DEPAUL UNIVERSITY

Chemical Hygiene Plan

Environmental Health & Safety

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This plan was developed using best practice examples from the University of Iowa and Princeton University as well as Federal and State regulations and guidance documents.

1. INTRODUCTION

1.1 PURPOSE

DePaul is committed to providing a safe laboratory environment for its faculty, staff, students and visitors. The goal of the Chemical Hygiene Plan (CHP) is to minimize the risk of injury or illness to laboratory users by ensuring they have the training, information, support and equipment needed to work safely with hazardous chemicals.

1.2 SCOPE AND APPLICATION

The CHP is intended to meet the requirements of OSHA's Lab Standard (29 CFR 1910.1450). This standard regulates the laboratory use of hazardous chemicals in order to protect the health and safety of employees.

The CHP applies to all University laboratory functions involving hazardous chemicals, and applies to DePaul students as well as employees.

OSHA's Lab Standard does not cover the treatment or disposal of hazardous waste, therefore neither does the CHP except as it pertains to general practices for safe handling of hazardous chemicals. Please refer to the Waste Disposal Guide for more information.

1.3 PLAN AVAILABILITY, REVIEW AND UPDATE

The CHP is available online at ehs.depaul.edu.

At least annually, the CHP is evaluated by EHS. Input from the Dean of the College of Science and Health, department chairs, laboratory coordinators, and other appropriate personnel (e.g., Facility Operations) is encouraged to assess the plan's continued effectiveness and identify areas where updates or improvements are needed.

For each laboratory where hazardous chemicals are used or stored, the PI or instructor should review the CHP and laboratory specific materials for adequateness annually and whenever the nature of the work changes (e.g. change in chemicals, chemical amounts, facilities, etc.).

2. ROLES AND RESPONSIBLITIES

2.1 UNIVERSITY ADMINISTRATION

The University administration has overall responsibility for instituting policies and programs, establishing systems, and providing resources to help ensure that research and teaching activities involving hazardous chemicals are conducted in a responsible manner and in accordance with all applicable requirements. While the University President has ultimate responsibility for the CHP and shall, with other administrators provide continuing support for the CHP, certain responsibilities have been delegated as outlined below.

2.2 DEAN AND DEPARTMENT CHAIRS

The Dean of the College of Science and Health and department chairs are responsible for providing the resources and leadership necessary to ensure that the CHP is carried out within their units. They carry out the responsibilities of the departmental chemical hygiene officer or otherwise delegate the authority to carry out those tasks to someone within the department (e.g., laboratory coordinators).

2.3 ENVIRONMENTAL HEALTH & SAFETY (EHS)

EHS provides training, resources and consultation for a variety of laboratory safety issues, including chemical safety as well as biological safety, laser safety, radiation safety and other topics. The Senior EHS Analyst serves as the Chemical Hygiene Officer.

EHS responsibilities include:

- Facilitate and maintain documentation of lab safety training for affected faculty, staff and students.
- Assist in selecting and verifying adequacy of protective measures. Help ensure that personal protective equipment (PPE) is available and serviceable.
- Monitor the storage, distribution, use and disposal of hazardous chemicals.
- Perform audits and inspections of facilities, procedures and practices to ensure compliance with the CHP and related regulations.
- Remain knowledgeable to current and future legal requirements and other best business practices related to chemical hygiene.
- Work with administrators, faculty and staff to implement, review and update the CHP.

2.4 PRINCIPAL INVESTIGATORS (PIs) AND INSTRUCTORS

PI and instructor responsibilities include:

- Implement appropriate safe work practices and procedures for all laboratory activities.
- Monitor safe behavior in the laboratory.
- Ensure that students and laboratory staff know and carry out proper practices for complying with the CHP.
- Ensure that any required PPE is available and serviceable.
- Seek assistance from EHS where necessary for planned changes in laboratory materials or

processes.
- Ensure all incidents that occur in laboratories are reported to EHS and/or Public Safety in accordance with Section 10: Reporting Requirements.

Teaching assistants (TAs) are responsible for assisting instructors in meeting the above responsibilities.

2.5 LABORATORY WORKERS

Responsibilities for all individuals working in a laboratory include:

- Know and observe the safe work practices and procedures outlined in the CHP.
- Observe all safety instructions given by the PI, instructor and/or TA, and observe all reasonable precautions to ensure that every laboratory operation is performed safely.
- Report unsafe conditions or other safety concerns to the PI, instructor and/or TA (e.g., faulty hoods, missing or damaged fire prevention equipment, unsafe storage of hazardous chemicals, etc.).
- Follow instructions on warning signs and labels.
- Follow emergency procedures and respond to alarms in an appropriate manner.
- Immediately report any spill, possible exposure, or other laboratory incident to the PI or instructor.

2.6 DEPARTMENT LABORATORY COORDINATORS

Department laboratory coordinators are responsible for managing the chemical inventory process within each department and acting as a liaison between the department and EHS where necessary.

2.7 LABORATORY VISITORS

Visitors and contractors who enter laboratory spaces on campus are responsible for meeting any minimum requirements for entry posted on the laboratory door (e.g., no eating/drinking, proper laboratory attire, etc.) and observing all warning signs and other instructions. Visitors and contractors must immediately report any incident that occurs in a laboratory, and should never attempt to conduct tasks that they are not trained and authorized to perform.

Any minors allowed in laboratories at the discretion of the PI must be accompanied and supervised at all times. Minors should not be present in a laboratory while hazardous operations are in process.

Where visiting scientists will be conducting work in a laboratory, the host PI is responsible for ensuring that the visitor has the appropriate training, is oriented to relevant University and laboratory-specific CHP requirements and emergency procedures, and that the laboratory operations to be conducted do not present an increased risk to the University and laboratory/building occupants. Each host PI is encouraged to contact EHS in advance of a visiting scientist's arrival on campus to ensure that all CHP requirements are met and that safety procedures are adequate for the planned laboratory activities.

2.7.1 SERVICE ANIMALS

Animals are not permitted in laboratories, with the exception of service animals (limited to dogs and miniature horses). If a student brings a service animal to a lab session, instructors should ask them privately to display their Service Animal Card issued by the Center for Students with Disabilities (CSD) and/or check the student's accommodations available on Campus Connect (Self Service > Faculty Center > Instructor Resources > Students with Disabilities > Student Accommodations tab). If these cannot be verified, refer the student to CSD.

DePaul reserves the right to restrict the presence of service animals in certain laboratories for which it would be unsafe for them to be. Reasonable accommodations will be provided to ensure that individuals requiring animals have equal access to the programs or activities taking place in these areas.

Please refer to the Service Animals and Assistance Animals on Campus policy and contact the Center for Students with Disabilities for assistance.

3. HAZARD IDENTIFICATION, EVALUATION AND CONTROL

3.1 HAZARD IDENTIFICATION

The hazards of laboratory chemicals can be determined by referring to information provided on the manufacturer's label and Safety Data Sheet (SDS). The ability to recognize the signs and symptoms of chemical exposure is important so that if adverse effects do arise despite the precautions taken to avoid exposure, those effects can be recognized early with the appropriate action taken.

3.2 EMPLOYEE EXPOSURE DETERMINATION

DePaul is required to ensure that employee exposures do not exceed permissible exposure limits (PELs). The use of properly operating fume hoods is expected to minimize exposure to airborne chemicals in the laboratory, supplemented by the use of appropriate PPE. Where necessary, industrial hygiene assessment techniques will be used to evaluate potential exposures and control measures.

