercury must be managed as a hazardous waste. This classification is dependent on amount of mercury collected and the timetable for its disposal.

If the weight of the waste lamps is less than 220 pounds, or approximately 300 four-foot T-12 lamps, then the lamps can be considered "Conditionally Exempt Hazardous Waste."

If this exemption is not applicable, the waste can then be managed as "Universal Waste." This classification streamlines the disposal process, saving time and money, while ensuring that the mercury is handled properly.

5.2.7.4 Scrap Metal. Different metals can be recycled by local vendors. Documents stating the vendor’s name, date, and approximate weight should be forwarded to the EHS Specialist to maintain.

5.2.7.5 Computer and Monitor Waste. The Director of Information Technology is responsible for contracting with a certified recycler any computer wastes that are generated. Shipping documents (Certificate of Environmental Recycling and Data Destruction, and Invoice) are maintained by the CHO.

5.2.7.6 Empty Cans and Containers. Chemical containers that have been emptied (generally this means drained of their contents by normal methods including pouring, pumping, aspirating, etc.) are not regulated as hazardous waste.

5.2.7.7 Training in proper waste handling and emergency procedures. Training will be provided for individuals who handle hazardous waste as part of their job duties. Proper handling and storage

procedures will be covered to protect stored items from breakage, or other damage. Containers must be closed, structurally sound, and compatible with its contents. They will also be trained in proper DOT shipping and receiving requirements.

5.2.8 General Discharge Prohibitions. (De Pere Municipality Code Section 70-1 adopts Green Bay Metropolitan Sewerage District Use Ordinance)

Sec. 70.1 – Purpose and intent of this chapter.

- (a) The purpose of this chapter is to promote and protect the public health, safety and general welfare of the citizenry of the city, to enhance aquatic life, scenic and ecological values and enhance municipal, industrial and recreational use of water.
- (b) The City hereby adopts and incorporates herein the Green Bay Metropolitan Sewerage District Use Ordinance, dated March 2, 2006, and may be amended from time to time. In case of a direct conflict between this chapter and the GBMSD sewer use ordinance, the terms of the GBMSD sewer use ordinance shall prevail.

5.2.9 Green Bay Metropolitan Sewerage District – GBMSD

Chapter 6 – Prohibited Discharges and Local Limits

6.05 Prohibitions on Discharge

5.3.4 Spill Control and Prevention

5.3.4.1 An SPCC Plan is required if a facility has greater than 1,320 gallons of above ground oil storage. Part of the plan requires spill kits in the immediate areas of oil storage. Mark Musser the CHO is responsible for the Spill Control Plan and its management, training, and recordkeeping.

5.3.4.2 Special application spill kits are located in room GMS 1078 of the Gehl-Mulva Science Center. (e.g. Mercury, Acid, and Base Spill Kits)

5.3.4.3 Secondary Containment – containers are used to provide containment for hazardous materials that could leak or spill into the city sewer system. Areas that need containment include chemicals being stored by sinks, over mop basins, or by floor drains.

5.3.4.4 Inspections of containers – See the below schedule.

ATTACHMENT 3.2 – Bulk Storage Container Inspection Schedule – onshore facilities (excluding production):

To comply with integrity inspection requirement for bulk storage containers, inspect/test each shop-built aboveground bulk storage container on a regular schedule in accordance with a recognized container inspection standard based on the minimum requirements in the following table. **Table G-17 Bulk Storage Container Inspection Schedule**

Container Size and Design Specification	Inspection requirement
---	------------------------

5.3.6 Training in Spill Prevention Control and Cleanup Procedures. Following and practicing prevention techniques; and proper procedures for the handling of containers of chemicals is the most important part of spill control. Most human error spills can be prevented from ever occurring. If a piece of equipment malfunctions chemicals can be released. Small slow leaks may be a warning sign for us to notice before total failure takes place.

5.3.6.1 Small spills of oil should be cleaned up immediately. Absorbent materials are in each of the laboratories next to the Emergency Eyewash and Shower Stations. A cart is located in the GMS 1077 Bulk Storage room. Always use the safety glasses with side shields or goggles and gloves provided in the spill kits. Report the spill and any items used during clean-up to CHO Mark Musser at 920.850.7261

(Example of a small oil leak report)

Date: 00/00/0000 **Building:** enter name – enter sub location (room Number)

Type: (hydraulic fluid leaking from elevator tank)

Amount: (Small amount less than a gallon)

Supplies: (1 absorbent pad 15"x 19", placed in 5 gallon pail)

Reported by: (please provide your name and phone number)

5.3.6.2 Small leak or spill less than 3.785L or 1 Gallon (contained inside building – no drains)

1. **Small spills should be cleaned up immediately.** Spill kits with absorbent materials are located in each of the laboratories next to the emergency eyewash and shower stations.
2. Always use the safety glasses with side shields or goggles and gloves provided in the spill kits.
3. Report the spill and any items used during clean-up to CHO Mark Musser at 920.850.7261

(Example of a small spill report)

Date: (00/00/2000) **Building:** (name and sub-location = GMS General Chemistry – room 2045)

Location: (spilled on first work station next to hood and also on floor)

Type: (HCL (Hydrochloric Acid) SDS warning DANGER! Strongly corrosive to all body tissue and moderately toxic by ingestion and inhalation. Target organs: Respiratory system, eyes, skin, lungs)

Amount: (Small amount less than a gallon - 2 liter glass bottle)

Supplies: (½ of package of bench top acid neutralizer, 1 pair rubber gloves, 4 - 500ml clear containers)

Reported by: (please provide your name and phone number)

5.3.6.3 Medium leak or spill less than 19.925L or 5 Gallons (contained inside building – no drains)

1. **Medium spills should be cleaned up immediately. The room may have to be evacuated depending on the characteristics of the chemical spilled, and the area where the chemical is spilled.**
2. Always use the goggles and gloves provided in the spill kits.
3. Report the spill and any items used during clean-up to CHO Mark Musser at 920.9850.7261

(Example of a medium spill report)

Date: (00/00/0000) **Building:** (Location, room number)

Location: (spilled on work bench)

Type: (Acid)

Amount: (Medium amount less than 5 gallons)

Supplies: (3 Spill absorbent pads)

Reported by: (please provide your name and phone number)

5.3.6.4 Large Leaks and Spills over 19.925 and over 5 gallons, and/or Releases to the Environment

1. **All Emergencies call 9.911 and state the type of emergency** Be prepared to provide as much detailed information as possible (e.g. location, type, amount, or volume)

Examples: Spill of Hazardous Substance / Cylinder leak releasing fumes and vapors /Large Spill of Substance that is not contained and is threatening the water supply / Natural Gas Leak / Fumes, Vapors)

Steps to take after calling emergency services

2. **Persons should be evacuated from the affected area at once.**
3. Seal off the area to prevent further contamination until the arrival of a trained responder.
4. Persons who may have been contaminated should seek medical attention immediately.
5. Call Senior Director of Campus Safety – Steve Jakups – 920.403.1346
6. Call Director of Facilities – Patrick Wrenn – 920.403.3176
7. Call Chemical Hygiene Officer - Mark Musser 920.850.7261 (cell)

Reporting a Spill into the City Sewer: 1.920.322.3660 (24/7)

REPORTING OF OPERATING UPSETS, SPILLS, SLUGS OR OTHER EMERGENCIES. (1) Users shall immediately notify the City of an upset, spill, or other slug that has a reasonable potential to cause a violation of any applicable pretreatment standard or requirement.

