Laboratory Chemical Hygiene Plan

for

Chemistry Department Research Laboratories

and

Undergraduate Chemistry Teaching Laboratories

Revised August 25, 2017

The Standard Operating Procedures contained in this document are modifications of the procedures developed by Indiana University, the University of California and the University of Pennsylvania and published to their websites.
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1. INTRODUCTION

The Chemistry *Laboratory Chemical Hygiene Plan* is a written program for ensuring the safe use of chemicals in laboratories at Wayne State University. It describes policies, procedures, and control measures which must be understood and observed by all individuals involved in the laboratory use of chemicals.

1.1. Regulatory Basis

The development and implementation of a *Laboratory Chemical Hygiene Plan* is a central requirement of the federal rule entitled "Occupational Exposure to Hazardous Chemicals in Laboratories," more commonly referenced as the Occupational Safety and Health Administration (OSHA) "Lab Standard" (see https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10106). The Lab Standard was published as a "final rule" in the January 31, 1990 issue of the *Federal Register* and was required to be fully implemented by January 31, 1991. The most recent update of the rule was March 26, 2012. Of particular importance in understanding the applicability of this standard are the definitions it contains for "hazardous chemical," "laboratory," "laboratory scale," and "laboratory use of hazardous chemicals." From a review of these definitions, it is clear that the Lab Standard applies to essentially all chemical use laboratories at Wayne State University. For laboratories that are not covered by the Lab Standard (i.e., those that do not meet the above definitions for hazardous chemical use) or for non-laboratory uses of chemicals, safety issues are typically governed by other state and federal regulations such as OSHA's "Hazard Communication Standard." Assistance in determining which regulatory requirements apply to specific work environments is provided by the Office of Environmental Health and Safety. WSU’s Office of Environmental Health and Safety’s regulatory requirements comply to The Michigan Occupational Safety and Health Administration’s Hazard Communication standard (part 430) and the Hazardous Work in Laboratories standard (part 431).

1.2. Responsibility for Implementation

It is the policy of Wayne State University to support the use of chemicals and other potentially hazardous materials for purposes of research and teaching. At the same time, the University is committed to ensuring the safety of its students, employees, and visitors and to complying with all regulatory requirements which impact its facilities and operations. Toward this end, WSU has designated the following specific responsibilities for developing and implementing the *Laboratory Chemical Hygiene Plan*. 
1.2.1. Office of Environmental Health and Safety
The University Office of Environmental Health and Safety (OEHS) is an administrative unit under the Vice President for Research which has responsibility for the development and implementation of all university programs concerning safety and environmental quality. OEHS and members of the Chemistry Department developed the Laboratory Chemical Hygiene Plan and have the primary role in overseeing its implementation. This role is accomplished by OEHS staff through the provision of a range of safety services including project reviews and consultations, formal training sessions, and periodic laboratory audits (http://research.wayne.edu/oehs/).

1.2.2. Academic Departments
The chair of each academic department (or head of each academic unit) is responsible for ensuring that all departmental faculty members understand and take seriously their roles in implementing the Laboratory Chemical Hygiene Plan. To facilitate this process, each chair must appoint a departmental safety committee who will coordinate and monitor the implementation of the Laboratory Chemical Hygiene Plan within the department.

1.2.3. Faculty Members
Each faculty member (or Principal Investigator) is responsible for the safety of individuals working within his or her laboratories. Toward this end, faculty members must work with the respective departmental safety committee to adapt and implement the provisions of the Laboratory Chemical Hygiene Plan. This includes ensuring that each individual working within the lab is provided with appropriate training on safety and regulatory requirements; that required safety equipment and personal protective devices are provided, maintained, and used; that specific standard operating procedures incorporating safety considerations are developed and observed; and that prompt action is taken to correct any unsafe acts or conditions which have been observed or reported.

1.2.4. Laboratory Workers
Each laboratory worker is responsible for implementing the requirements of the Laboratory Chemical Hygiene Plan. This includes participating in required training, utilizing appropriate safety equipment and personal protection devices and apparel, observing standard operating procedures, and informing the supervisor (i.e., principal investigator or lab supervisor) of any accidents or unsafe conditions.

1.3. Organization and Content
The Laboratory Chemical Hygiene Plan (LCHP) is intended to serve as an operational guide for the incorporation of prudent safety practices into the day-to-day use of chemicals within laboratories. It was developed and issued in a general form which
should be adapted and expanded by particular departments and research groups to meet their specific needs. The LCHP was organized in a format that should enable desired information to be quickly found and readily updated. The content of the LCHP was established directly from the requirements of the MIOSHA Lab Standard and includes the following general types of information:

- Designation of the personnel responsible for the implementation of the Laboratory Chemical Hygiene Plan.
- Criteria that the employer will use to implement control measures to reduce individual exposures to chemicals. These measures include administrative controls, engineering controls, procedural controls, and the use of personal protective equipment.
- Standard operating procedures (SOPs) relevant to safety and health considerations which are to be observed for the use of hazardous chemicals in the laboratory. A number of generic SOPs have been included in this manual. However, each laboratory group should develop and add specific SOPs which are appropriate for their particular uses of chemicals.
- Provisions for personnel training.
- Provisions for medical consultations and examinations.
- Circumstances under which a laboratory procedure shall require prior approval before implementation.
- Provisions for additional personnel protection for work with carcinogens, reproductive toxins, and chemicals with high acute toxicity.
- A requirement that fume hoods and other protective equipment function properly and that measures will be taken to ensure this.
2. CONTROL MEASURES

The MIOSHA Lab Standard requires that laboratory personnel implement appropriate control measures to ensure that chemical exposures are maintained below regulatory limits and as low as reasonably achievable. In general, control measures can be categorized as administrative controls (i.e., standard operating procedures), engineering controls, or personal protective equipment.

2.1. Administrative Controls

Administrative controls consist of various policies, procedures and requirements which are established at an administrative level (e.g., by the Principal Investigator, Laboratory Supervisor, department Chair, department Safety Committee or OEHS) to promote safety in the laboratory. They may include,

- Ensuring that all laboratory personnel have been provided with adequate training to enable them to conduct their duties safely.
- Requiring prior approval and additional control measures for certain particularly hazardous operations or activities.
- Restricting access to areas in which particularly hazardous chemicals are used.
- Posting appropriate signs to identify specific hazards within an area.
- Requiring that various standard practices for chemical safety and good housekeeping be observed at all times in the laboratory.