If any University personnel has reason to believe that exposure to any substance routinely exceeds the action level (or in the absence of an action level, the PEL), EHS will arrange for an evaluation of the employee(s)' (or students') exposures, using qualitative exposure assessment and quantitative monitoring techniques as appropriate. EHS, with input from the Dean of the College of Science and Health and the Office of the General Counsel (OGC) will determine on a case by case basis the level of evidence needed to constitute a reason to believe that exposures routinely exceed permissible levels, or otherwise where additional evaluation or control is warranted.

3.2.1 MONITORING

Regular quantitative monitoring of airborne contaminants is usually not justified or practical in university laboratory settings. There may be some instances when air monitoring is justified (e.g., routine tasks involving volatile hazardous chemicals must be performed outside of fume hoods, where expressly required by regulation, etc.). EHS will arrange or conduct any exposure assessments and monitoring in accordance with the following provisions:

- If initial monitoring conducted under this scenario reveals that employee exposure exceeds the OSHA action level (or in the absence of an action level, the PEL), DePaul will investigate and implement appropriate controls to reduce employee exposures to an acceptable level.
- Periodic monitoring will be used to assess the effectiveness of the control measures and evaluate the level of employee exposures until they have reached acceptable levels.

3.2.2 EXPOSURE RECORDS

Within 15 working days after the receipt of any monitoring results, EHS will notify the affected employee(s) of the results in writing either individually or by posting results in an appropriate location accessible to employees.

For each employee, EHS will establish and maintain an accurate record of any measurements taken to monitor employee exposures. These records will be kept, transferred and made available in accordance with OSHA requirements for exposure records (29 CFR 1910.1020).

3.3 EXPOSURE CONTROL METHODS

A critical method for control of hazardous chemicals in the laboratory is through facility design and the use of engineering controls such as fume hoods. Other exposure control methods may include safe work practices, training, and PPE. The following hierarchy of controls will be applied to the extent feasible or practical:

- Elimination of material/process
- Substitution of less hazardous material/process
- Engineering controls
- Administrative controls
- PPE

Selection of the necessary exposure control methods will be based on: knowledge of the material properties and conditions of use (e.g., quantity and physical form, area of use, potential for vapors or aerosols); results from any industrial hygiene exposure assessments conducted, as well as laboratory inspections and audits; and specific measures specified within this plan, within other University policies or procedures, or by the PI or instructor.

Additional measures are required for particularly hazardous substances. See Section 8.5.1 for more information.

3.3.1 LABORATORY FACILITIES

- **Design.** Planning committees must take prudent measures in designing for safety and health controls when planning future laboratory facilities or the renovation of existing facilities.
- **Maintenance.** Routine maintenance is essential to maintaining safe laboratory facilities. Most maintenance functions both routine and non-routine are coordinated by Facility Operations.
- **Usage.** All laboratory facilities have limitations and no one laboratory can meet the requirements of all research or instructional work. Laboratory facilities at DePaul University are generally intended for educational and smaller scale research type operations and may not be suitable for some processes. Whenever there is a doubt to the suitability of a laboratory for a specific procedure, consult with Facility Operations and EHS.
- **Ventilation.** A properly functioning ventilation system is critical in protecting laboratory occupants' health and safety, as well as maintaining general comfort. Laboratory ventilation systems should meet or exceed ANSI/AIHA Z9.5 standards.
    - The laboratory should be maintained under negative pressure in relation to adjoining non- laboratory areas. All air from laboratories should be exhausted outdoors. It should not be re- circulated in the ventilation system. The general ventilation system should provide adequate make up air for fume hood exhaust. General air flow should not be turbulent, as this may negatively affect the capture efficacy of the fume hoods.
    - The fume hoods are designed to remove toxic or potentially harmful vapors, mists and fumes away from personnel breathing zones and out of the laboratory/building.
        - A minimum of one lab hood with 2.5 linear feet of hood space for every 2 persons must be provided.
        - Each hood should have a continual flow monitoring device.

- Fume hoods should be inspected for adequate face velocity and capture efficacy at least annually (ANSI/AIHA Z9.5).
- New fume hoods should be tested and certified for compliance with ANSI/ASHRAE 110.

Fume hoods (and any similar local exhaust ventilation systems) must be inspected, tested and maintained as part of a regular certification program. Facility Operations contracts with a vendor to conduct annual checks of fume hood performance. Fume hoods that pass the evaluation will be labeled with a fume hood certification sticker indicating the date of evaluation and/or the date the next evaluation is due.

The effectiveness of a fume hood is evaluated using face velocity measurements and alternate testing protocols. Since face velocity alone may not be an adequate measure of fume hood performance, an evaluation of the hood's ability to capture airborne contaminants should be qualitatively assessed using non-irritant smoke. Tracer gas studies to more rigorously assess fume hood performance will be conducted on an as needed basis as determined by EHS (e.g., upon commissioning; existing hoods as appropriate based on risk level, etc.).

Laboratory personnel should immediately report broken or malfunctioning fume hoods to their department chair and remove the hood from service until repaired and properly functioning.

3.3.2 HOUSEKEEPING AND MAINTENANCE

Maintaining a neat and orderly laboratory is essential to the safety of those who work and learn in the laboratory. Poor housekeeping is found to be the cause or a contributing factor in many laboratory accidents. General practices for maintaining good housekeeping include:

- Maintain clear walkways, with unobstructed exits and no slip/trip hazards such as containers on the floor or outlet strips or extension cords across walkways. Keep all aisles clear of obstructions.
- Keep floors clean, dry and free of clutter.
- Keep work areas clean and uncluttered. At the completion of each work day or operation, clean the work area. Maintain reasonably neat and clean benchtops and shelves.
- Clean work surfaces after use or periodically as otherwise needed. Protect work surfaces from contamination where appropriate.
- Store all materials in secure positions/locations.
- Avoid storing materials and equipment on top of cabinets. If you must place things there, maintain a clearance of at least 18 inches from the sprinkler heads or (if no sprinkler heads are present) 24 inches from the ceiling.
- Do NOT block access to emergency exits or emergency equipment such as safety showers, eyewashes, spill kits, fire extinguishers, etc.
- Check that equipment is in safe operating condition, including: glassware free of chips/cracks, electrical wires in good condition and not overloaded to any one outlet, pumps, belt guards on pumps, all equipment electrically grounded, and refrigerators properly designated and used.
- Immediately report malfunctioning equipment to coordinate prompt repair or replacement. If being repaired, clearly label malfunctioning equipment with a tag indicating "do not use" and the status.
- Use all laboratory equipment only for its intended purpose. Do not use damaged equipment, glassware, or other materials or laboratory devices that are not in good working order.

- Immediately report or clearly tag malfunctioning/damaged items/equipment to coordinate prompt repair or replacement.

3.3.3 LABORATORY INSPECTIONS

EHS performs annual inspections of all laboratories using hazardous chemicals. Informal inspections should be carried out continually in order to correct any deficiencies as quickly as possible.

Eyewash stations, emergency showers and fire extinguishers are inspected monthly by Facility Operations.

4. CHEMICAL MANAGEMENT

4.1 INVENTORY

The Vertére chemical inventory system is used to track, share and account for the thousands of chemicals used on campus. Upon initial receipt, chemicals should be entered into the system by the department laboratory coordinator. At minimum, the name, amount, date of receipt, location and owner should be recorded. Specific procedures vary by department.

All departments may perform searches of chemicals in order to track their location and current use. Faculty and staff can choose whether to make their chemicals available for sharing. This functionality is encouraged as a way to reduce waste and use our chemical inventory most efficiently.