(2) The report required by subsection (1) shall include:

- (a) The location, date and time of the discharge;
- (b) The character (e.g. oil, hydraulic fluid, used cooking oil) and volume of the discharged material; and
- (c) Containment or other corrective action taken by the user.

Note: After reporting the above information (1) (a),(b),(c) forward it to the Chemical Hygiene Officer (CHO) Mark Musser mark.musser@snc.edu or call 920.850.7261(cell) who will complete and submit subparts (3) and (4).

(3) Within five (5) days after the report required by subsection (1), the user shall submit to the City a written report describing the cause of the discharge, the duration of the discharge, and the measures to be taken by the user to prevent similar discharges in the future.

(4) The report required by subsection (3) shall contain the certification set forth in § 13.50.14 and be signed according to § 13.50.15.

(5) Users shall immediately notify the City at 1.920.322.3660 (24 hours per day/7 days per week) of any emergency that may affect the sewerage system.

6.0 Safety Recommendations

6.1 Flammable Materials

6.1.1 Properties of Flammable and Combustible Liquids

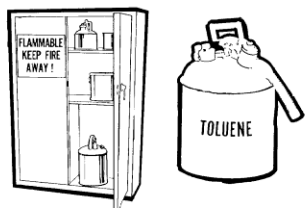
Flammable and combustible liquids vaporize and form flammable mixtures with air when in open containers, when leaks occur, or when heated. To control these potential hazards, several properties of these materials, such as volatility, flashpoint, and flammable range and auto ignition temperatures must be understood. An explanation of these terms and other properties of flammable liquids is available the

[Laboratory Training Guide](#). Information on the properties of a specific liquid can be found in that liquid's [safety data sheet](#) (SDS), or other reference material.

6.1.2 Storage of Flammable and Combustible Liquids

Flammable and combustible liquids should be stored only in approved containers. Approval for containers is based on specifications developed by organizations such as the US [Department of Transportation](#) (DOT), [OSHA](#), the [National Fire Protection Agency](#) (NFPA) or [American National Standards Institute](#) (ANSI). Containers used by the manufacturers of flammable and combustible liquids generally meet these specifications.

Safety Cans and Closed Containers



Many types of containers are required depending on the quantities and classes of flammable or combustible liquids in use. A *safety can* is an approved container of not more than 5 gallons capacity that has a spring closing lid and spout cover. Safety cans are designed to safely relieve internal pressure when exposed to fire conditions. **A closed container is one sealed by a lid or other device so that liquid and vapor cannot escape at ordinary temperatures.**

Flammable Liquid Storage Cabinets

A *flammable liquid storage cabinet* is an approved cabinet that has been designed and constructed to protect the contents from external fires. Storage cabinets are usually equipped with vents, which are plugged by the cabinet manufacturer. Since venting is not required by any code or the by local municipalities and since venting may actually prevent the cabinet from protecting its contents, vents should remain plugged at all times. **Storage cabinets must also be conspicuously labeled "FLAMMABLE – KEEP FIRE AWAY".**

Refrigerators

Use only those refrigerators that have been designed and manufactured for flammable liquid storage. Standard household refrigerators must not be used for flammable storage because internal parts could spark and ignite. Refrigerators must be prominently labeled as to whether or not they are suitable for flammable liquid storage.

Storage Considerations:

- Quantities should be limited to the amount necessary for the work in progress.
- **No more than 10 gallons of flammable and combustible liquids, combined, should be stored outside of a flammable storage cabinet unless safety cans are used.** When safety cans are used, up to 25 gallons may be stored without using a flammable storage cabinet.
- Storage of flammable liquids must not obstruct any exit.

- **Flammable liquids should be stored separately from strong oxidizers, shielded from direct sunlight, and away from heat sources.** See [Anecdotes](#) for a description of an incident involving a flammable material stored near a hot plate.

6.1.3 Handling Precautions

The main objective in working safely with flammable liquids is to avoid accumulation of vapors and to control sources of ignition.

Besides the more obvious ignition sources, such as open flames from Bunsen burners, matches and cigarette smoking, less obvious sources, such as electrical equipment, static electricity and gas-fired heating devices should be considered. Accounts of a few of the fires that have occurred in our laboratories may be found in [Anecdotes](#).

Some electrical equipment, including switches, stirrers, motors, and relays can produce sparks that can ignite vapors. Although some newer equipment has spark-free induction motors, the on-off switches and speed controls may be able to produce a spark when they are adjusted because they have exposed contacts. One solution is to remove any switches located on the device and insert a switch on the cord near the plug end.

Pouring flammable liquids can generate static electricity. The development of static electricity is related to the humidity levels in the area. Cold, dry atmospheres are more likely to facilitate static electricity. Bonding or using ground straps for metallic or non-metallic containers can prevent static generation.

- **Control all ignition sources in areas where flammable liquids are used. Smoking, open flames and spark producing equipment should not be used.**
- **Whenever possible use plastic or metal containers or safety cans.**
- **When working with open containers, use a [laboratory fume hood](#) to control the accumulation of flammable vapor.**
- **Use bottle carriers for transporting glass containers.**
- **Use equipment with spark-free, intrinsically safe induction motors or air motors to avoid producing sparks. These motors must meet National Electric Safety Code (US DOC, 1993) Class 1, Division 2, Group C-D explosion resistance specifications. Many stirrers, Variacs, outlet strips, ovens, heat tape, hot plates and heat guns do not conform to these code requirements.**
- **Avoid using equipment with series-wound motors, since they are likely to produce sparks.**
- **Do not heat flammable liquids with an open flame. Steam baths, salt and sand baths, oil and wax baths, heating mantles and hot air or nitrogen baths are preferable.**
- **Minimize the production of vapors and the associated risk of ignition by flashback. Vapors from flammable liquids are denser than air and tend to sink to the floor level where they can spread over a large area.**
- **Electrically bond metal containers when transferring flammable liquids from one to another. Bonding can be direct, as a wire attached to both containers, or indirect, as through a common ground system.**

- When grounding non-metallic containers, contact must be made directly to the liquid, rather than to the container.
- In the rare circumstance that static cannot be avoided, proceed slowly to give the charge time to disperse or conduct the procedure in an inert atmosphere.

6.1.4 Flammable Aerosols

Flammable liquids in pressurized containers may rupture and aerosolize when exposed to heat, creating a highly flammable vapor cloud. As with flammable liquids, these should be stored in a flammable storage cabinet.

6.1.5 Flammable and Combustible Solids

Flammable solids often encountered in the laboratory include alkali metals, magnesium metal, metallic hydrides, some organometallic compounds, and sulfur. Many flammable solids react with water and cannot be extinguished with conventional dry chemical or carbon dioxide extinguishers. See [Anecdotes](#) for descriptions of incidents involving such materials.

- Ensure Class D extinguishers, e.g., Met-L-X, are available where flammable solids are used or stored.
- Sand can usually be used to smother a fire involving flammable solids. Keep a container of sand near the work area.
- If a flammable, water-reactive solid is spilled onto skin, brush off as much as possible, then flush with copious amounts of water.
- NEVER use a carbon dioxide fire extinguisher for fires involving [lithium aluminum hydride \(LAH\)](#). LAH reacts explosively with carbon dioxide.