2.1.1. Prior Approval of Hazardous Operations

The OSHA Lab Standard requires that activities which involve certain particularly hazardous chemicals be reviewed and approved in advance by an appropriate individual or group. Depending upon the specific department, this approving entity could be the Principal Investigator, Laboratory Supervisor, department Chair, department Safety Committee and/or OEHS. At the time of approval, any additional required control measures for the project should be specified. Examples of the types of operations which should receive prior approval are those involving the use of select carcinogens, reproductive toxins, acutely toxic chemicals, highly reactive or shock sensitive chemicals, or highly corrosive or oxidizing chemicals. In addition, any operation that produces unknown but potentially hazardous results should receive prior approval.

2.1.2. Laboratory Caution Signs

The entrance to each laboratory in which chemicals are used or stored shall be posted with the names and phone numbers of the principal investigator (or lab
supervisor) and any other designated personnel who can be contacted in the event of an emergency. In addition, laboratory entrance postings should indicate the presence of certain specific hazards.

All persons in supervisory or management positions are responsible for proper signage in their areas and for ensuring that University guidelines for labeling are followed. In addition to signage, supervisory and management personnel are responsible for ensuring annual completion of the forms required by the Emergency Planning and Community Right-to-Know Act. All laboratories must conduct an annual inventory of all chemicals stored in their location and provide this inventory to OEHS for inclusion in the annual report. Chemical inventory forms can be found on the OEHS website – http://research.wayne.edu/oehs/chemical/index.php. In addition, supervisory and management personnel are responsible for ensuring that all persons in their respective areas that handle hazardous waste (1) have been through the training class offered by the OEHS, and (2) have been trained and understand the waste handling procedures in their individual lab or work area.

Additional information concerning laboratory safety is available at http://research.wayne.edu/oehs/index.php. Teaching laboratories should provide laboratory safety training to each class of users in addition to written safety protocols due to high user volume and frequent turnover.

The 10" x 10" hazard warning sign illustrated in this section (Figure 1) is intended to warn personnel that a hazard exists in the area. The specific hazards are indicated by symbols and/or hazard warnings affixed to the placard.
Pressure-sensitive labels identifying the type(s) of hazard will be affixed to the placard. The available hazard pictograms are shown next to the definitions of conditions warranting posting of these labels. If more than one hazard exists in an area, the appropriate labels (up to a total of ten) should all be displayed on one placard.

Hazard identification labels have been divided into three priority categories: signage required by (A) federal or state regulation; (B) federal, state or industry standard guidelines; and (C) prudent or good work practice. If more than ten labels are applicable to the lab, labels will be assigned first from category A; then B; then C. No more than ten labels will be applied to any hazard warning sign.

Signs will be posted at the entrance(s) to each functionally separate lab. All entrances to laboratories from hallways will be posted with a completed sign. Entrances to laboratory prep rooms that serve multiple labs or require different labels from the main lab will also be posted.

More information can be found at [http://research.wayne.edu/oehs/chemical/lab-signage.php](http://research.wayne.edu/oehs/chemical/lab-signage.php).
2.2. **Engineering Controls**

Engineering controls consist of various measures for reducing a hazard at its source or for separating personnel from the hazard. In the laboratory, examples of engineering controls include the substitution of less hazardous chemicals in an operation, isolating a particular chemical operation, enclosing a potentially explosive reaction, or utilizing local exhaust such as a fume hood for an operation which produces airborne chemicals. Because engineering controls function to reduce or eliminate a hazard at its source *before* it is created, they should be fully considered and utilized whenever possible as the *first* step in chemical hazard control within the laboratory.

2.3. **Procedural Controls**

Procedural controls (or work practice controls) are typically in the form of standard operating procedures (SOPs) which define the *manner* in which certain types of chemicals are to be handled, or the manner in which specific operations involving chemicals are to be conducted, in order to minimize hazards. Section 3.0 of this Plan contains a number of SOPs which are generally applicable to all laboratories. It is the responsibility of personnel in each laboratory however to develop specific SOPs which reflect the operations and experimental protocols performed in their laboratory and to ensure that all laboratory personnel have read and understood these SOPs.

2.4. **Personal Protective Equipment**

For many laboratory operations, the risk of chemical exposure cannot be totally eliminated through the use of engineering and procedural control measures. For this reason, it is necessary to supplement such measures with the use of personal protective equipment and apparel (PPE). Because PPE functions as a barrier between the laboratory worker and the chemical hazard, rather than by actually reducing or eliminating the hazard, its use should always be in addition to (and never as a substitute for) appropriate engineering and procedural controls. It is the responsibility of the principal investigator (or supervisor) of the laboratory to ensure that appropriate personal protective equipment is provided to, and used by, all laboratory personnel. Such equipment should be adequate to ensure personnel are protected from chemical exposure to the eyes, skin, and respiratory tract.

2.4.1. **Eye Protection**

Appropriate PPE for the eyes is *required* whenever there is a reasonable probability that the eyes could be exposed to chemicals. Vented safety goggles are the preferred eye protection to be worn when chemicals are handled in the laboratory. *Vented safety*
goggles are required in all undergraduate teaching laboratories. These should be worn over prescription glasses.

All protective equipment for the eyes must bear the stamp Z87, which indicates that it meets the performance guidelines established by the American National Standards Institute in ANSI Z87.1 "Practice for Occupational and Educational Eye and Face Protection."

2.4.2. Face Protection

A face shield is required whenever there is a potential for severe chemical exposure from splashes, fumes, or explosions. Because a face shield alone does not adequately protect the eyes, it must be worn over safety goggles. In general, any operation that requires a face shield should be conducted inside a hood with the sash down as an additional barrier.

2.4.3. Hand Protection

Because the hands are typically the part of the body in closest contact with chemicals in the laboratory, they are particularly vulnerable to chemical exposures. For this reason it is essential that laboratory personnel select appropriate protective gloves and wear them whenever handling chemicals. Because different glove materials resist different chemicals, no one glove is suited for all chemical exposures. Glove selection guides are available from most manufacturers and should be consulted before choosing a glove.

2.4.4. Foot Protection

Safety shoes or other specialized foot protection are generally not required for most laboratory operations. However, footwear which completely covers the skin of the feet must be worn whenever chemicals are being used (sandals and open-toed shoes are prohibited in the laboratory).