4.2 PROCUREMENT

It is the responsibility of each department to ensure that no chemical is ordered without having a plan in place for its safe storage, use and disposal. Hazardous chemicals should be ordered on a "just-in-time" basis, meaning they should be ordered only in the amount needed when they are needed. Smaller containers are preferable to larger containers even when multiple smaller containers may be required. Ordering bulk or wholesale quantities of chemicals is prohibited as any savings from bulk orders are quickly spent by the increased cost of handling, storage and disposal as well as the immeasurable cost of increased risk to employees, students and the environment by having unnecessarily large quantities of hazardous chemicals present at DePaul.

Procurement of new chemicals that are highly hazardous requires prior approval from EHS and the Department Chair to ensure adequate safety provisions are in place to control risks to laboratory workers and/or the University community, as well as to comply with any additional regulatory requirements. This includes the procurement of particularly hazardous substances (carcinogens, reproductive toxins, highly acute toxins) and highly reactive or flammable chemicals that present a physical safety hazard to the user or other laboratory/building occupants. Procurement of radioactive materials requires approval from the Radiation Safety Officer. See Section 7.1.1 for more information.

4.3 DISTRIBUTION

Hazardous chemicals should only be received in designated areas which are properly equipped to handle them. Only designated and trained personnel are authorized to receive shipments.

- Personal vehicles should never be used to move hazardous chemicals.
- Chemicals distributed from the stockroom should be moved on designated carts.
- Chemicals should be distributed using break-resistant secondary containers made of materials that are compatible with the chemicals, especially for corrosives and solvents.
- Secondary containers must have adequate volume to contain primary container volume.
- Compressed gas cylinders must be properly strapped to a cylinder cart during transport. See the Compressed Gas Safety Manual for more information.

5. TRAINING AND INFORMATION

Departments are responsible for ensuring that all individuals working in their laboratories have been adequately trained. Training must be provided prior to the time when individuals begin their duties involving hazardous chemicals and as needed whenever there is a significant change in the types or quantities of chemicals used.

EHS provides 2 types of Lab Safety Training: one for students enrolled in lab classes and one for faculty, staff and students with any lab duties (working in research labs, serving as TAs for lab classes, etc.) These trainings are designed to cover, in a general way, many of the topics required by OSHA's Lab Standard. They are not intended to be the sole means of training laboratory personnel and must be supplemented by additional safety instruction from the PI, instructor and/or Department Laboratory Coordinator on the potential hazards associated with an individual's specific duties. This individualized training should include a review of the laboratory's safety features and equipment.

Topics that must be covered include:

- Content of OSHA's Lab Standard.
- Location and availability of this Chemical Hygiene Plan.
- The permissible exposure limits (PELs) for OSHA regulated substancecs or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA standard.
- Signs and symptoms associated with exposures to hazardous chemicals present.
- The location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including but not limited to Safety Data Sheets (SDSs).
- Methods to detect the presence or release of chemicals.
- Physical and health hazards of chemicals in work areas.
- Measures that laboratory personnel can take to protect themselves from chemical hazards.

6. HAZARD COMMUNICATION

6.1 SIGNS

Various signs are posted throughout the laboratories and chemical storage areas indicating potential hazards, policies, etc. Signs are intended to serve as a reminder or to indicate a specific regulated area. Signs should, under no circumstance, be used as a substitute for properly disseminating information to personnel. Training, access to the CHP and other safety related resources should be the primary source by which affected personnel are informed of issues related to chemical hygiene.

6.2 LABELS

All chemical containers shall be properly labeled as to their contents. Containers that are in immediate use and under constant supervision (e.g., a beaker during a laboratory experiment) should be labeled with the chemical name(s). Containers not in immediate use should comply with the full labeling requirements:

- Labels on incoming containers must not be removed or defaced.
- The full chemical name should be typed or clearly printed with permanent non-smearing ink.
- Any pertinent warnings, hazards, or preventative safety measures that should be taken must be made clear on the label (e.g., reactive with water).
- The CAS registry number should be included on the label whenever possible, especially when the chemical may be known by multiple names.
- Labels should be resistant to fading, smudging, tearing, etc.

6.3 SAFETY DATA SHEETS (SDSs)

All chemical manufacturers or distributors are required to conduct a hazard evaluation of their products and include that information on an SDS. The manufacturer or distributor is required to provide an SDS with the initial shipment of their products. Any SDSs received by the laboratory must be maintained so they are easily accessible to those using the chemical. If the SDS cannot be found, contact the manufacturer or distributor at the number listed on the container label and request an SDS.

Note: If a chemical substance is produced in the laboratory for another user outside of the laboratory, then the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200) must be met including the requirements for preparation of SDSs and labeling. Contact EHS for assistance.

7. LABORATORY WORK PRACTICES

This section contains general guidance applicable to most laboratories and is intended to be supplemented by more specific requirements provided by departments, PIs/instructors, experimental protocols, equipment manuals, or otherwise as appropriate based on the nature and risks of the laboratory work.

Other DePaul programs and procedures contain guidance and requirements on specific topics that may apply to certain types of laboratory work, such as biological hazards, compressed gases, controlled substances, fume hoods, mercury clean up, respiratory protection and waste disposal. Faculty, staff and students must also ensure these requirements are followed.

7.1 PREPARATION AND PLANNING

Proper preparation and planning is essential for safely working with hazardous chemicals. Before beginning work involving hazardous chemicals, the PI or instructor must consider and plan for the chemicals, equipment and other materials needed, the proper sequence of steps to be followed, and the necessary protective measures and other safety considerations.

- **Chemicals**. Make sure all involved parties are familiar with the hazards of the chemicals and reactions before beginning work (e.g., flammability, reactivity, volatility). Review SDSs and/or contact EHS for assistance as appropriate. Where feasible, consider how the procedure could be conducted using a less hazardous substitute, or using smaller quantities.
- **Equipment**. Check that that equipment is assembled and/or functioning properly before use, and that all involved understand procedures for safe use. Review specific information in the instruction manual as necessary. Use equipment only for its intended use.
- **Written Protocol**. Develop and/or follow written experimental protocols wherever feasible. Step-by-step instructions help to minimize the possibility of errors and identify steps where special precautions may be necessary.
- **Setup**. Check that materials needed are in place before actual work begins, including the necessary protective equipment. Ensure there is sufficient working space and that the work area is uncluttered and orderly. Remove unnecessary materials, equipment and supplies. Avoid placement of chemicals and equipment on the floor of working areas where they may be knocked over or create a tripping hazard.
- **Clean up**. Consider ahead of time the necessary steps and materials for proper clean up, including as appropriate: hazardous waste to be collected in satellite accumulation areas, surfaces to be decontaminated, glassware to be washed and similar considerations.

7.1.1 PRIOR APPROVAL

Certain laboratory use of hazardous materials, equipment or operations requires prior approval because of the hazards they present, the waste materials and byproducts they generate, the additional regulatory requirements that may apply, or for other health and safety concerns.

Examples of materials, chemicals, equipment or operations that may require prior approval include:

1. Procurement of particularly hazardous substances (e.g., select carcinogens, reproductive toxins, highly acute toxins) Refer to the definitions provided in Appendix A.
2. Procurement of highly reactive or flammable chemicals that present a physical safety hazard to the user or other occupants.
3. Procurement of radioactive materials requires approval from the Radiation Safety Officer.
4. New or modified procedures presenting a potentially serious risk to the laboratory worker or other occupants due to the materials, quantity, equipment, or nature of the operation.
5. Procedures where exposures exceed or are reasonably likely to exceed the PELs or other established exposure limits.
6. Procedures where a failure of any of the equipment did or could have resulted in injury, illness or exposure of a laboratory worker to a hazardous chemical before the procedure may be conducted again.
7. Procedures where laboratory workers become ill injured or suspect that others have been exposed to a hazardous chemical due to an experimental procedure.