6.1.6 Catalyst Ignition

Some hydrogenated catalysts, such as palladium, platinum oxide, and Raney nickel, when recovered from hydrogenation reactions, may become saturated with hydrogen and present a fire or explosion hazard.

- Carefully filter the catalyst.
- Do not allow the filter cake to become dry.
- Place the funnel containing moist catalyst into a water bath immediately.

Purge gases, such as nitrogen or argon, may be used so that the catalyst can be filtered and handled in an inert atmosphere.

6.2 Corrosive Materials

Many chemicals commonly used in the laboratory are corrosive or irritating to body tissue. They present a hazard to the eyes and skin by direct contact, to the respiratory tract by inhalation or to the

gastrointestinal system by ingestion. [Anecdotes](#) offers incidents involving chemical burns from incorrectly handling corrosives.

6.2.1 Corrosive Liquids

Corrosive liquids (e.g. mineral acids, alkali solutions and some oxidizers) represent a very significant hazard because skin or eye contact can readily occur from splashes and their effect on human tissue generally takes place very rapidly. Bromine, sodium hydroxide, sulfuric acid and hydrogen peroxide are examples of highly corrosive liquids. See [Chemical Specific Issues](#) for specific corrosive liquids such as [Hydrofluoric Acid](#) and [Phenol](#).

The following should be considered:

1. The eyes are particularly vulnerable. It is therefore essential that approved [eye and face protection](#) be worn in all laboratories where corrosive chemicals are handled.
2. [Gloves](#) and other [chemically resistant protective clothing](#) should be worn to protect against skin contact.
3. To avoid a flash steam explosion due to the large amount of heat evolved, always add acids or bases to water (and not the reverse).
4. Acids and bases should be segregated for storage.
5. Liquid corrosives should be stored below eye level.
6. Adequate quantities of spill control materials should be readily available. Specialized spill kits for acids and bases are available through most chemical and laboratory safety supply catalogs.

6.2.2 Corrosive Gases and Vapors

Corrosive gases and vapors are hazardous to all parts of the body; certain organs (e.g. the eyes and the respiratory tract) are particularly sensitive. The magnitude of the effect is related to the solubility of the material in the body fluids. Highly soluble gases (e.g. ammonia, hydrogen chloride) cause severe nose and throat irritation, while substances of lower solubility (e.g. nitrogen dioxide, phosgene, sulfur dioxide) can penetrate deep into the lungs.

1. Warning properties such as odor or eye, nose or respiratory tract irritation may be inadequate with some substances. Therefore, they should not be relied upon as a warning of overexposure.
2. Perform manipulations of materials that pose an inhalation hazard in a chemical [fume hood](#) to control exposure or wear appropriate respiratory protection.
3. Protect all exposed skin surfaces from contact with corrosive or irritating gases and vapors.
4. Regulators and valves should be closed when the [cylinder](#) is not in use and flushed with dry air or nitrogen after use.

5. When corrosive gases are to be discharged into a liquid, a trap, check valve, or vacuum break device should be employed to prevent dangerous reverse flow.

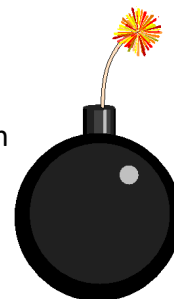
6.2.3 Corrosive Solids

Corrosive solids, such as sodium hydroxide and phenol, can cause burns to the skin and eyes. Dust from corrosive solids can be inhaled and cause irritation or burns to the respiratory tract. Many corrosive solids, such as potassium hydroxide and sodium hydroxide, can produce considerable heat when dissolved in water.

1. Wear gloves and eye protection when handling corrosive solids.
2. When mixing with water, always slowly add the corrosive solid to water, stirring continuously. Cooling may be necessary.
3. If there is a possibility of generating a significant amount of dust, conduct work in a fume hood.

6.3 Peroxide Forming Compounds and Reactives

Certain chemicals can form dangerous peroxides on exposure to air and light. Since they are sometimes packaged in an atmosphere of air, peroxides can form even though the containers have not been opened. Peroxides may detonate with extreme violence when concentrated by evaporation or distillation, when combined with other compounds, or when disturbed by unusual heat, shock or friction. Formation of peroxides in ethers is accelerated in opened and partially emptied containers. Refrigeration will not prevent peroxide formation and stabilizers will only retard formation.



Peroxide formation may be [detected](#) by visual inspection for crystalline solids or viscous liquids, or by using chemical methods or specialized kits for quantitative or qualitative analysis. If you suspect that peroxides have formed, do not open the container to test since peroxides deposited on the threads of the cap could detonate.

See [Anecdotes](#) for an account of an incident in our laboratories involving peroxide detonation.

6.3.1 Recommended Work Practices

The following recommendations should be followed to control the hazards of peroxides.

- Know the properties and hazards of all chemicals you are using through adequate research and study, including reading the label and [SDS](#).
- Inventory all chemical storage at least twice a year to detect forgotten items, leaking containers, and those that need to be discarded.
- Identify chemicals that form peroxides or otherwise deteriorate or become more hazardous with age or exposure to air. Label containers with the date received, the date first opened and the date for disposal as recommended by the supplier.

- Minimize peroxide formation in ethers by storing in tightly sealed containers placed in a cool place in the absence of light. Do not store ethers at or below the temperature at which the peroxide freezes or the solution precipitates.
- Choose the size container that will ensure use of the entire contents within a short period of time.
- Visually or chemically check for peroxides of any opened containers before use.
- Clean up spills immediately. The safest method is to absorb the material onto vermiculite or a similar loose absorbent.
- When working with peroxidizable compounds, wear impact-resistant [safety eyewear and face shields](#). Visitor specs are intended only for slight and brief exposure, and should not be used when working with peroxidizable compounds.
- Do not use solutions of peroxides in volatile solvents under conditions in which the solvent might be vaporized. This could increase the concentration of peroxide in the solution.
- Do not use metal spatulas or magnetic stirring bars (which may leach out iron) with peroxide forming compounds, since contamination with metals can lead to explosive decomposition. Ceramic, Teflon or wooden spatulas and stirring blades are usually safe to use.
- Do not use glass containers with screw-top lids or glass stoppers. Polyethylene bottles with screw-top lids may be used.

6.3.2 Examples of Peroxide-forming compounds

*Peroxide Hazard on Storage: **Discard After Three Months***

Divinyl acetylene

Potassium metal

Divinyl ether

Sodium amide

Isopropyl ether

Vinylidene chloride

*Peroxide Hazard on Concentration: **Discard After One Year***

Acetal

Dioxane

Cumene

Ethylene glycol dimethyl ether (glyme)

Cyclohexene

Furan

Cyclooxyene

Methyl acetylene

Cyclopentene

Methylcyclopentane

Diacetylene

Methyl isobutyl ketone

Dicyclopentadiene	Tetrahydronaphtalene (Tetralin)
Diethyl ether	Tetrahydrofuran
Diethylene glycol dimethyl ether (diglyme)	Vinyl ethers
Hazardous Due to Peroxide Initiation of Polymerization*: <i>Discard After One Year</i>	
Acrylic acid	Styrene
Acrylonitrile	Tetrafluoroethylene
Butadiene	Vinyl acetylene
Chloroprene	Vinyl acetate
Chlorotrifluoroethylene	Vinyl chloride
Methyl methacrylate	Vinyl pyridine

* Under storage conditions in the liquid state the peroxide-forming potential increases and certain of these monomers (especially butadiene, chloroprene, and tetrafluoroethylene) should be discarded after three months.