2.4.5. Body Protection

By virtue of its large surface area, the skin is at considerable risk of exposure to chemicals in the laboratory. To lessen this risk, it is essential that laboratory personnel wear clothing which, to the extent possible, covers all skin surfaces (shorts and short skirts are inappropriate attire for the laboratory). In addition, a fully buttoned lab coat should be worn during chemical manipulations. Clothing and lab coats should be regarded, not as means of preventing exposure, but as means of lessening or delaying exposure. The effectiveness of clothing as a protective barrier for the skin depends upon its prompt removal in the event that it becomes contaminated.
2.4.6. **Respiratory Protection**

The implementation of appropriate engineering and procedural controls should always be the preferred strategy for ensuring that any airborne levels of chemicals within the laboratory are well below regulatory limits. However, in rare circumstances where such control measures are not sufficient, laboratory personnel may need to utilize respirators for a particular operation. In such instances, personnel must participate fully in the university's *Respiratory Protection Program* which requires a medical exam, respirator fit-testing, and training prior to respirator use. Contact the Office of Environmental Health and Safety for more information (313) 577-1200.
3. GENERAL LABORATORY SOPS

The following laboratory safety standard operating procedures (SOPs) are to be used as guidelines for the work on your work areas. They are general guidelines that apply many industry recognized safety rules to laboratory settings and operations. Use these SOPs as a starting point to implement any lab-specific SOPs to be written and incorporated into your daily lab routines. A template for creating lab specific SOPs can be found on the OEHS website http://research.wayne.edu/oehs/chemical/sops.php.
3.1. General Laboratory Safety Procedures

**DO**
- Know the potential hazards of the materials used in the laboratory. Review the Safety Data Sheet (SDS), formerly known as the Material Safety Data Sheet (MSDS), and container label prior to using a chemical.
- Know the location of safety equipment such as emergency showers, eyewashes, fire extinguishers, fire alarms, spill kits, first aid kits, and telephones.
- Review emergency procedures to ensure that necessary supplies and equipment for spill response and other accidents are available.
- Practice good housekeeping to minimize unsafe work conditions such as obstructed exits and safety equipment, cluttered benches and hoods, and accumulated chemical waste.
- Wear personal protective apparel when working with chemicals. This includes eye protection, lab coat, gloves, and appropriate foot protection (closed-toe shoes, no sandals). Gloves should be made of a material known to be resistant to permeation by the chemical in use.
- Wash skin promptly if contacted by any chemical, regardless of corrosivity or toxicity.
- Always wash your hands before leaving the lab.
- Label all new chemical containers with the "date received" and "date opened."
- Expiration dates must be clearly marked for materials known to deteriorate or to become unstable or reactive, including: Picrics originating at less than 10% hydration, Perchlorates, Peroxides, Peroxidizable materials and Polymerizers that react violently or become hazardous after polymerization.
- Since ethers form explosive peroxides over time, they must be disposed of either 12 months after date of receipt or six months after being opened, whichever comes first.
- Label and store chemicals properly. All chemical containers should be labeled to identify the container contents (no abbreviations or formulas) and hazard information. Chemicals should be stored by hazard groups and chemical compatibilities.
- Use break-resistant bottle carriers when transporting chemicals in glass containers that are greater than 500 milliliters.
- Use fume hoods when processes or experiments may result in the release of toxic or flammable vapors, fumes, or dusts.

**DON'T**
- Eat, drink, chew gum, or apply cosmetics in areas where chemicals are used and stored.
- Store food in laboratory refrigerators, ice chests, cold rooms, or ovens.
- Drink water from laboratory water sources.
- Don’t use ice from laboratory sources in beverages.
- Use laboratory glassware to prepare or consume food.
- Smell or taste chemicals.
- Pipet by mouth.
- Work alone in the laboratory without prior approval from the lab supervisor.
- Leave potentially hazardous experiments or operations unattended without prior approval from the lab supervisor. In such instances, the lights in the laboratory should be left on and emergency phone numbers posted at the laboratory entrance.

FOR CHEMICAL SAFETY ASSISTANCE CALL
Office of Environmental Health and Safety (313) 577-1200 (8:30a.m.-5p.m., Mon.-Fri.)
3.2. **Proper Labeling and Safe Storage of Chemicals**

Proper chemical labeling and storage is essential for a safe laboratory work environment. Inappropriate storage of incompatible or unknown chemicals can lead to spontaneous fire and explosions with the associated release of toxic gases. To minimize these hazards, chemicals in the laboratory must be segregated properly. The storage procedures listed below are not intended to be all-inclusive but should serve instead, to supplement more specific procedures and recommendations obtained from container labels, Safety Data Sheets (SDSs), and other chemical reference material. For more information about chemical storage contact the Office of Environmental Health and Safety ((313) 577-1200).

**LABELING**

- Manufacturer chemical labels should never be removed or defaced until the chemical is completely used.
- All chemical and waste containers should be clearly labeled with the full chemical name(s) (no abbreviations or formulas) and appropriate hazard warning information. Small containers that are difficult to label such as 1-10 ml vials and test tubes can be labeled as a group and stored together. When appropriate a reference to a laboratory notebook should be provided. Unattended beakers, flasks, and other laboratory equipment containing chemicals used during an experiment should be labeled with the full chemical name(s).
- All chemicals should be labeled with the "date received" and "date opened."
- All hazardous waste containers must be tagged with the WSU OEHS "hazardous waste tag."
- All hazardous waste that contains radioactive waste must be tagged with the WSU OEHS “radioactive waste tag”.
- All hazardous waste that is mixed waste (e.g., chemical waste and radioactive waste) must be tagged with WSU OEHS ‘hazardous waste tag” and a “radioactive waste tag”.
- All hazardous waste containers must be marked with an accumulation date. The accumulation date represents the date that hazardous waste is first placed in the container (waste containers should NOT be filled to more than 90% of their capacity).
- All full waste containers should be processed for pick up through the OEHS on-line waste request system. [http://research.wayne.edu/oehs/chemical/waste.php](http://research.wayne.edu/oehs/chemical/waste.php)
- All chemical storage areas such as cabinets, shelves and refrigerators should be labeled to identity the hazardous nature of the chemicals stored within the area (e.g., flammables, corrosives, oxidizers, water reactives, toxics, carcinogens, and reproductive toxins). All signs should be legible and conspicuously placed.