It is anticipated that the use of materials and procedures as described above will not be permitted in teaching laboratories and will be restricted to laboratory research activities involving properly trained personnel.

As part of the preparation and planning process for laboratory operations, a PI who wishes to engage in any of the activities described above should seek guidance and prior approval from EHS and the Department Chair, and should also notify the Laboratory Coordinator. To facilitate this process, the PI should email EHS and the Department Chair, with a copy to the Laboratory Coordinator, the following information:

- Brief description of the project including the chemical name, procedural steps, the exposure controls that will be used (e.g., fume hood, PPE, employee training, etc.), and waste handling practices;
- Safety Data Sheet(s);
- Date requested for initiation of the new chemical or new/modified procedures;
- Personnel that will be involved in using the chemical or conducting the procedure; and
- Any other pertinent details.

7.2 PERSONAL BEHAVIOR

Everyone working in a laboratory must maintain a professional decorum at all times. This includes:

- Avoid behavior that might startle, distract, or confuse others. Practical jokes or horseplay are prohibited.
- Never smell or taste laboratory chemicals.
- Never pipet by mouth.
- Do not eat, drink, store food/drinks or eating/drinking utensils, chew gum, apply cosmetics or take medication in areas where hazardous chemicals are handled or stored.
- Do not store food/drink in laboratory fridges or use laboratory microwaves for food/drink.
- Wash hands frequently, after removing gloves, before leaving the laboratory area, etc.
- Do not wear laboratory coats outside the laboratory to reduce the risk of contaminating

other spaces.
- Remove gloves before touching common equipment such as phones, doorknobs and computer keyboards.

7.2.1 WORKING ALONE

Individuals using hazardous chemicals should not work alone. Students are prohibited from working alone with hazardous chemicals. Where faculty or staff must work alone, the PI should develop an appropriate system for periodic check-ins, based on the risks of the materials and operations. The use of particularly hazardous substances or operations should never be conducted alone.

7.3 PERSONAL ATTIRE

- Arms and legs should be covered at all times while handling hazardous chemicals. Lab coats or long sleeve shirts should be worn.
- Shoes should be appropriate for laboratory work and cover the entire foot. Open toed shoes, sandals, clogs, crocs, etc. are not appropriate for the lab.
- Loose clothing such as neckties and baggy clothing are inappropriate for the lab. Long hair should be tied back.
- Jewelry such as rings, bracelets and watches should be avoided as they may trap or react to chemicals close to the skin or cause shocks when contacted by electrical sources.
- Clothing made of cotton material is preferable to synthetic fibers such as polyester or nylon, and should be worn during potentially flammable lab experiments or procedures.
- Avoid long nails that can interfere with proper fit of gloves.

7.4 FUME HOODS

Fume hoods are an engineering control present in all DePaul laboratories. Experiments and chemical reactions should be carried out in fume hoods whenever feasible (see Section 3.1.1 regarding fume hood design and maintenance considerations).
Requirements related to fume hood use include:

- Use only fume hoods that have current certification stickers.
- Keep all materials inside the hood at least six inches from the sash opening.
- Never put your head inside the fume hood.
- Keep the fume hood sash closed when not working.
- Keep the fume hood sash as low as possible while conducting reactions. This will increase the face velocity protecting against inhalation as well as provide a shield to protect against any splashes or violent reactions that may occur.
- Keep fume hoods free of debris and excessive equipment. Having excessive bottles and equipment inside the hood disrupts the air flow and makes the hood less effective.
- Keep all containers closed when not in use and never dispose of chemicals by letting them volatilize in the fume hood.
- Notify the department chair of any malfunctioning hoods. Remove malfunctioning hoods from service until they are repaired and properly functioning.

See the Fume Hoods Manual for more information.

7.5 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Engineering and administrative controls are the primary methods for reducing the risks of chemical exposures in the laboratory. PPE is used to offer an additional layer of protection if engineering and administrative controls fail or where they are not fully sufficient.

The degree of PPE required varies depending on the specific type of lab work that is being conducted and the materials involved. Experimental protocols should include specific PPE requirements.

Basic requirements include:

- Safety eyewear conforming to ANSI Z87.1 must be worn whenever the potential for splash, impact or other contact exists. Safety eyewear must provide for impact as well as splash protection.
- Specialized eye protection may be required in certain circumstances such as when there is potential exposure to lasers or ultraviolet light.
- Full face shields must be worn in addition to goggles when conducting procedures that may result in splashes to the face (e.g., a violent reaction), and may also be necessary when working with extremely hazardous substances such as highly corrosive chemicals.
- Gloves must be worn whenever the potential for contact with hazardous or toxic substances exist. Gloves must be of a material that is compatible with the chemicals/hazards present. Refer to relevant SDSs or specific glove manufacturer data for guidance.
- PPE for use with hot or extremely cold (e.g., cryogenic) items shall have adequate thermal protection.
- Splash aprons and other additional PPE such as chemical protective suits and shoe covers may be required when working with highly hazardous chemicals. Care should be taken to ensure that the PPE material is suitable to the chemicals it is meant to guard against.

7.5.1 RESPIRATORY PROTECTION

Respirators may be used when engineering controls such as general ventilation or a fume hood are not feasible or do not reduce exposure to acceptable levels. Since the use of a respirator is regulated by OSHA's Respiratory Protection Standard, respirator use at DePaul University is subject to prior review by EHS.

Any laboratory worker who believes that respiratory protection is needed must notify EHS to request an evaluation of the hazard and enrollment in the Respiratory Protection Program. This program involves procedures for hazard evaluation, respirator selection, medical clearance, employee training, fit testing, respirator inspection and maintenance and recordkeeping.

Voluntary use of filtering facepieces (negative pressure particulate respirators with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium, most commonly N95s) is allowed without enrollment in the Respiratory Protection Program provided that the use doesn't in itself create a hazard and that employees are provided with a copy of Appendix D of the Respiratory Protection Standard (29 CFR 1910.134).

Please see the Respiratory Protection Program for more information.

7.6 UNATTENDED EXPERIMENTS

While unattended experiments should be avoided, laboratory operations involving hazardous chemicals are sometimes carried out continuously or overnight with no one present. It is the responsibility of the PI to design these experiments to prevent the release of hazardous chemicals in the event of interruptions in utility services such as electricity, cooling water or inert gas.

General provisions for unattended experiments include:

- The PI must carefully examine how chemicals and apparatus are stored, considering the possibility for fire, explosion or unintended reactions.
- Laboratory lights should be left on, and signs should be posted identifying the nature of the experiment and the hazardous chemicals in use.
- If appropriate, arrangements should be made for other workers to periodically inspect the operation.
- Contact information for the responsible individual should be posted by the experiment in the event of an emergency.

7.7 LABORATORY SECURITY

Safeguarding DePaul resources from unauthorized access, misuse or removal is a duty of all faculty, staff and students. In laboratories, this obligation rests primarily with the PI or instructor; however, all laboratory personnel have a responsibility to take reasonable precautions against theft or misuse of materials, particularly those that could threaten the public. Any extraordinary laboratory security measures should be commensurate with the potential risks and imposed in a manner that do not unreasonably hamper research.