6.3.3 Detection of Peroxides

If there is any suspicion that peroxide is present, do not open the container or otherwise disturb the contents. Call CHO (x4019) for disposal. The container and its contents must be handled with extreme care. If solids, especially crystals, for example, are observed either in the liquid or around the cap, peroxides are most likely present.

If no peroxide is suspected but the chemical is a peroxide former, the chemical can be tested by the lab to ensure no peroxide has formed.

- Peroxide test strips, which change color to indicate the presence of peroxides, may be purchased through most laboratory reagent distributors. For proper testing, reference the manufacturer's instruction. Do not perform a peroxide test on outdated materials that potentially have dangerous levels of peroxide formation.

6.3.4 Removal of Peroxides

If peroxides are suspected, the safest route is to alert EHS for treatment and disposal of the material. Attempting to remove peroxides may be very dangerous under some conditions.

For more information:

- [Chemical Incompatibility Chart](#)
- [Chemical Reactivity Worksheet](#) - Excellent web-based database
- [Chemical Reactivity Hazards](#) - OSHA

Additional resources for chemicals that exhibit [explosive properties](#), [peroxide formation](#) and [container pressurization](#) hazards.

6.4 Compressed Gases

Compressed gases can be toxic, flammable, oxidizing, corrosive, inert or a combination of hazards. In addition to the chemical hazards, compressed gases may be under a great deal of pressure. The amount of energy in a compressed gas cylinder makes it a [potential rocket](#). Appropriate care in the handling and storage of compressed gas cylinders is essential.



6.4.1 Hazards

The following is an overview of the hazards to be avoided when handling and storing compressed gases:

- **Asphyxiation:** Simple asphyxiation is the primary hazard associated with *inert gases*. Because inert gases are colorless and odorless, they can escape into the atmosphere undetected and quickly reduce the concentration of oxygen below the level necessary to support life. The use of oxygen monitoring equipment is strongly recommended for enclosed areas where inert gases are being used.
- **Fire and Explosion:** Fire and explosion are the primary hazards associated with *flammable gases, oxygen and other oxidizing gases*. Flammable gases can be ignited by static electricity or by a heat source, such as a flame or a hot object. [Oxygen](#) and other oxidizing gases do not burn, but will support combustion of organic materials. Increasing the concentration of an oxidizer accelerates the rate of combustion. Materials that are nonflammable under normal conditions may burn in an oxygen-enriched atmosphere.
- **Chemical Burns:** *Corrosive gases can chemically attack various materials, including fire-resistant clothing*. Some gases are not corrosive in their pure form, but can become extremely destructive if a small amount of moisture is added. Corrosive gases can cause rapid destruction of skin and eye tissue.
- **Chemical Poisoning:** Chemical poisoning is the primary hazard of *toxic gases*. Even in very small concentrations, brief exposure to these gases can result in serious poisoning injuries. Symptoms of exposure may be delayed.

- **High Pressure:** All compressed gases are potentially hazardous because of the high pressure stored inside the cylinder. [A sudden release of pressure can cause injuries and property damage by propelling a cylinder or whipping a line.](#)
- **Cylinder Weight:** A full size cylinder may weigh more than 130 pounds. Moving a cylinder manually may lead to back or muscle injury. Dropping or dragging a cylinder could cause serious injury.

6.4.2 Handling Precautions and list of gases that Require Special Handling

- **Avoid dropping, dragging or sliding cylinders.** Use a suitable hand truck or cart equipped with a chain or belt for securing the cylinder to the cart, even for short distances.
- **Do not permit cylinders to strike each other violently.** Cylinders should not be used as rollers for moving material or other equipment.
- **Cylinder caps should be left on each cylinder until it has been secured against a wall or bench or placed in a cylinder stand, and is ready for installation of the regulator.** Cylinder caps protect the valve on top of the cylinder from damage if knocked.



- **Never tamper with pressure relief devices in valves or cylinders.**
- **Use only wrenches or tools provided by the cylinder supplier to remove a cylinder cap or to open a valve. Never use a screwdriver or pliers.**
- **Keep the cylinder valve closed except when in use.**
- **Position cylinders so that the cylinder valve is accessible at all times.**
- **Use compressed gases only in a well-ventilated area.** Toxic, flammable and corrosive gases should be carefully handled in a hood or gas cabinet. Proper containment systems should be used and minimum quantities of these products should be kept on-site.
- **When discharging gas into a liquid, a trap or suitable check valve should be used to prevent liquid from getting back into the cylinder or regulator.**
- **Where more than one type of gas is in use, label gas lines.** This is particularly important when the gas supply is not in the same room or area as the operation using the gases.
- **Do not use the cylinder valve itself to control flow by adjusting the pressure.**

Gases Requiring Special Handling

The following gases present special hazards either due to their toxicity or physical properties. Review this information before using these gases.

- [Acetylene](#)
- [Arsine](#)
- [Boron Trifluoride](#)
- [Diborane](#)
- [Ethylene Oxide](#)
- [Fluorine](#)
- [Germane](#)
- [Hydrogen Cyanide](#)
- [Germane](#)
- [Oxygen](#)

- [Phosgene](#)
- [Silane](#)

6.4.3 Storage of Compressed Gas Cylinders

- All cylinders must be secured to a wall, bench or fixed support using a chain or strap placed 2/3 of the way up. Cylinder stands are an alternative to straps.
- Cylinders shall be strapped individually.
- Cylinders should not be stored with a regulator attached. Secure the proper gas cap to the threaded portion on the top of the cylinder to protect the valve.*
- Do not store full and empty cylinders together.
- Oxidizers and flammable gases should be stored in areas separated by at least 20 feet or by a noncombustible wall.
- Cylinders should not be stored near radiators or other heat sources. If storage is outdoors, protect cylinders from weather extremes and damp ground to prevent corrosion.
- No part of a cylinder should be subjected to a temperature higher than 125°F. A flame should never be permitted to come in contact with any part of a compressed gas cylinder.
- Do not place cylinders where they may become part of an electric circuit.
- Keep the number of cylinders in a laboratory to a minimum to reduce the fire and toxicity hazards.
- Lecture bottles should always be returned to the distributor or manufacturer promptly when no longer needed or discarded if at atmospheric pressure.
- Ensure that the cylinder is properly and prominently labeled as to its contents.
- NEVER place acetylene cylinders on their side.

*Air Liquide offers a [new type of valve protection device](#) that remains permanently attached and still allows access to the main valve. See [Air Liquide](#) for more information.

6.4.4 Using Compressed Gas Cylinders



Before using cylinders, read all label information and [safety data sheets](#) (SDSs) associated with the gas being used. The cylinder valve outlet connections are designed to prevent mixing of incompatible gases. The outlet threads vary in diameter; some are internal and some are external; some are right-handed and some are left-handed. Generally, right-handed threads are used for fuel gases.

To set up and use the cylinder, follow these steps:

1. Attach the closed regulator to the cylinder. Never open the cylinder valve unless the regulator is completely closed. Regulators are specific to the gas involved. A regulator should be attached to a cylinder without forcing the threads. Ensure the threads of both the regulator and main valve are clean. If the inlet of a regulator does not fit the cylinder outlet, no effort should be made to try to force the fitting. A poor fit may indicate that the regulator is not intended for use on the gas chosen.