**STORAGE**

- A definite storage place should be provided for each chemical and the chemical should be returned to that location after each use.
- Chemical containers should be in good condition before they are stored. Containers should be managed to prevent leaks.
- Chemicals (including waste) should be separated and stored according to their hazard group and specific chemical incompatibilities. **Chemicals within the same hazard group can be incompatible and therefore it is important to review the chemical label and SDS to determine the specific storage requirements and possible incompatibilities.**
• Special attention should be given to the storage of chemicals that can be classified into two or more hazard groups. For example, acetic acid and acetic anhydride are both corrosive and flammable. In addition, perchloric acid is both corrosive and a strong oxidizer. Refer to the SDS for proper storage procedures.
• Chemicals should be separated by distance. Physical barriers such as storage cabinets and secondary containers should be used to prohibit contact of incompatible chemicals in the event that they are accidentally released or spilled.
• Secondary containers are highly recommended for the storage of liquid chemicals. Secondary container should be made of a material that is compatible with the chemical(s) it will hold and should be large enough to contain the contents of the largest container.
• Liquid chemicals should not be stored above dry chemicals unless they are stored in secondary containers.
• Storage of chemicals within hoods and on bench tops should be avoided.
• Stored chemicals should not be exposed to heat or direct sunlight.
• Storage shelves and cabinets should be secure to prevent tipping. Shelving should contain a front-edge lip or doors to prevent containers from falling.
• Flammable and corrosive storage cabinets should be used when possible.
• Flammable liquids in quantities exceeding a total of 25 gallons in each laboratory must be stored in an approved flammable storage cabinet.
• Only explosion-proof or laboratory-safe refrigerators may be used to store flammable liquids.
• Liquid chemicals should be stored below eye level to avoid accidental spills.
• Chemicals should not be stored in areas where they can be accidentally broken and spilled such as on the floor or on the edge of a bench top.
• Chemicals should not be stored in areas where they obstruct aisles, exits, and emergency equipment.
### SUGGESTED SHELF STORAGE PATTERN – INORGANIC REAGENTS

<table>
<thead>
<tr>
<th>INORGANIC #1</th>
<th>INORGANIC #2</th>
<th>INORGANIC #3</th>
<th>INORGANIC #4</th>
<th>INORGANIC #5</th>
<th>INORGANIC #6</th>
<th>INORGANIC #7</th>
<th>INORGANIC #8</th>
<th>INORGANIC #9</th>
<th>MISCELLANEOUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>METALS &amp; HYDRIDES</td>
<td>HALIDES, SULFATES, SULFITES, THIOSULFATES, PHOSPHATES, HALOGENS, ACETATES</td>
<td>AMIDES, NITRATES (Not AMMONIUM NITRATE) NITRITES, AZIDES</td>
<td>HYDROXIDES, OXIDES, SILICATES, CARBONATES, CARBON</td>
<td>SULFIDES, SELENIDES, PHOSPHIDES, CARBIDES, NITRIDES</td>
<td>CHLORATES, PERCHLORATES, CHLORITES, PERCHLORIC ACID, PEROXIDES, HYPOCHLORITES, HYDROGEN PEROXIDE</td>
<td>ARSENATES, CYANIDES, CYANALEs (Store away from any water)</td>
<td>BORATES, CHROMATES, MANGATES, PERMANGANATES</td>
<td>ACIDS, except NITRIC (Acids are best stored in dedicated cabinets)</td>
<td>If possible, avoid using the floor</td>
</tr>
</tbody>
</table>

If possible, avoid using the floor.
### SUGGESTED SHELF STORAGE PATTERN – ORGANIC

<table>
<thead>
<tr>
<th>ORGANIC #2</th>
<th>ORGANIC #8</th>
<th>ORGANIC #6</th>
<th>ORGANIC #1</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALCOHOLS, GLYCOLS, AMINES, AMIDES, IMINES, INIDES</td>
<td>PHENOL, CRESOLS</td>
<td>PEROXIDES, AZIDES, HYDROPEROXIDES</td>
<td>ACIDS, ANHYDRIDES, PERACIDS</td>
</tr>
<tr>
<td>(Store flammables in a dedicated cabinet)</td>
<td></td>
<td></td>
<td>(Store certain organic acids in acid cabinet)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ORGANIC #3</th>
<th>ORGANIC #4</th>
<th>MISCELLANEOUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>HYDROCARBONS, ESTERS, ALDEHYDES</td>
<td>Ethers, Ketones, Ketenes, Halogenated Hydrocarbons, Ethylene Oxide</td>
<td></td>
</tr>
<tr>
<td>(Store flammables in a dedicated cabinet)</td>
<td>(Store flammables in a dedicated cabinet)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ORGANIC #5</th>
<th>MISCELLANEOUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPOXY COMPOUNDS, ISOCYANATES</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ORGANIC #7</th>
<th>MISCELLANEOUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SULFIDES, POLYSULFIDES, ETC.</td>
<td></td>
</tr>
</tbody>
</table>

If possible, avoid using the floor
## Chemical Segregation & Incompatibilities Guidelines

<table>
<thead>
<tr>
<th>Class of Chemical</th>
<th>Examples</th>
<th>Recommended Storage Method</th>
<th>Incompatible Materials</th>
<th>Possible Reaction If Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Corrosive Acids</strong></td>
<td><strong>Mineral Acids</strong>—Chromic Acid, Hydrogen Chloride, Hydrochloric Acid, Nitric Acid, Perchloric Acid, Phosphoric Acid, Sulfuric Acid</td>
<td>Separate cabinet or storage area away from potential water sources, i.e. under sink</td>
<td>Flammable Liquids, Flammable Solids, Bases, Oxidizers, Poisons</td>
<td>Heat, Gas Generation, Violent Reaction</td>
</tr>
<tr>
<td><strong>Corrosive Bases/Caustics</strong></td>
<td>Ammonium Hydroxide, Sodium Hydroxide, Sodium Bicarbonate</td>
<td>Separate cabinet or storage area away from potential water sources, i.e. under sink</td>
<td>Flammable Liquids, Flammable Solids, Acids, Oxidizers, Poisons</td>
<td>Heat, Gas Generation, Violent Reaction</td>
</tr>
<tr>
<td><strong>Explosives</strong></td>
<td>Ammonium Nitrate, Nitro Urea, Picric Acid, Trinitroaniline, Trinitrobenzene, Trinitrobenzoic Acid, Trinitrotoluene, Urea Nitrate</td>
<td>Secure location away from other chemicals</td>
<td>Flammable Liquids, Oxidizers, Poisons, Acids, Bases</td>
<td>Explosion Hazard</td>
</tr>
<tr>
<td><strong>Flammable Liquids</strong></td>
<td>Acetone, Benzene, Diethyl Ether, Methanol, Ethanol, Toluene, Glacial Acetic Acid</td>
<td>Grounded flammable storage cabinet of flammable storage refrigerator</td>
<td>Acids, Bases, Oxidizers, Poisons</td>
<td>Fire Hazard, Heat, Violent Reaction</td>
</tr>
<tr>
<td><strong>Flammable Solids</strong></td>
<td>Phosphorus, Magnesium</td>
<td>Separate dry cool area</td>
<td>Acids, Bases, Oxidizers, Poisons</td>
<td>Fire Hazard, Heat, Violent Reaction</td>
</tr>
</tbody>
</table>
| **Oxidizers** | Sodium Hypochlorite  
Benzoyl Peroxide  
Potassium Permanganate  
Potassium Chlorate  
Potassium Dichromate  
Peroxides  
Chlorates  
Nitrates | Spill tray that is separate from flammable and combustible materials | **Reducing Agents** | Fire Hazard  
**Toxic Gas**  
**Generation** | **Flammables**  
**Combustibles**  
**Corrosives** |
|---|---|---|---|---|
| **Poisons** | Cyanides  
Cadmium  
Mercury  
Osmium  
Acrylamide  
DMSO | Vented, cool, dry area in unbreakable chemically resistant secondary containers | **Flammable Liquids**  
**Acids**  
**Bases**  
**Oxidizers**  
**Corrosives** | **Generation of Toxic & Flammable Gas**  
**Violent Reaction** |
| **Water Reactive Chemicals** | Sodium Metal  
Potassium Metal  
Lithium Metal  
Lithium Aluminum Hydride | Dry, cool location away from potential spray from fire sprinklers and other water sources, i.e. under sink | **Aqueous Solutions**  
**Oxidizers** | **Heat**  
**Violent Reaction** |
| **Flammable Compressed Gases** | Methane  
Acetylene  
Propane  
Hydrogen | Cool, dry area away from oxidizing gases while securely attached to wall or bench | **Oxidizing & Toxic Compressed Gases**  
**Oxidizing Solids** | **Fire Hazard**  
**Explosion Hazard** |
| **Oxidizing Compressed Gases** | Oxygen  
Chlorine  
Bromine | Cool, dry area away from flammable gases while securely attached to wall or bench | **Flammable Gases** | **Fire Hazard**  
**Explosion Hazard** |
| **Poisonous Compressed Gases** | Carbon Monoxide  
Hydrogen Sulfide | Cool, dry area away from flammable gases or liquids while securely attached to wall or bench | **Flammable Gases**  
**Oxidizing Gases** | **Release of Toxic Gas**  
**Violent Reaction** |
**Partial Incompatibility Listing**