At a minimum, DePaul University expects all laboratory personnel to comply with the following security procedures:

- Keep all laboratories locked when not in use.
- Question the presence of unfamiliar individuals in laboratories and report any suspicious activity immediately to Public Safety at 773-325-7777.
- Laboratory building exterior doors are secured after normal business hours. To minimize the likelihood of unauthorized access, all after hours building users should:
  - Avoid providing building access to unfamiliar individuals.
  - Secure doors behind them.
  - Immediately report any building security problem to Public Safety at 773-325-7777.

Research or other activities involving the use of laboratory space, materials or equipment without the knowledge and approval of the responsible PI or instructor is strictly prohibited. Violation of this prohibition may result in disciplinary action including employee termination or student suspension or expulsion.

8. CHEMICAL HANDLING AND STORAGE

This section contains general guidance applicable to most laboratories and is intended to be supplemented by more specific requirements provided by departments, PIs/instructors, experimental protocols, equipment manuals, or otherwise as appropriate based on the nature and risks of the laboratory work.

Other DePaul programs and procedures contain guidance and requirements on specific topics that may apply to certain types of laboratory work, such as biological hazards, compressed gases, controlled substances, fume hoods, mercury clean up, respiratory protection and waste disposal. Faculty, staff and students must also ensure these requirements are followed.

8.1 GENERAL PRACTICES

- Minimize exposure to all chemicals regardless of how familiar they are.
- Develop and encourage safe habits and avoid unnecessary exposure to chemicals by any route.
- Be familiar with the signs and symptoms of exposure for all chemicals in use and review applicable SDSs.
- Use bottle carriers, carts designed for chemical transport, or other appropriate second containment, especially when transporting chemicals in glass containers.

8.2 CORROSIVES

- Purchase corrosives in the smallest container size practical.
- Wear appropriate clothing and PPE for handling corrosives (e.g., eye/face protection, buttoned lab coat or splash apron, and impervious gloves).
- Segregate corrosives from incompatible chemicals, using storage bins as necessary to further segregate and provide secondary containment in storage. Check the SDS for proper storage (e.g., segregate oxidizing acids from organic acids, and flammable and combustible liquids; segregate acids from bases).
- Store liquid corrosives on low shelves or in acid or caustic storage cabinets. Avoid storage of corrosives above the bench or on upper storage shelves (to lessen the chance of accidental splashes to the eyes/face).
- Always add acids to water (NOT water to acids). Use cold water; add slowly in small amounts.
- Use caution when transferring corrosives from one container to another. Dispense from only one container at a time. Finish all dispensing of one material before starting to dispense another. Use only containers recommended by the manufacturer/supplier. Corrosives will damage or destroy containers made of improper materials.
- Keep containers tightly closed when not in use.
- Always handle corrosive material carefully to avoid the generation of dusts or other aerosols for solid corrosives, and mists or vapors for liquid corrosives.

8.3 CRYOGENICS

- Use only containers specifically designed for holding cryogenic liquids. Where appropriate, tape containers and cold traps to prevent flying glass in case of breakage.
- Do not store cryogenic liquids in a container with a tight-fitting lid as the pressure will build-up as the cryogen boils and the container may fail.
- Store cryogenic materials only in large and well-ventilated areas so that the rapid boil-off of fluids will not displace oxygen to create a potentially oxygen-deficient atmosphere. Never lower your head into a dry ice chest, as the oxygen content may be inadequate and asphyxiation can result.
- Wear required PPE, such as safety glasses with side shields and/or a full-face shield to protect the eyes and face from splash hazards and potential projectiles from pressure build-up. Use suitable gloves to protect hands from cryogenic materials.
- Remove jewelry (or cover, if necessary), such as watches, rings, etc. to minimize the risk of cryogenic liquid being trapped beneath them, resulting in cold burns.
- Put objects into a cryogenic liquid slowly, and pour liquids into containers slowly in order to minimize boiling and splashing. If using dry ice, add to liquid slowly and in small amounts to avoid foaming and boil over.

8.4 FLAMMABLE AND COMBUSTIBLE LIQUIDS

- Limit quantities to the amount necessary for the work.
- 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 on the first floor 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.
- Flammable and combustible liquids should be stored only in approved containers (i.e. by the US Department of Transportation (DOT) or a Nationally Recognized Testing Laboratory (NRTL)).

Different types of containers may be 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 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 the local authority having jurisdiction 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."

When refrigeration is needed, only use 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.

8.5 PEROXIDE FORMERS

- Purchase only the quantity that will be used in a short time and in the smallest size of container that is practical. Purchase chemicals that have a peroxide formation inhibitor, where possible.
- Upon receipt, use a permanent marker to label the container with the date received and initials.
- Upon opening a new container of a peroxide forming material, use a permanent marker to label the container with the date opened and initials. The length of time a peroxide forming chemical can be safely stored depends on the particular material (e.g., some form peroxides on aging, others upon concentration, etc.). Refer to Appendix B, read the SDS and other sources of hazard information, or contact EHS for assistance.
- Do not open containers if the date of receipt indicates that it is past the recommended shelf life (or more than twelve months old), or if it's past the manufacturer's expiration date.
- Inspect containers for peroxide formation before opening or moving the containers. Do not open, touch, or otherwise disturb any container if crystalline solids are observed in liquid peroxide forming chemicals. From a safe location, immediately contact Public Safety.
- Store peroxide forming chemicals in airtight amber glass containers. The amber glass container protects the substance from excess light exposure and allows the user visual access to the substance without opening the container. Once material is removed from the source container it must not be returned to the reagent container.
- Before storing, ensure that bottles and caps are free of chemical residue. Keep containers tightly capped to minimize peroxide formation.
- Store peroxide forming chemicals away from heat sources, sparks, direct light, flammables, and combustibles. Check the SDS for any additional incompatibilities of the specific material.
- Avoid the use of metal implements, since metals contamination can lead to explosive decomposition.
- Use extra caution when handling near-empty or empty containers of peroxide forming materials because the air space above the liquid can accelerate the formation of peroxides.
- If antioxidant inhibitors are used, be aware that the inhibitor may be consumed with time, making the compound again sensitive to peroxidation.
- Consider the need for additional controls, such as shielding of reactions. [Note: Fume hoods sashes may provide some level of physical protection against minor explosions; however, most sashes are not explosion-proof.]

  See Appendix B for a list of peroxide formers and recommended timeframes for use.

8.5 TOXICS

- Evaluate whether a less toxic alternative is feasible.
- Use the smallest amount of chemical that is consistent with the requirements of the work to be done.
- Conduct all procedures in fume hoods.

8.5.1 PARTICULARLY HAZARDOUS SUBSTANCES

While DePaul typically does not use such chemicals, where tasks will involve work with particularly hazardous substances, including select carcinogens, reproductive toxins and/or substances with high acute toxicity (see Appendix A for definitions), certain provisions for additional employee protection may also be necessary, such as:

- Specification of designated area(s)
- Use of containment equipment such as fume hoods
- Procedures for safe removal of contaminated waste
- Decontamination procedures

Specific procedures should be developed as the need arises. General procedures for working with Particularly Hazardous Substances include:

- Evaluate whether a safer alternative is feasible.
- Wherever feasible, conduct the procedure in a fume hood. Otherwise, use equivalent engineering or combinations of other controls.
- Use the smallest amount of chemical that is consistent with the requirements of the work to be performed.
- Wear appropriate PPE to prevent exposure.
- Where work with particularly hazardous substances is to be conducted on a routine basis, establish designated areas (e.g., benches or hoods) for work with these materials, clearly label the designated area with a sign, restrict access, and implement special decontamination procedures.
- Use care when weighing solids to avoid creation of aerosols. Where possible, use fume hoods or other vented enclosures.
- Establish a schedule and procedure for decontamination of work surfaces and equipment (e.g., at the completion of the operation or at the end of the day). The decontamination solution must be compatible with the materials with which it is being used, and should be selected based on the properties of the materials it is being used to decontaminate.
- Establish proper housekeeping procedures. Use a wet mop or a vacuum cleaner equipped with a HEPA filter instead of dry sweeping if the toxic substance is a dry powder.
- Carefully handle waste generated from procedures involving particularly hazardous substances. Follow all waste procedures (e.g., labeling of containers, keeping waste collection containers tightly closed when not in use, providing secondary containment for liquid waste containers, etc.) while waste is in storage.
- Store particularly hazardous substances in appropriately labeled, unbreakable, chemically resistant, secondary containers.
- Review each use of these materials annually or whenever a procedural change is made.