2. Turn the delivery pressure adjusting screw counter-clockwise until it turns freely. This prevents unintended gas flow into the regulator.
3. Open the cylinder slowly until the inlet gauge on the regulator registers the cylinder pressure. If the cylinder pressure reading is lower than expected, the cylinder valve may be leaking.
4. With the flow control valve at the regulator outlet closed, turn the delivery pressure adjusting screw clockwise until the required delivery pressure is reached.
5. Check for leaks using *Snoop* or soap solution. At or below freezing temperatures, use a glycerin and water solution, such as *Snoop*, rather than soap. Never use an open flame to detect leaks.
6. When finished with the gas, close the cylinder valve, release the regulator pressure and replace the gas cap if it will not be used in the near future.

6.4.5 Assembly of Equipment and Piping

- Do not force threads that do not fit exactly.
- Use Teflon tape or thread lubricant for assembly. Teflon tape should only be used for tapered pipe thread, not straight lines or metal-to-metal contacts.
- Avoid sharp bends of copper tubing. Copper tubing hardens and cracks with repeated bending.
- Inspect tubing frequently and replace when necessary.
- Tygon and plastic tubing are not appropriate for most pressure work. These materials can fail under pressure or thermal stress.
- Do not mix different brands and types of tube fittings. Construction parts are usually not interchangeable.
- Do not use oil or lubricants on equipment used with [oxygen](#).
- Do not use copper piping for [acetylene](#).
- Do not use cast iron piping for [chlorine](#).

6.4.6 Leaking Cylinders

Most leaks occur at the valve in the top of the cylinder and may involve the valve threads valve stem, valve outlet, or pressure relief devices. Lab personnel should not attempt to repair leaking cylinders.



Where action can be taken without serious exposure to lab personnel:

1. Move the cylinder to an isolated, well-ventilated area (away from combustible materials if the cylinder contains a flammable or oxidizing gas).
2. Contact [Public Safety](#) at 911 or CHO at (920) 850-7261.

	Whenever a large or uncontrollable leak occurs, evacuate the area and immediately contact Public Safety at 911 or CHO at (920) 850-7261.
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6.4.7 Empty Cylinders

- Remove the regulator and replace the cylinder cap.
- Mark the cylinder as "empty" or "MT" and store in a designated area for return to the supplier.
- Do not store full and empty cylinders together.
- Do not have full and empty cylinders connected to the same manifold. Reverse flow can occur when an empty cylinder is attached to a pressurized system.
- Do not refill empty cylinders. Only the cylinder supplier should refill gases.
- Do not empty cylinders to a pressure below 25 psi (172 Kpa). The residual contents may become contaminated with air.
- Lecture bottles should always be returned to the distributor or manufacturer promptly when no longer needed. Do not purchase lecture bottles that cannot be returned.

6.4.8 Flammable Gases

- **Keep sources of ignition away from the cylinders.**
- Oxidizers and flammable gases should be stored in areas separated by at least 20 feet or by a non-combustible wall.
- Bond and ground all cylinders, lines and equipment used with flammable compressed gases.

6.4.9 Highly Toxic Gases (Not Used at St. Norbert College)

Highly toxic gases, such as [arsine](#), [boron trifluoride](#), [diborane](#), [ethylene oxide](#), [fluorine](#), [germane](#), [hydrogen cyanide](#), [phosgene](#), and [silane](#), can pose a significant health risk in the event of a leak. Use of these materials requires written approval by the Principal Investigator or supervisor, using the *Particularly Hazardous Substances Use Approval* form, and the Chemical Hygiene Officer (CHO).

The following additional precautions must be taken:

- Use and store in a specially ventilated gas cabinet or fume hood.
- Use coaxial (double walled) tubing with nitrogen between the walls for feed lines operating above atmospheric pressure.
- Regulators should be equipped with an automatic shut-off to turn off gas supply in the event of sudden loss of pressure in the supply line.
- An alarm system should be installed to check for leaks in routinely used gases with poor warning properties. The alarm level must be set at or lower than the permissible exposure limit of the substance.
- Self-contained breathing apparatus (SCBA) may be appropriate for changing cylinders of highly toxic gases. Use of an SCBA requires enrollment in the [Respiratory Protection Program](#) and annual training and fit-testing.

- Ensure storage and use areas are posted with [Designated Area](#) signage.

6.5 Cryogenics

Cryogenic liquids have boiling points less than -73°C (-100°F). Liquid nitrogen, liquid oxygen and carbon dioxide are the most common cryogenic materials used in the laboratory. Hazards may include fire, explosion, embrittlement, pressure buildup, frostbite and asphyxiation.

Many of the safety precautions observed for compressed gases also apply to cryogenic liquids. Two additional hazards are created from the unique properties of cryogenic liquids:

- **Extremely Low Temperatures** –The cold boil-off vapor of cryogenic liquids rapidly freezes human tissue. Most metals become stronger upon exposure to cold temperatures, but materials such as carbon steel, plastics and rubber become brittle or even fracture under stress at these temperatures. Proper material selection is important. Cold burns and frostbite caused by cryogenic liquids can result in extensive tissue damage.
- **Vaporization - All cryogenic liquids produce large volumes of gas when they vaporize.** Liquid nitrogen will expand 696 times as it vaporizes. The expansion ratio of argon is 847:1, hydrogen is 851:1 and oxygen is 862:1. If these liquids vaporize in a sealed container, they can produce enormous pressures that could rupture the vessel. (See [Anecdotes](#) for an account of such an incident.) For this reason, pressurized cryogenic containers are usually protected with multiple pressure relief devices.
Vaporization of cryogenic liquids (except oxygen) in an enclosed area can cause asphyxiation. Vaporization of liquid oxygen can produce an oxygen-rich atmosphere, which will support and accelerate the combustion of other materials. Vaporization of liquid hydrogen can form an extremely flammable mixture with air.

6.5.1 Handling Cryogenic Liquids (NMR Room – Liquid Nitrogen GMS 3038)

Most cryogenic liquids are odorless, colorless, and tasteless when vaporized. When cryogenic liquids are exposed to the atmosphere, the cold boil-off gases condense the moisture in the air, creating a highly visible fog.

- **Always handle these liquids carefully to avoid skin burns and frostbite.** Exposure that may be too brief to affect the skin of the face or hands may damage delicate tissues, such as the eyes.
- Boiling and splashing always occur when charging or filling a warm container with cryogenic liquid or when inserting objects into these liquids. Perform these tasks slowly to minimize boiling and splashing. Use tongs to withdraw objects immersed in a cryogenic liquid.

- **Never touch uninsulated pipes or vessels containing cryogenic liquids.** Flesh will stick to extremely cold materials. Even nonmetallic materials are dangerous to touch at low temperatures.
- **Use wooden or rubber tongs to remove small items from cryogenic liquid baths.** Cryogenic gloves are for indirect or splash protection only, they are not designed to protect against immersion into cryogenic liquids.
- Cylinders and [dewars](#) should not be filled to more than 80% of capacity, since expansion of gases during warming may cause excessive pressure buildup.
- Check cold baths frequently to ensure they are not plugged with frozen material.

6.5.2 Protective Clothing

Face shields worn with safety glasses or chemical splash goggles are recommended during transfer and handling of cryogenic liquids.

Wear loose fitting, dry, insulated cryogenic gloves when handling objects that come into contact with cryogenic liquids and vapor. Trousers should be worn on the outside of boots or work shoes.