<table>
<thead>
<tr>
<th>Compound/Class</th>
<th>Avoid Storage Near or Contact With</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acids</strong></td>
<td></td>
</tr>
<tr>
<td>Acetic Acid</td>
<td>Chromic Acid, nitric acid, hydroxyl compounds, ethylene, glycogen, perchloric acid, peroxides, permanganate</td>
</tr>
<tr>
<td>Hydrofluoric Acid</td>
<td>Ammonia (aqueous or anhydrous)</td>
</tr>
<tr>
<td>Nitric Acid (conc.)</td>
<td>Acetic acid, aniline, chromic acid, acetone, alcohol, or other flammable liquids, hydrocyanic acid, hydrogen sulfide, or other flammable gases, nitratable substances: copper, brass or any heavy metals (or will generate nitrogen dioxide/nitrous fumes) or organic products such as wood and paper</td>
</tr>
<tr>
<td>Sulfuric Acid</td>
<td>Light metals (lithium, sodium, potassium), chlorates, perchlorates, permanganates</td>
</tr>
<tr>
<td><strong>Bases</strong></td>
<td></td>
</tr>
<tr>
<td>Ammonia</td>
<td>Mercury, chlorine, bromine, iodine, hydrofluoric acid, calcium hypochlorite</td>
</tr>
<tr>
<td>Calcium oxide</td>
<td>Water</td>
</tr>
<tr>
<td>Alkaline metals</td>
<td>Sodium, potassium, magnesium, calcium, aluminum, carbon dioxide, carbon tetrachloride or other chlorinated hydrocarbons, halogens, water</td>
</tr>
<tr>
<td>Bromine</td>
<td>Ammonia, acetylene, butadiene, methane, propane, butane (or other petroleum gases), hydrogen, sodium carbide, turpentine, benzene, finely divided metals</td>
</tr>
<tr>
<td>Carbon, activated</td>
<td>Calcium hypochlorite, oxidizing agents</td>
</tr>
<tr>
<td>Chlorine</td>
<td>Ammonia, acetylene, butadiene, methane, propane, butane, or other petroleum gases, hydrogen, sodium carbide, turpentine, benzene, finely divided metals</td>
</tr>
<tr>
<td>Copper</td>
<td>Acetylene, hydrogen peroxide, nitric acid</td>
</tr>
<tr>
<td>Fluorine</td>
<td>Isolate from everything</td>
</tr>
<tr>
<td>Iodine</td>
<td>Acetylene, ammonia (aqueous or anhydrous), hydrogen</td>
</tr>
<tr>
<td>Mercury</td>
<td>Acetylene, ammonia, fulminic acid (produced in nitric acid ethanol mixtures)</td>
</tr>
<tr>
<td>Oxygen</td>
<td>Oils, grease, hydrogen, other flammable gases, liquids, or solids</td>
</tr>
<tr>
<td>Phosphorous (White)</td>
<td>Air, oxygen, caustic alkalis as reducing agents (or will generate phosphine)</td>
</tr>
<tr>
<td>Potassium</td>
<td>Carbon tetrachloride, carbon dioxide, water</td>
</tr>
<tr>
<td>Silver</td>
<td>Acetylene, oxalic acid, tartaric acid, fulminic acid (produced in nitric acid-ethanol mixtures), and ammonium compounds</td>
</tr>
<tr>
<td><strong>Organics</strong></td>
<td></td>
</tr>
<tr>
<td>Acetone</td>
<td>Concentrated nitric acid and sulfuric acid mixtures</td>
</tr>
<tr>
<td>Acetylene</td>
<td>Fluorine, chlorine, bromine, copper, silver, mercury</td>
</tr>
<tr>
<td>Aniline</td>
<td>Nitric acid, hydrogen peroxide</td>
</tr>
<tr>
<td>Flammable Liquids</td>
<td>Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens</td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>Fluoride, chlorine, bromine, chromic acid, sodium peroxide (propane, butane, etc.)</td>
</tr>
<tr>
<td>Nitroparaffins</td>
<td>Inorganic bases, amines</td>
</tr>
<tr>
<td>Oxalic Acid</td>
<td>Silver, mercury</td>
</tr>
</tbody>
</table>
### Oxidizers