8.5.1.1 DICHLOROMETHANE (DCM) USE

The Environmental Protection Agency (EPA) determined under the Toxic Substances Control Act (TSCA) that dichloromethane (DCM) poses an unreasonable risk of injury to health, and its continued use as a laboratory chemical is permissible only when certain requirements are met. All laboratory uses of DCM must be approved by EHS in order to ensure compliance with these regulations.

8.6 STORAGE

While chemical storage requirements will vary depending on the nature of the laboratory work and the chemicals being stored, basic practices for safe chemical storage include:

- Store chemicals only in compatible containers.
- Segregate chemicals based on compatibility. Note that storing chemicals alphabetically, without regard to compatibility, can increase the risk of a hazardous reaction, especially in the event of container breakage.
- Use common sense when setting up chemical storage. Segregation that disrupts normal workflow can increase the potential for spills.
- In general, dry reagents, liquids and compressed gases should be stored separately, then by hazard class, then by any additional incompatibilities (and then alphabetically if desired).
- Provide a specific storage location for each type of chemical, and return the chemicals to those locations after each use.
- Make arrangements for the storage of highly reactive chemicals before procurement.
- Avoid storing chemicals in the workspace within a fume hood or on lab benchtops, except for those chemicals currently in use.
- If a chemical does not require a flammable storage cabinet or ventilated cabinet, store it inside a closable cabinet or on a shelf that has a lip to prevent containers from sliding off in the event of an accident or fire.
- Ensure cabinets for chemical storage are of a solid, sturdy construction, preferably hardwood or metal. Be sure that the weight of the chemicals does not exceed the load capacity of the shelf or cabinet.
- Do not store chemicals near direct sunlight or heat sources.
- Avoid storing chemicals near exits, passageways and emergency equipment.
- For compressed gas cylinders and lecture bottles, follow guidelines in the Compressed Gas Safety Manual.

8.7 GLASSWARE

- Regularly inspect glassware for damage and dispose of any chipped, broken, star-cracked, or badly etched pieces in a broken glass box.
- Always use care when handling and storing laboratory glassware to avoid damage and injury.
- Use a lubricant and wear hand protection if pushing glass through rubber stoppers.
- When handling heated glassware, use heat-resistant gloves and/or tongs.
- Use plastic or shatter-proof glass containers, when possible.
- Use both hands to pick up containers.
- Use carts, caddies or other appropriate containment when transporting glass containers.
- Be aware of implosion hazards when working with vacuums.
- Apply vacuum only to glassware specifically designed for that purpose, such as thick-walled, pressure resistant glassware (e.g., heavy wall filter flasks, desiccators, etc.).Where feasible, use plastic (e.g., polycarbonate) desiccators and other containers designed to reduce the implosion hazard.
- Use shielding (hood sash or portable shield) to protect against flying glass.
- Do not allow water, solvents, or corrosive gases to be drawn into a building vacuum system (e.g., use traps where needed).
- High-pressure operations should be performed only in pressure vessels that are

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 temperature and pressures and must not corrode or otherwise react when in contact with the materials they contain.

9. MEDICAL SERVICES

An opportunity for employee medical evaluation, treatment and follow up as warranted, must be provided under the following circumstances:

- Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in thelaboratory.
- Whenever exposure monitoring indicates an exposure level that routinely meets or exceeds the OSHA action level (or PEL when no action level exists) for regulated substances for which there are exposure monitoring and medical requirements.
- Whenever an event takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure.

All medical examinations and consultations shall be provided by or under the direct supervision of a licensed physician and shall be provided at no cost to the employee.

The consulting/treating physician must be provided with the following information as applicable:

- A description of the signs and symptoms of exposure.
- A description of the conditions under which the exposure occurred (e.g. chemical mixtures, amounts, fume hood use, etc.).
- The identity of the hazardous chemical(s) to which the exposure occurred, including any known byproducts of chemical mixtures that may have occurred. SDSs should be provided to the physician.

10. REPORTING REQUIREMENTS

Whenever someone experiences a medical emergency on campus, faculty, staff and students are advised to call 911 immediately, and then contact Public Safety. Please note that all campus phones are able to dial 911 directly (dialing 9-911 is no longer necessary but the call will still go through).

All accidents or injuries that occur on University property, regardless of severity, must be promptly reported to Public Safety so that a report can be issued. Minor spills only need to be reported to Public Safety if someone is injured or the situation poses danger to people or property. See Section 10 for more information on minor (incidental) spills.

EHS should be notified via online incident report form within 72 hours of all laboratory incidents involving hazardous chemicals, including incidental spills.

If an incident occurs related to an Institutional Animal Care and Use Committee (IACUC), Institutional Biosafety Committee (IBC) or Institutional Review Board (IRB) protocol, please refer to those committees' policies and the Office of Research Services for additional reporting responsibilities.

11. SPILL RESPONSE

Although all procedures should be designed with spill prevention in mind, the risk of spills in the laboratory can never be completely eliminated. For spills involving elemental mercury, please see the Mercury Spill Clean Up Manual.

10.1 INCIDENTAL SPILLS

Most spills likely to occur at DePaul can be considered incidental, or minor - involving relatively small quantities of materials, and not extremely hazardous substances. It is up to each laboratory to determine what will be considered an incidental vs. emergency spill, and to ensure all laboratory personnel are aware of the distinction and procedures for handling both.

Laboratory personnel are permitted to handle incidental spills as long as they have the necessary knowledge, supplies and training.

10.2 EMERGENCY SPILLS

DePaul faculty, staff and students are not permitted to handle any spills of an emergency nature and should never place themselves or others at risk by attempting to do so. In the event of an emergency spill (or any other emergency involving hazardous materials), the Emergency Plan for Hazardous Materials Incidents should be immediately implemented by evacuating the area and calling 911/Public Safety. The Chicago Fire Department has a Hazardous Materials Unit that is equipped to handle all such emergencies.

10.3 SPILL KITS

All laboratories should contain an appropriate spill kit that is readily accessible and kept stocked. It is the department's responsibility to provide and maintain spill kits and to ensure that laboratory personnel are trained on containing any incidental spills they may encounter. It is acceptable to use premade spill kits or assemble your own.

Basic items to include:

- Spill absorbent/neutralizing material for the classes of chemicals used (acid/base/toxic/flammable/etc.)
- Container for collected spill material (Ziploc bags, sturdy plastic container)
- Absorbent mat squares
- Paper towels
- Broom and dustpan
- Instructions for safely cleaning up a spill (what PPE to wear, when a spill is too large to handle and Public Safety should be called [who will alert the fire department hazmat team])

12. CHEMICAL EXPOSURES

Chemical exposure can occur through the following routes: absorption (via skin or eye contact), inhalation, ingestion or injection. This section provides general guidance for properly responding to such exposures.