6.5.3 Cooling Baths and Dry Ice

- Neither liquid nitrogen nor liquid air should be used to cool a flammable mixture in the presence of air, because oxygen can condense from the air, leading to an explosion hazard.
- Wear insulated, dry gloves and a face shield when handling dry ice.
- Add dry ice slowly to the liquid portion of the cooling bath to avoid foaming over. Do not lower your head into a dry ice chest, since suffocation can result from carbon dioxide buildup.

6.5.4 Liquid Nitrogen Cooled Traps

Traps that open to the atmosphere condense liquid air rapidly. If you close the system, pressure builds up with enough force to shatter glass equipment. Therefore, only sealed or evacuated equipment should use liquid nitrogen cooled traps.

6.6 Pressure/Vacuum Systems

Working with hazardous chemicals at high or low pressures requires planning and special precautions. Procedures should be implemented to protect against explosion or implosion through appropriate equipment selection and the use of safety shields. Care should be taken to select glass apparatus that can safely withstand designated pressure extremes.

6.6.1 High Pressure Vessels

- High-pressure operations should be performed only in pressure vessels appropriately selected for the operation, properly labeled and installed, and protected by pressure-relief and necessary control devices.
- Vessels must be strong enough to withstand the stresses encountered at the intended operating temperatures and pressures and must not corrode or otherwise react when in contact with the materials it contains.
- Systems designed for use at elevated temperatures should be equipped with a positive temperature controller. Manual temperature control using a simple variable autotransformer,

such as a Variac, should be avoided. The use of a back-up temperature controller capable of shutting the system down is strongly recommended.

- All pressure equipment should be inspected and tested at intervals determined by the severity of the equipment's usage. Visual inspections should be accomplished before each use.
- Hydrostatic testing should be accomplished before equipment is placed in initial service. Hydrostatic testing should be re-accomplished every ten years thereafter, after significant repair or modification, or if the vessel experiences overpressure or over temperature. Contact the CHO at 920.403.4019 for more information about hydrostatic testing.

6.6.2 Vacuum Apparatus

Vacuum work can result in an implosion and the possible hazards of flying glass, splattering chemicals and fire. All vacuum operations must be set up and operated with careful consideration of the potential risks. Equipment at reduced pressure is especially prone to rapid pressure. Such conditions can force liquids through an apparatus, sometimes with undesirable consequences.

- [Personal protective equipment](#), such as safety glasses with side shields or chemical goggles, face shields, and/or an explosion shield should be used to protect against the hazards of vacuum procedures, and the procedure should be carried out inside a hood.
- Do not allow water, solvents and corrosive gases to be drawn into vacuum systems. Protect pumps with cold traps and vent their exhaust into an exhaust hood.
- Assemble vacuum apparatus in a manner that avoids strain, particularly to the neck of the flask.
- Avoid putting pressure on a vacuum line to prevent stopcocks from popping out or glass apparatus from exploding.
- Place vacuum apparatus in such a way that the possibility of being accidentally hit is minimized. If necessary, place transparent plastic around it to prevent injury from flying glass in case of an explosion.
- When possible, avoid using mechanical vacuum pumps for distillation or concentration operations using large quantities of volatile materials. A water aspirator or steam aspirator is preferred. This is particularly important when large quantities of volatile materials are involved.

Vacuum Trapping

When using a vacuum source, it is important to place a trap between the experimental apparatus and the vacuum source. The vacuum trap

- **protects the pump and the piping from the potentially damaging effects of the material**
- **protects people who must work on the vacuum lines or system, and**
- **prevents vapors and related odors from being emitted back into the laboratory or system exhaust.**

There have been incidents at Princeton where improper trapping caused vapor to be emitted from the exhaust of the house vacuum system, resulting in either re-entry into the building or potential exposure to maintenance workers. Unfortunately, this type of incident is not the worst that can happen. In 2001,

at the University of California - Davis, two plumbers were injured when a house vacuum line burst after one of the plumbers attempted to solder a fitting on the copper line. Results of analysis found evidence of copper perchlorate (an oxidizer) and acetate, which created an explosive mixture upon heating by the torch.

Proper Trapping Techniques

To prevent contamination, all lines leading from experimental apparatus to the vacuum source should be equipped with filtration or other trapping as appropriate.

- For particulates, use filtration capable of efficiently trapping the particles in the size range being generated
- For most aqueous or non-volatile liquids, a filter flask at room temperature is adequate to prevent liquids from getting to the vacuum source.
- For solvents and other volatile liquids, use a cold trap of sufficient size and cold enough to condense vapors generated, followed by a filter flask capable of collecting fluid that could be aspirated out of the cold trap.
- For highly reactive, corrosive or toxic gases, use a sorbent canister or scrubbing device capable of trapping the gas.

Cold Traps

For most volatile liquids, a cold trap using a slush of dry ice and either isopropanol or ethanol is sufficient (to -78 deg. C). Avoid using acetone. Ethanol and isopropanol are cheaper and less likely to foam.

Liquid nitrogen may only be used with sealed or evacuated equipment, and then only with extreme caution. If the system is opened while the cooling bath is still in contact with the trap, oxygen may condense from the atmosphere and react vigorously with any organic material present.

6.6.3 Glass Vessels

Although glass vessels are frequently used in pressure and vacuum systems, they can explode or implode violently, either spontaneously from stress failure or from an accidental blow. See [Anecdotes](#) for descriptions of some of these incidents.

- Conduct pressure and vacuum operations in glass vessels behind adequate shielding.
- Ensure the glass vessel is designed for the intended operation.
- **Carefully check glass vessels for star cracks, scratches or etching marks before each use.** Cracks can increase the likelihood of breakage or may allow chemicals to leak into the vessel.
- Seal glass centrifuge tubes with rubber stoppers clamped in place. Wrap the vessel with friction tape and shield with a metal screen. Alternatively, wrap with friction tape and surround the vessel with multiple layers of loose cloth, then clamp behind a safety shield.
- Glass tubes with high-pressure sealers should be no more than 3/4 full.
- Sealed bottles and tubes of flammable materials should be wrapped in cloth, placed behind a safety shield, then cooled slowly, first with an ice bath, then with dry ice.
- Never rely on corks, rubber stoppers or plastic tubing as pressure-relief devices.

- Glass vacuum dessicators should be made of Pyrex or similar glass and wrapped partially with friction tape to guard against flying glass. Plastic dessicators are a good alternative to glass, but still require shielding.
- Never carry or move an evacuated dessicator.

6.6.4 Dewar Flasks

Dewar flasks are under vacuum to provide insulation and can collapse from thermal shock or slight mechanical shock.

- Shield flasks with friction tape or enclose in a wooden or metal container to reduce the risk of flying glass.
- Use metal flasks if there is a significant possibility of breakage.
- Styrofoam buckets offer a short-term alternative to dewar flasks.

6.6.5 Rotovaps

Rotovaps can implode under certain conditions. Since some Rotovaps contain components made of glass, this can be a serious hazard. See [Rotary Evaporators](#) for more information about their safe handling.

6.7 Electrical Safety

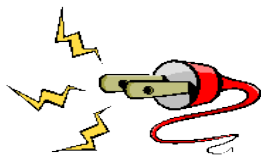
Electrically powered equipment, such as hot plates, stirrers, vacuum pumps, electrophoresis apparatus, lasers, heating mantles, ultrasonicators, power supplies, and microwave ovens are essential elements of many laboratories. These devices can pose a significant hazard to laboratory workers, particularly when mishandled or not maintained. Many laboratory electrical devices have high voltage or high power requirements, carrying even more risk. Large capacitors found in many laser flash lamps and other systems are capable of storing lethal amounts of electrical energy and pose a serious danger even if the power source has been disconnected.