<table>
<thead>
<tr>
<th>Compound</th>
<th>Reaction Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorates</td>
<td>Ammonia salts, acids, metal powders, sulfur, finely divided organics, or combustible materials</td>
</tr>
<tr>
<td>Chromic Acid (trioxide)</td>
<td>Acetic acid, naphthalene, camphor, glycerol, turpentine, alcohol or flammable liquids</td>
</tr>
<tr>
<td>Ammonium Nitrate</td>
<td>Acids, metal powders, flammable liquids, chlorates, nitrates, sulfur, finely divide organic or combustible materials</td>
</tr>
<tr>
<td>Chlorine Dioxide</td>
<td>Ammonia, methane, phosphate, hydrogen sulfide</td>
</tr>
<tr>
<td>Cumene Hydroperoxide</td>
<td>Organic or inorganic acids</td>
</tr>
<tr>
<td>Hydrogen Peroxide</td>
<td>Copper, chromium, iron, most other metals or salts, alcohols, acetone, or other flammable liquids, aniline, nitromethane, or other organic or combustible materials</td>
</tr>
<tr>
<td>Hypochlorites</td>
<td>Acids (will generate chlorine or hypochlorous acid)</td>
</tr>
<tr>
<td>Nitrates</td>
<td>Sulfuric acid (will generate nitrogen dioxide)</td>
</tr>
<tr>
<td>Perchloric Acid</td>
<td>Acetic acid, bismuth and its alloys, alcohol, paper, wood, grease, oils</td>
</tr>
<tr>
<td>Peroxides (Organics)</td>
<td>Organic or inorganic acids; also avoid friction and store cold</td>
</tr>
<tr>
<td>Potassium Chlorate</td>
<td>Acids, especially sulfuric acid</td>
</tr>
<tr>
<td>Potassium Permanganate</td>
<td>Glycerol, ethylene glycol, benzaldehyde, sulfuric acid</td>
</tr>
<tr>
<td>Sodium Peroxide</td>
<td>Any oxidizable substance such as methanol, ethanol, glycerol, ethylene glycol, glacial acetic acid, acetic anhydride, benzaldehyde, furfural, methyl acetate, ethyl acetate, carbon disulfide</td>
</tr>
<tr>
<td>Alkaline metals</td>
<td>Sodium, potassium, magnesium, calcium, aluminum, carbon dioxide, carbon tetrachloride or other chlorinated hydrocarbons, halogens, water</td>
</tr>
<tr>
<td>Calcium Oxide</td>
<td>Water</td>
</tr>
<tr>
<td>Cyanides</td>
<td>Acids (will generate hydrogen cyanide)</td>
</tr>
<tr>
<td>Phosphorous (white)</td>
<td>Air, oxygen, caustic alkalis as reducing agents (will generate phosphine)</td>
</tr>
<tr>
<td>Potassium</td>
<td>Carbon tetrachloride, carbon dioxide, water</td>
</tr>
<tr>
<td>Sodium</td>
<td>Carbon tetrachloride, carbon dioxide, water</td>
</tr>
<tr>
<td>Sodium Peroxide</td>
<td>Any oxidizable substance such as methanol, ethanol, glycerol, ethylene glycol, glacial acetic acid, acetic anhydride, benzaldehyde, furfural, methyl acetate, ethyl acetate, carbon disulfide</td>
</tr>
<tr>
<td>Sulfides</td>
<td>Acids (will generate hydrogen sulfide)</td>
</tr>
</tbody>
</table>

### Reducing Agents

<table>
<thead>
<tr>
<th>Compound</th>
<th>Reaction Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrazine</td>
<td>Hydrogen peroxide, nitric acid, other oxidants</td>
</tr>
<tr>
<td>Nitrites</td>
<td>Acids (will generate nitrous fumes)</td>
</tr>
<tr>
<td>Sodium Nitrite</td>
<td>Ammonium nitrate and other ammonium salts</td>
</tr>
</tbody>
</table>

### Toxics/Poisons

<table>
<thead>
<tr>
<th>Compound</th>
<th>Reaction Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenicals</td>
<td>Reducing agents (will generate arsine)</td>
</tr>
<tr>
<td>Azides</td>
<td>Acids (will generate hydrogen azide)</td>
</tr>
<tr>
<td>Cyanides</td>
<td>Acids (will generate hydrogen cyanide)</td>
</tr>
<tr>
<td>Hydrocyanic Acid</td>
<td>Nitric Acid, alkalis</td>
</tr>
<tr>
<td>Hydrogen Sulfide</td>
<td>Fuming nitric acid, oxidizing gases</td>
</tr>
<tr>
<td>Selenides</td>
<td>Reducing agents (will generate hydrogen selenide)</td>
</tr>
<tr>
<td>Sulphides</td>
<td>Acids (will generate hydrogen sulfide)</td>
</tr>
<tr>
<td>Tellurides</td>
<td>Reducing agents (will generate hydrogen telluride)</td>
</tr>
</tbody>
</table>
3.3. Proper and Safe Use of Chemical Fume Hoods

The fume hood is the best known local exhaust device used in laboratories. When used properly, it will protect the user from exposure to potentially harmful chemical contaminatees. It's important to remember that the hood is just part of the building's complete ventilation system, and its performance may be strongly influenced by other features in the system.

Successful hood performance depends on the velocity of air moving through the hood. Airflow is affected by cross drafts, entrance shapes, thermal loading and objects placed in the hood.

The hood sash is meant to protect the user from exposure to harmful vapors, and to minimize the effects of explosions, fires, spills and splashes that may occur within the hood.

Arrows on the side of the hood should indicate where the sash should be positioned to achieve the proper airflow. This sash height should be set between 12 and 18 inches from the bottom of the opening to protect the user and allow adequate room to work.

A fume hood that isn't performing properly is often worse than no hood at all because the user is likely to have a false sense of security about its ability to provide protection.

Newer models of hoods have a built in velometer to let the user know what the airflow is at all times. Older models must be monitored by OEHS to determine the airflow.

Chemical fume hoods are one of the most important items of safety equipment present within the laboratory. Chemical fume hoods serve to control the accumulation of toxic, flammable, and offensive vapors by preventing their escape into the laboratory atmosphere. In addition, fume hoods provide physical isolation and containment of chemicals and their reactions and thus serve as a protective barrier (with the sash closed) between laboratory personnel and the chemical or chemical process within the hood.

The Office of Environmental Health and Safety (OEHS) evaluates the performance of hoods annually and works with the department of Facilities Planning and Management to identify and correct problems that may arise.

- For optimum safety, use all hazardous chemicals in the hood. Always perform procedures with highly toxic materials in the hood, especially those with a permissible exposure limit (PEL) of 50 ppm or less. A chemical fume hood should be used for any chemical procedures which have the potential of creating:
  1. Airborne chemical concentrations which might approach Permissible Exposure Limits (PELs) for an Occupational Safety and Health Administration (OSHA) regulated substance. These substances include carcinogens, mutagens, teratogens, and other toxic compounds (see the Laboratory Hazard Assessment Checklist).
2. Flammable/combustible vapors approaching one tenth the lower explosion limit (LEL). The LEL is the minimum concentration (percent by volume) of the fuel (vapor) in air at which a flame is propagated when an ignition source is present.