Absorption (Skin)

- Immediately drench the skin with copious amounts of water for at least 15 minutes.
- While rinsing, remove any contaminated clothing and/or jewelry.
- Use caution when removing contaminated pullover shirts or sweaters to prevent contamination of the eyes.
- Discard contaminated clothing or launder them separately from other clothing. Leather garments or accessories that cannot be decontaminated should be discarded.
- Consult the SDS for guidance on appropriate action and whether any delayed effects should be expected. It is important to determine all of the chemicals, including any intermediaries or mixtures, which the person may have come in contact with. The victim should be encouraged to seek medical attention regardless of the assumed severity of the injury/exposure.
- Do not use solvents to wash skin. They remove the natural protective oils from the skin, can cause irritation and inflammation, and in some cases, may facilitate absorption of a toxic chemical.

Absorption (Eyes)

- Immediately flush eye(s) with copious amounts of water for at least 15 minutes.
- The use of an eyewash station is desirable so hands are free to hold the eyes open.
- If an eyewash station is not available, pour water on the eye, rinsing from the nose outward to avoid contamination of the unaffected eye.
- Remove contact lenses while rinsing. Do not lose time removing contact lenses before rinsing. Do not attempt to rinse and reinsert contact lenses.

Inhalation

- Move affected person to fresh air and close containers, open windows or otherwise increase ventilation if necessary.
- Review the SDS to determine what health effects are expected, including delayed effects.

Ingestion

- Do not induce vomiting unless directed to do so by a healthcare provider.

Injection

- Wash the area with soap and water.

If you are unsure how to respond, you may always call Illinois Poison Control for free and confidential assistance. They are qualified to provide first aid instructions for any potentially hazardous exposures.

Illinois Poison Control: 1-800-222-1222

Report all exposures or suspected exposures to the PI/instructor, Public Safety and EHS.

13. RECORDKEEPING

Records of industrial hygiene monitoring or hazard assessment will be maintained by EHS.

Records of personnel monitoring and medical consultations or examinations must be made available to the affected employee and/or their representative. Refer to Section 3.2.2.

Records of any maintenance or repairs to facilities or equipment that affect chemical hygiene are maintained by Facility Operations and/or the department.

Records of any maintenance or repairs contracted by outside vendors should be maintained by the department for no fewer than three years.

APPENDIX A: CHEMICAL HAZARD CATEGORIES

CHEMICAL HAZARD CATEGORIES	
Flammable Liquids (NFPA 30)	
A liquid having a flash point below 100°F (37.8°C) with a vapor pressure less than 40 psi at 100°F (37.8°C) is designated a Class I liquid with subclasses as follows:	**Class IA** – A liquid having a flash point below 73°F (22.8°C) and having a boiling point below 100°F (37.8°C).
	Class IB – A liquid having a flash point below 73°F (22.8°C) and having a boiling point at or above 100°F (37.8°C).
	Class IC – A liquid having a flash point at or above 73°F (22.8°C), but below 100°F (37.8°C).
Combustible Liquids (NFPA 30)	
This class is subdivided as follows:	**Class II -** is a liquid having a flash point at or above 100°F (37.8°C) but below 140°F (60°C).
	Class IIIA - is a liquid having a flash point at or above 140°F (60°C) but below 200°F (93°C).
	Class IIIB - is a liquid having a flash point at or above 200°F (93°C).
Reactive Chemicals	
Any chemical which fits any one of the following:	Identified or described in the SDS or on the label as unstable or reactive.
	Ranked by the NFPA as 3 or 4 for reactivity.
	Determined by the US DOT (49 CFR 173) as an oxidizer, organic peroxide or explosive.
	Determined by the US EPA (40 CFR 261.23) as reactive: • It is normally unstable and readily undergoes violent change without detonating. • It reacts violently with water. • It forms potentially explosive mixtures with water. • When mixed with water, it generates toxic gases, vapors, or fumesin a quantity sufficient to present a danger to human health or the environment. • It is a cyanide or sulfide material which, when exposed to pH conditions between 2.0 and 12.5 generate toxic gases, vapors, or fumes in a quantity sufficient to present a danger to human healthor the environment. • It is capable of detonation or explosive decomposition if it is subjected to a strong initiating source or if heated under confinement. • It is readily capable of detonation or explosive.

CHEMICAL HAZARD CATEGORIES	
Reactive Chemicals (Cont.)	
	Meets the 30 CFR 47.11 definition of Unstable (reactive): • A chemical which in 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.
	In the experience of the user is known or found to be reactive with ordinary substances.
Corrosive Chemicals	
Any chemical which fits any one of the following:	Is identified or described in the SDS or on the label as corrosive.
	Is identified by the DOT (49 CFR 173) as corrosive.
	Meets the EPA (40 CFR 261.22) definition of corrosive: • An aqueous solution and has a pH less than or equal to 2.0 or greater than or equal to 12.5. • A liquid and corrodes steel at a rate greater than 6/35 mm per year at a test temperature of 55°C (130°F).
	Meets the OSHA definition of corrosive: A chemical that causes visible destruction of or irreversible alteration in living tissue by chemical action at the site of contact.
	In the experience of the user is known or found to be corrosive.
Contact Hazards	
Any chemical which fits any of the following:	Is identified or described as an allergen or sensitizer in the SDS or on the label.
	Is identified or described in the medical or industrial hygiene literature as an allergen or sensitizer.
	In the experience of the user is found to cause contact hazards.

CHEMICAL HAZARD CATEGORIES	
Carcinogens (Select Carcinogens)	
Any chemical which fits any one of the following:	Is identified or described as a carcinogen in the SDS or on the label.
	Is regulated by OSHA as a carcinogen.
	Is listed under the category "Known to be Carcinogenic" or "Reasonably Anticipated to Carcinogenic" in the Annual Report on Carcinogens published by the National Toxicology Program (NTP latest edition).
	Is listed under Group 1 "Carcinogenic to Humans," by the International Agency for Research on Cancer Monographs (IRAC latest edition).
Reproductive Toxins	
Any chemical which fits any one of the following:	Is identified or described as a reproductive toxin, mutagen or teratogen in the SDS or on the label.
	Is known or suspected to affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetus (teratogenesis).
	Is identified or described in medical or industrial hygiene literature as a reproductive toxin.
Highly Toxic Chemicals	
Any chemical which fits any one of the following:	Is identified or described as highly toxic in the SDS or on the label.
	Is identified or described in the medical or industrial hygiene literature as being acutely toxic.
	• The median lethal dose (LD_{50}) is equal to or less than 50mg/kg of the body weight when administered orally to rats. • The median lethal dose (LD_{50}) is equal to or less than 200mg/kg of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of rabbits. • The median lethal concentration (LD_{50}) in air is equal to or less than 200 parts per million (ppm) by volume or less of gas or vapor, or equal to or less than 2 mg per liter or less of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to rats.
	The TLV or PEL is equal to or less than 5 ppm or 5 mg/m^3.

APPENDIX B: PEROXIDE FORMERS

These lists were taken from Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards and are not all inclusive. Always review the SDS and other manufacturer's safety information to determine if a chemical is a peroxide hazard.