Accounts of incidents on campus that resulted in electrical shock, including a near fatal incident, are described in [Anecdotes](#).

6.7.1 Electrical Hazards

The major hazards associated with electricity are electrical shock and fire. Electrical shock occurs when the body becomes part of the electric circuit, either when an individual comes in contact with both wires of an electrical circuit, one wire of an energized circuit and the ground, or a metallic part that has become energized by contact with an electrical conductor.

The severity and effects of an electrical shock depend on a number of factors, such as the pathway through the body, the amount of current, the length of time of the exposure, and whether the skin is wet



or dry. Water is a great conductor of electricity, allowing current to flow more easily in wet conditions and through wet skin. The effect of the shock may range from a slight tingle to severe burns to cardiac arrest. The chart below shows the general relationship between the degree of injury and amount of current for a 60-cycle hand-to-foot path of one second's duration of shock. While reading this chart, keep in mind that most electrical circuits can provide, under normal conditions, up to 20,000 milliamperes of current flow

Current	Reaction
1 Milliampere	Perception level
5 Milliamperes	Slight shock felt; not painful but disturbing
6-30 Milliamperes	Painful shock; "let-go" range
50-150 Milliamperes	Extreme pain, respiratory arrest, severe muscular contraction
1000-4,300 Milliamperes	Ventricular fibrillation
10,000+ Milliamperes	Cardiac arrest, severe burns and probable death

In addition to the electrical shock hazards, sparks from electrical equipment can serve as an ignition source for flammable or explosive vapors or combustible materials. See [Anecdotes](#).

Power Loss

Loss of electrical power can create hazardous situations. Flammable or toxic vapors may be released as a chemical warms when a refrigerator or freezer fails. Fume hoods may cease to operate, allowing vapors to be released into the laboratory. If magnetic or mechanical stirrers fail to operate, safe mixing of reagents may be compromised.

6.7.2 Preventing Electrical Hazards

There are various ways of protecting people from the hazards caused by electricity, including insulation, guarding, grounding, and electrical protective devices. Laboratory workers can significantly reduce electrical hazards by following some basic precautions:

- Inspect wiring of equipment before each use. Replace damaged or frayed electrical cords immediately.
- Use [safe work practices](#) every time electrical equipment is used.
- Know the location and how to operate shut-off switches and/or circuit breaker panels. Use these devices to shut off equipment in the event of a fire or electrocution.
- Limit the use of extension cords. Use only for temporary operations and then only for short periods of time. In all other cases, request installation of a new electrical outlet.

- **Multi-plug adapters must have circuit breakers or fuses.**
- **Place exposed electrical conductors (such as those sometimes used with electrophoresis devices) behind shields.**
- **Minimize the potential for water or chemical spills on or near electrical equipment.**

Insulation

All electrical cords should have sufficient insulation to prevent direct contact with wires. In a laboratory, it is particularly important to check all cords before each use, since corrosive chemicals or solvents may erode the insulation.

Damaged cords should be repaired or taken out of service immediately, especially in wet environments such as cold rooms and near water baths.

Guarding

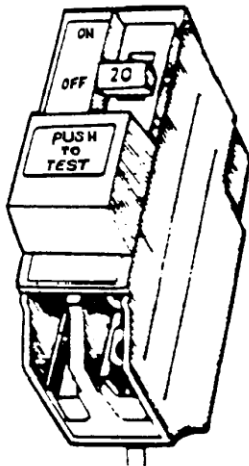
Live parts of electric equipment operating at 50 volts or more (i.e., electrophoresis devices) must be guarded against accidental contact. Plexiglas shields may be used to protect against exposed live parts.

Grounding



Only equipment with three-prong plugs should be used in the laboratory. The third prong provides a path to ground for internal electrical short circuits, thereby protecting the user from a potential electrical shock.

Circuit Protection Devices



Circuit protection devices are designed to automatically limit or shut off the flow of electricity in the event of a ground-fault, overload or short circuit in the wiring system. Ground-fault circuit interrupters, circuit breakers and fuses are three well-known examples of such devices.

Fuses and circuit breakers prevent over-heating of wires and components that might otherwise create fire hazards. They disconnect the circuit when it becomes overloaded. This overload protection is very useful for equipment that is left on for extended periods of time, such as stirrers, [vacuum pumps](#), drying ovens, Variacs and other electrical equipment.

The ground-fault circuit interrupter, or GFCI, is designed to shutoff electric power if a ground fault is detected, protecting the user from a potential electrical shock. The GFCI is particularly useful near sinks and wet locations. Since GFCIs can cause equipment to shutdown unexpectedly, they may not be appropriate for certain apparatus. Portable GFCI adapters (available in most safety supply catalogs) may be used with a non-GFCI outlet.

Motors

In laboratories where volatile [flammable materials](#) are used, motor-driven electrical equipment should be equipped with non-sparking induction motors or air motors. These motors must meet National Electric Safety Code (US DOC, 1993) Class 1, Division 2, Group C-D explosion resistance specifications. Many stirrers, Variacs, outlet strips, ovens, heat tape, hot plates and heat guns do not conform to these code requirements.

Avoid series-wound motors, such as those generally found in some vacuum pumps, rotary evaporators and stirrers. Series-wound motors are also usually found in household appliances such as blenders, mixers, vacuum cleaners and power drills. These appliances should not be used unless flammable vapors are adequately controlled.

Although some newer equipment have spark-free induction motors, the on-off switches and speed controls may be able to produce a spark when they are adjusted because they have exposed contacts. One solution is to remove any switches located on the device and insert a switch on the cord near the plug end.

6.7.3 Safe Work Practices

The following practices may reduce risk of injury or fire when working with electrical equipment:

- **Avoid contact with energized electrical circuits.**
- **Use guarding around exposed circuits and sources of live electricity.**
- **Disconnect the power source before servicing or repairing electrical equipment.**
- **When it is necessary to handle equipment that is plugged in, be sure hands are dry and, when possible, wear nonconductive gloves and shoes with insulated soles.**
- **If it is safe to do so, work with only one hand, keeping the other hand at your side or in your pocket, away from all conductive material. This precaution reduces the likelihood of accidents that result in current passing through the chest cavity.**
- **Minimize the use of electrical equipment in cold rooms or other areas where condensation is likely. If equipment must be used in such areas, mount the equipment on a wall or vertical panel.**
- **If water or a chemical is spilled onto equipment, shut off power at the main switch or circuit breaker and unplug the equipment.**
- **If an individual comes in contact with a live electrical conductor, do not touch the equipment, cord or person. Disconnect the power source from the circuit breaker or pull out the plug using a leather belt.**

6.7.4 High Voltage or Current

Repairs of high voltage or high current equipment should be performed only by trained electricians. Laboratory workers who are experienced in such tasks and would like to perform such work on their own laboratory equipment must first receive specialized [electrical safety related work practices training](#) by the Chemical Hygiene Officer (CHO). Contact Mark Musser at 920.403.4019 for more information.

6.7.5 Altering Building Wiring and Utilities

Any modifications to existing electrical service in a laboratory or building must be completed or approved by either the building facility manager, an engineer from the Facilities department or the building's Special Facilities staff. All modifications must meet both safety standards and Facilities Engineering design requirements.