3. Explosion or fire hazards.

4. Odors which are annoying to personnel within the laboratory or adjacent laboratory/office units.

- Chemicals and equipment (apparatus, instruments, etc.) should be placed at least 6 inches (15 cm) from the front edge of the hood. Perform work at least 6 inches into the hood to protect yourself from exposure to vapors.
- Keep only equipment and chemicals necessary for your experiment in the hood. Equipment should be placed as far back in the hood as practical without blocking the baffles. Separate and elevate equipment by using blocks to ensure that air can flow easily around and under the equipment.
- Chemical fume hoods should be kept clean and free from unnecessary items and debris at all times. Keep combustibles, such as paper towels, out of the hood. Solid material (paper, tissue, aluminum foil, etc.) should be kept from obstructing rear baffles and from entering the exhaust ducts of the hood. Minimize the amount of bottles, beakers and equipment used and stored inside the hood because these items interfere with the air flow across the work surface of the hood.
- Hood baffles or slots should be positioned properly. The top baffle/slot should be opened when chemicals with a vapor density of less than 1 (lighter than air) are used. The bottom baffle/slot should be opened when chemicals with vapor densities greater than 1 (heavier than air) are used. Do not block the rear hood exhaust slots with equipment or materials.
- The hood sash opening should be kept to a minimum while the hood is used. When working with hazardous chemicals, the hood sash should be positioned so that it acts as a protective barrier between laboratory personnel and the chemicals.
- Sliding horizontal sash windows should not be removed from the hood sash.
- Minimize traffic near the hood, especially when conducting a hazardous procedure.
- Laboratory personnel should not extend their head into the hood or leave the sash fully open during experiments involving hazardous chemicals.
- When the hood is not in use lower the sash to the closed position. The majority of fume hoods on campus draw less airflow when the sash is closed, reducing heating and cooling costs for the university.
- Do not position fans or air conditioners in the room in a manner that will direct air flow across the face of the hood and interfere with containment.
- Chemical fume hoods should never be used as a means of evaporating old or unwanted chemicals. Call OEHS at (313) 577-1200 for free chemical disposal.
- Fume hoods are not meant for storage of chemicals or lab equipment. Chemicals should not be stored in a hood because they will likely become involved if there is an accidental spill, fire or explosion in the hood, thus creating a more serious problem.
• Hoods should be monitored daily by the user to ensure that air is moving into the hood. A strip of tissue taped to the hood sash will indicate if the hood is pulling air. Any hoods that are not working properly should be taken out of service and reported to the Office of Environmental Health and Safety ((313) 577-1200). OEHS is responsible for inspecting chemical fume hoods annually.

• Perchloric acid must not be used in a regular chemical fume hood. Specially designed Perchloric Acid Fume Hoods must be utilized for this purpose. Call OEHS for more information.

• Know the health hazards of the materials you are working with, and become familiar with the signs and symptoms of overexposure.
3.4. **Corrosive Chemicals**

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact OEHS at (313) 577-1200 or the Principal Investigator/Laboratory Instructor of your laboratory. Specific written procedures are the responsibility of the Principal Investigator/Laboratory Instructor.

If compliance with all the requirements of this standard operating procedure is not possible, the Principal Investigator/Laboratory Instructor must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Corrosive chemicals are substances that cause visible destruction or permanent changes in human skin tissue at the site of contact, or are highly corrosive to steel. Corrosive chemicals can be liquids, solids, or gases and can affect the eyes, skin, and respiratory tract. The major classes of corrosives include strong acids, bases, and dehydrating agents. Liquid **corrosive** chemicals are those with a pH of 4.0 or lower or a pH of 9 or higher. Solid chemicals are considered corrosive when in solution they fall in the above pH range. A **highly corrosive** chemical has a pH of 2 or lower or a pH of 12.5 or higher. **Injurious** chemicals cause tissue destruction at the site of contact.

Some examples of corrosive materials:

**Strong Acids:** hydrochloric, sulfuric, phosphoric, nitric

**Strong Bases:** hydroxides of sodium, potassium, ammonia

**Strong Dehydrating Corrosives:** sulfuric, phosphorous pentoxide, calcium oxide

**Strong Oxidizing Corrosives:** concentrated hydrogen peroxide, sodium hypochlorite, nitric acid

**Corrosive Gases:** chlorine, ammonia

**Corrosive Solids:** phosphorous, phenol

**Before you begin**

- **Approvals and Notifications**

Most corrosives can be used by properly-trained individuals in the laboratory environment without the need for specific OEHS approval. Special circumstances, such as abnormally large-scale use may require evaluation. Contact OEHS at 313-577-1200 for assistance.
OEHS should be notified before purchasing hydrofluoric acid for use in your laboratory for the first time. OEHS will consult with you to establish proper safety procedures.

OEHS should be notified before purchasing certain corrosive compressed gases such as anhydrous ammonia.

- **Training required**

  Training requirements based on job duties and responsibilities are determined for each employee by the Principal Investigator/Laboratory Instructor

  Any users of corrosive chemicals should have taken an Introduction to Laboratory Safety course as well as any required annual updates.

  Most introductory programs are offered annually. Dates are available on the OEHS website: [http://research.wayne.edu/oehs/training/lab.php](http://research.wayne.edu/oehs/training/lab.php). Annual updates of these programs can be completed online. For more information on these programs or to request a training program on safety or health topics for your department, please contact **OEHS at (313) 577-1200**.

- **Purchasing materials**

  Purchase of any container of corrosives with a volume of greater than 5 gallons for laboratory use requires OEHS approval.

- **Hazard Assessment**

  A hazard assessment for work involving corrosives must thoroughly address the issues of proper use and handling, fire safety, chemical toxicity, storage, and spill response.

  A hazard assessment must be conducted when a process/reaction/work-up/or purification is changed or when scaling-up any corrosives use to more than 10 times the original volume.

  The first time a highly hazardous corrosive material such as concentrated sulfuric or nitric acid is used for a process, a hazard assessment should be conducted.

  Upon request OEHS can assist you in performing a thorough hazard assessment.

### Setting up

- **Storage: Corrosive Chemical Storage Cabinets**

  Chemicals should be segregated according to the Proper Labeling and Safe Storage section of the Chemical Hygiene Plan (SOP 3.2)

  Cabinets: Specially designed corrosion resistant cabinets should be used for the storage of large quantities of corrosive materials. For new lab construction, renovations, and whenever possible in
existing labs, industry standards on the specifications for acid cabinets should be followed. Cabinets for storing alkaline corrosive materials should be of the same construction whenever possible.