Class A: Chemicals that form explosive levels of peroxides without concentration	
*The following chemicals present severe peroxide hazards on storage with exposure to air and should typically be discarded within **3 months** of opening.*	
Butadiene (liquid monomer)	Potassium amide
Chlorobutadiene (Chloroprene) (liquid monomer)	Sodium amide (Sodamide)
Diisopropyl ether (Isopropyl ether)	Tetrafluoroethylene (liquid monomer)
Divinylacetylene (DVA)	Vinylidene chloride (1,1-Dichloroethylene)
Potassium metal	
Class B: Chemicals that are a peroxide hazard on concentration (distillation/evaporation)	
*The following chemicals present peroxide hazards on concentration. Do not distill or evaporate these chemicals without first testing for the presence of peroxides. These chemicals should typically be discarded or tested for peroxides within **6 months** of opening.*	
Acetal (Acetaldehyde diethyl acetal)	Dioxane (p-dioxane)
Cumene (Isopropyl benzene)	Ethylene glycol dimethyl ether (Glyme)
Cyclohexene	Furan
Cyclooctene	Methyl acetylene
Cyclopentene	Methyl cyclopentane
Diacetylene (Butadiyne)	Methyl-isobutyl ketone
Dicyclopentadiene	Tetrahydrofuran (THF)
Diethylene glycol dimethyl ether (Diglyme)	Tetrahydronaphthalene
Diethyl ether (Ether)	Vinyl ethers
Class C: Chemicals that may autopolymerize as a result of peroxide accumulation if inhibitors are removed/depleted	
*The following chemicals present hazards of rapid polymerization initiated by internally formed peroxides. These chemicals should typically be discarded or tested for peroxides **within 6 months** of opening (gases should be discarded or tested for peroxides **within 12 months**).*	
Acrylic acid	Styrene
Butadiene (gas)	Vinyl acetate
Chlorotrifluoroethylene	Vinyl chloride
Ethyl acrylate	Vinyl pyridine
Methyl methacrylate	

APPENDIX C: INCOMPATIBLE CHEMICALS

This list is provided to illustrate incompatibilities for common laboratory chemicals and is not a complete list; always consult the SDS for the chemical or other chemical hazard reference. The material on the left should be stored and handled so that it does NOT come in contact with the incompatible chemical(s) on the right.

	CHEMICAL	KEEP OUT OF CONTACT WITH
A	Acetic acid	Acetaldehyde, ammonium nitrate, chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
	Acetaldehyde	Acetic acid, acetic anhydride, ammonia (anhydrous)
	Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
	Acetone	Concentrated nitric and sulfuric acid mixtures
	Alkali and Alkaline Earth (e.g. Powdered Aluminum or Magnesium, Calcium, Lithium, Sodium, Potassium)	Water, carbon tetrachloride or other chlorinated metals, hydrocarbons, carbon dioxide, halogens
	Aluminum	Ammonium nitrate, bromates, chlorates, iodates, bromine vapor, carbon disulfide vapor
	Ammonia (Anhydrous)	Mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid (anhydrous)
	Ammonium Nitrate	Acids, powdered metals, flammable liquids, chlorates, nitrates, sulfur, finely divided organic or combustible materials
	Aniline	Nitric acid, hydrogen peroxide
	Arsenic	Any bromate, chlorate, or iodate
	Azides	Acids
B	Bromine	See “Chlorine”
	Barium	Carbon tetrachloride
C	Calcium Oxide	Water
	Carbon (Activated)	Calcium hypochlorite, all oxidizing agents
	Carbon Tetrachloride	Sodium
	Chlorates	Ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials, sulfides

	CHEMICAL	KEEP OUT OF CONTACT WITH
	Chromic Acid	Acetic acid, naphthalene, camphor, glycerin, turpentine, alcohol
	Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals, turpentine
	Chlorine Dioxide	Ammonia, methane, phosphine, hydrogen sulfide
	Copper	Acetylene, hydrogen peroxide
	Cumene Hydroperoxide	Acids (organic or inorganic)
	Cyanides	Acids
F	Flammable Liquids	Ammonium nitrate, chromatic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
	Fluorine	Isolate from everything
H	Hydrocarbons (e.g. Butane, Benzene)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
	Hydrocyanic Acid	Nitric acid, alkali
	Hydrofluoric Acid (Anhydrous)	Ammonia (aqueous or anhydrous)
	Hydrogen Peroxide	Copper, chromium, iron, most metals or their salts, alcohols, acetone, ferrous sulfide, lead IV oxide, lead II oxide, lead sulfide, organic materials, aniline, nitromethane, combustible materials, flammable liquids, oxidizing gases
	Hydrogen Sulfide	Fuming nitric acid, oxidizing gases
	Hypochlorites	Acids, activated carbon
I	Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
M	Maleic Anhydride	Magnesium hydroxide, lithium metal
	Magnesium Metal	Mercury II oxide, nitric acid
	Mercury	Acetylene, fulminic acid, ammonia
	Methanol	Lead perchlorate, mercury II nitrate
N	Nitrates	Sulfuric acid
	Nitric Acid	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, powdered magnesium metal, phosphorus, phthalic acid
	Nitroparaffins	Inorganic bases, amines
O	Oxalic Acid	Silver, mercury
	Oxygen	Oils, grease, hydrogen, flammable liquids, solids
P	Perchloric Acid	Acetic anhydride, aluminum, Bakelite, bismuth and its alloys, alcohol, paper, wood, plastics, nylon (polyamide), modacrylic ester (35-85% acrylonitrile), polyester, Lucite, cellulose-based lacquers, metals, copper and copper alloys, high nickel alloys, cotton, wool, glycerin-lead oxide, grease, oils
	Peroxides, Organic	Acids (organic or mineral), avoid friction, store cold

	CHEMICAL	KEEP OUT OF CONTACT WITH
	Phosphorus (White)	Air, oxygen, alkalis, reducing agents
	Phosphorus Pentoxide	Water
	Potassium	Carbon tetrachloride, carbon dioxide, water
	Potassium Chlorate	Sulfuric and other acids
	Potassium Perchlorate (See Also Chlorates)	Sulfuric and other acids
	Potassium Permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid
S	Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds
	Selenides	Reducing agents
	Sodium	Carbon tetrachloride, carbon dioxide, water
	Sodium Nitrate	Ammonium nitrate and other ammonium salts
	Sodium Peroxide	Ethanol, methanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
	Sulfides	Acids
	Sulfuric Acid	Potassium chlorate, potassium perchlorate, potassium permanganate (or similar compounds of light metals, such as sodium, lithium)

In addition to the segregation noted in above, dangerously incompatible substances, even in small quantities, should not be stored next to each other on shelves or in such a position that accidental rupture of containers may allow mixing. For example:

CHEMICAL	KEEP OUT OF CONTACT WITH
Chlorine	Acetylene
Chromic acid	Ethyl alcohol
Oxygen (compressed, liquefied)	Propane
Sodium	Chloroform and aqueous solutions
Nitrocellulose (wet, dry)	Phosphorous
Potassium permanganate	Sulfuric acid
Perchloric acid	Acetic acid
Sodium chlorate	Sulfur in bulk

Oxidizing agents are incompatible with reducing agents.

OXIDIZING AGENTS	REDUCING AGENTS
Chlorates	Ammonia
Chromates	Carbon
Dichromates	Metals
Chromium trioxide	Metal hydrides
Halogens	Nitrates
Halogenating agents	Organic compounds
Hydrogen peroxide	Phosphorus
Nitric acid	Silicon
Nitrates	Sulfur
Perchlorates	
Peroxides	
Permanganates	
Persulfates	

APPENDIX D: PROGRAM HISTORY

Date	Brief Description of Changes	Review Completed by
May 2014	MSDS to SDS	J. Graham
May 2015	Phone numbers	J. Graham
May 2016	Dates	J. Graham
March 2018	Clarified reporting requirements and spill response information	K. Abma
March 2023	Significant updates and restructuring	K. Abma
December 2025	Peroxide former updates, DCM section	K. Abma