Any unapproved laboratory facilities modifications discovered during laboratory surveys or other activities are reviewed by EHS and facility staff to determine whether they meet design specifications.

6.8 Gehl-Mulva Science Center Floor Plans

7.0 Definitions

Definitions --

Action level means a concentration designated in 29 CFR part 1910 for a specific substance, calculated as an eight (8)-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

Assistant Secretary means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

Carcinogen (*see select carcinogen*).

Chemical Hygiene Officer means an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organizational structure.

Chemical Hygiene Plan means a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that (i) are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace and (ii) meets the requirements of paragraph (e) of this section.

Combustible liquid means any liquid having a flashpoint at or above 100 deg. F (37.8 deg. C), but below 200 deg. F (93.3 deg. C), except any mixture having components with flashpoints of 200 deg. F (93.3 deg. C), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

Compressed gas means:

(i) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 deg. F (21.1 deg. C); or

(ii) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 deg. F (54.4 deg. C) regardless of the pressure at 70 deg. F (21.1 deg. C); or

(iii) A liquid having a vapor pressure exceeding 40 psi at 100 deg. F (37.8 C) as determined by ASTM D-323-72.

Designated area means an area which may be used for work with "select carcinogens," reproductive toxins or substances which have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of a laboratory or a device such as a laboratory hood.

Emergency means any occurrence such as, but not limited to, equipment failure, rupture of containers or failure of control equipment which results in an uncontrolled release of a hazardous chemical into the workplace.

Employee means an individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.

Explosive means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

Flammable means a chemical that falls into one of the following categories:

(i) **Aerosol, flammable** means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame protection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;

(ii) **Gas, flammable** means:

(A) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less; or

(B) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit.

(iii) **Liquid, flammable** means any liquid having a flashpoint below 100 deg. F (37.8 deg. C), except any mixture having components with flashpoints of 100 deg. C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.

(iv) **Solid, flammable** means a solid, other than a blasting agent or explosive as defined in § 1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

Flashpoint means the minimum temperature at which a liquid gives off a vapor in sufficient

concentration to ignite when tested as follows:

(i) Tagliabue Closed Tester (See American National Standard Method of Test for Flash Point by Tag Closed Tester, Z11.24 - 1979 (ASTM D 56-79)) - for liquids with a viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100 deg. F (37.8 deg. C), that do not contain suspended solids and do not have a tendency to form a surface film under test; or

(ii) Pensky-Martens Closed Tester (See American National Standard Method of Test for Flashpoint by Pensky-Martens Closed Tester, Z11.7 - 1979 (ASTM D 93-79)) - for liquids with a viscosity equal to or greater than 45 SUS at 100 deg. F (37.8 deg. C), or that contain suspended solids, or that have a tendency to form a surface film under test; or

(iii) Setaflash Closed Tester (see American National Standard Method of test for Flash Point by Setaflash Closed Tester (ASTM D 3278-78)).

Organic peroxides, which undergo autoaccelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.

Hazardous chemical means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

Appendices A and B of the Hazard Communication Standard (29 CFR 1910.1200) provide further guidance in defining the scope of health hazards and determining whether or not a chemical is to be considered hazardous for purposes of this standard.

Laboratory means a facility where the "laboratory use of hazardous chemicals" occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

Laboratory scale means work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials.

Laboratory-type hood means a device located in a laboratory, enclosure on five sides with a movable sash or fixed partial enclosed on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.

Walk-in hoods with adjustable sashes meet the above definition provided that the sashes are adjusted during use so that the airflow and the exhaust of air contaminants are not compromised and employees do not work inside the enclosure during the release of airborne hazardous chemicals.

Laboratory use of hazardous chemicals means handling or use of such chemicals in which all of the following conditions are met:

- (i) Chemical manipulations are carried out on a "laboratory scale;"
- (ii) Multiple chemical procedures or chemicals are used;
- (iii) The procedures involved are not part of a production process, nor in any way simulate a production process; and
- (iv) "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

Medical consultation means a consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

Organic peroxide means an organic compound that contains the bivalent -O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

Oxidizer means a chemical other than a blasting agent or explosive as defined in § 1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

Physical hazard means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer pyrophoric, unstable (reactive) or water-reactive.

Protective laboratory practices and equipment means those laboratory procedures, practices and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.

Reproductive toxins means chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

Select carcinogen means any substance which meets one of the following criteria:

- (i) It is regulated by OSHA as a carcinogen; or
- (ii) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP)(latest edition); or
- (iii) It is listed under Group 1 ("carcinogenic to humans") by the International Agency for research on Cancer Monographs (IARC)(latest editions); or
- (iv) It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be

carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

(A) After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m³;

(B) After repeated skin application of less than 300 (mg/kg of body weight) per week; or

(C) After oral dosages of less than 50 mg/kg of body weight per day.

Unstable (reactive) means a chemical which is the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.

Water-reactive means a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

Appendix A. Particularly Hazardous Substances (Using examples from Princeton University EHS website)

Particularly hazardous substances are defined to include select carcinogens, reproductive toxins and substances that have a high degree of acute toxicity (such as cyanides and dimethyl mercury).

Select carcinogens include any substance that is included on any of the following lists of carcinogens:

[OSHA Carcinogen List](#)

[Annual Report on Carcinogens](#) published by the National Toxicology Program (NTP), including all of the substances listed as "known to be carcinogens" and some substances listed as "reasonably anticipated to be carcinogens"

[International Agency for Research on Cancer](#) (IARC), including all of Group 1 "carcinogen to humans" and some in Group 2A or 2B, "reasonably anticipated to be carcinogens"

[Reproductive toxin](#) includes any chemical that may affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

[High acute toxicity](#) includes any chemical that falls within any of the following categories:

- A chemical with a median lethal dose (LD₅₀) of 50 mg or less per kg of body weight when administered orally to certain test populations
- A chemical with an LD₅₀ of 200 mg or less per kg of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) to certain test populations
- A chemical with a median lethal concentration (LC₅₀) in air of 200 parts per million (ppm) by volume or less of gas or vapor, or 2 mg per liter or less of mist, fume, or dust, when administered to certain test populations by continuous inhalation for one hour, provided such concentration and/or condition are likely to be encountered by humans when the chemical is used in any reasonably foreseeable manner.

A list of the more commonly used particularly hazardous substances is available in the [Laboratory Safety Manual](#), however, this list is not exhaustive. Consult the product SDS or contact EHS for assistance in determining whether a substance is classified as particularly hazardous.

Before using a particularly hazardous substance, an individual must:

1. Complete a *Particularly Hazardous Substance Use Approval Form*. This form is available from mark.musser@snc.edu or can be [downloaded](#).
2. Submit the completed form to their supervisor or Principal Investigator for approval.
3. Submit the approved form to the departmental Chemical Hygiene Officer for his or her approval.
4. Post the area where the substance will be used with a *Designated Area* sign, available from the departmental Chemical Hygiene Officer or can be [downloaded](#).
5. Follow the procedures outlined in the approved form and in the *Laboratory Safety Manual*.

The *Particularly Hazardous Substance Use Approval Form* provides documentation of the specific standard operating procedure for use of the substance. These procedures include the use of containment devices and personal protective equipment, decontamination procedures and procedures for safe removal of contaminated waste.