If no corrosion-resistant cabinet is available, store corrosives on plastic trays.

Do not store corrosive liquids above eye level.

- **Engineering Controls (ventilation, shielding, vacuum protection)**

  **Safety Shielding**: Shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of corrosives which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are also acceptable.

  **Special Ventilation**: Corrosive materials must be handled in a chemical fume hood if production of corrosive vapor is anticipated. Manipulation of corrosives outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to corrosives in the laboratory and are the preferred ventilation control device. Always attempt to handle quantities of corrosives greater than 500 mL in a fume hood. If your research does not permit the handling of large quantities of corrosives in your fume hood, contact the OEHS to review the adequacy of all special ventilation.

  **Vacuum Protection**: Evacuated glassware can implode and eject flying glass, and chemicals. Vacuum work involving corrosives must be conducted in a fume hood, glove box or isolated in an acceptable manner. Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood. Vacuum pumps should be rated for use with corrosives.

- **Personal Protective Equipment**

  Splash proof goggles in addition to standard laboratory personal protective equipment (PPE) consisting of a 100% cotton lab coat, closed toe shoes and nitrile gloves must be worn when there is a significant risk of splash. Pouring very large volumes or handling particularly corrosive materials may require additional PPE consisting of thicker gloves and an apron. Contact OEHS with assistance in selecting chemical resistant personal protective equipment that is appropriate for the materials you are handling and the type of work you are doing.

  Eye protection in the form of safety glasses must be worn at all times when handling corrosives. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87.1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for a
splash hazard exists other eye protection and/or face protection must be worn. In addition to safety glasses, a face shield should be worn when splash or spray is foreseeable.

Gloves must be worn when handling corrosives. Disposable nitrile gloves (4 mil minimum thickness) provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. Information on glove selection is provided in section A-2 of the Laboratory Hazard Assessment Tool
(http://www.chem.wayne.edu/grad_students/Laboratory_Hazard_Assessment_Tool-v2_Dec_16_2016.pdf). Lab workers should contact OEHS for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated.

Some examples of when specialty gloves may be necessary are: handling of hydrofluoric acid, when immersion in corrosive liquids is anticipated, and when large volumes of corrosive liquids are being transferred or dispensed.

At a minimum, 100% cotton lab coats, closed toed shoes, and long-sleeved clothing must be worn when handling corrosives. Additional protective clothing, such as a chemical-resistant apron, should be worn if the possibility of skin contact is likely.

Protect all skin surfaces from contact with corrosive or irritating gases and vapors.

- Emergency Irrigation (Eyewash and safety shower)

A safety or drench shower should be available within 10 seconds of travel from where the corrosives are used.

Safety showers are tested annually by OEHS or Facilities Planning and Management (FP&M) personnel.

Where the eyes or body of any person may be exposed to corrosives, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Eyewashes must be activated weekly by laboratory workers to ensure proper function of equipment and to flush the plumbing.

Carrying out your work

Consult the Safety Data Sheet (SDS) for any new corrosive chemicals you introduce to your lab. Fully assess the potential hazards and consider what safety equipment will be needed before you begin your work. OEHS can provide you with an SDS for any chemical you plan to use.

- Handling

Handling process for liquids should be designed to minimize the potential for splash, splatter, or other likely scenarios for accidental contact.
Do not pour water into acid. Slowly add acid to water with stirring and cooling if heat generation can be anticipated.

Reactions involving acids and bases are often very exothermic.

Use only heat resistant lab ware.

Allow for extra volume in your mixing or reaction vessel to account for expansion and/or foaming.

It may be necessary to pre-cool solutions and cool while mixing or reacting.

**Corrosive Gases**

Corrosive compressed gases can burn and destroy body tissue (especially the eyes or respiratory contact) on contact. The magnitude of the effect is related to the solubility of the material in the body fluids. Highly soluble gases such as ammonia or hydrogen chloride can cause severe nose and throat irritation, while substances of lower solubility such as nitrogen dioxide, phosgene, or sulfur dioxide can penetrate deep into the lungs. Corrosive gases also can corrode metals. Warning properties such as odor or eye, nose or respiratory tract irritation may be inadequate with some substances. Do not rely upon these symptoms as warning of overexposure.

All procedures detailed in the Compressed Gases Standard Operating Procedure (3.9) should be followed for work with corrosive gases.

Perform manipulations of materials that pose an inhalation hazard in a chemical fume hood to control exposure.

To prevent environmental pollution and damage to equipment it may be necessary to trap and or scrub exhaust from processes which utilize corrosive gases even when working in the fume hood. Contact OEHS for assistance with design and set-up of gas neutralization processes.

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

Regulators and valves must be closed when the cylinder is not in use and flushed with dry air or nitrogen after use.

**Labeling**

All corrosives must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

The label on any containers of corrosives should say “Corrosive” and include any other hazard information, such as “Flammable” or “Toxic”, as applicable.
• **Heating/Open flame**

Do not store corrosives in chemical fume hoods or allow containers of corrosives in proximity to heating mantles, hot plates, or torches.

• **Transferring/Dispensing**

Weighing, transferring, and dispensing of corrosive solids must be performed carefully to avoid aspiration and ingestion of airborne powders and solids.

The materials of construction for lab apparatus and vessels that will come in contact with corrosive chemicals must be evaluated for compatibility with the chemical in use.

Transport corrosives in secondary containment, preferably a polyethylene or other non-reactive bottle carrier and/or a sturdy cart designed for chemical transport.

When combining acid and water, always add ACID to WATER.

**Cleaning-up**

• **Small spills**

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Safety Data Sheet. This should occur prior to the use of any corrosives.

Corrosive spill controls neutralize the hazardous nature of the spilled material. Acids and bases require different types of spill control materials.

Specific acid and base neutralizing spill kits are available from chemical supply safety vendors, such as Fisher Safety.

Sodium carbonate (soda ash) can also be used to neutralize spills of acidic liquids prior to clean-up. Do not attempt to neutralize a hydrofluoric acid spill. OEHS should be notified to handle all spills involving hydrofluoric acid.

In the event of a spill all personnel in the area should be alerted. Turn off all sources of ignition.

• **Waste disposal**

Corrosives are hazardous wastes. Questions regarding waste disposal should be directed to the OEHS.

Vented caps for 1-gallon sized plastic containers are available from OEHS for collection of wastes that are likely to produce gas. These wastes include mixtures of corrosive liquids and peroxides (such as Piranha and Chromerge).

**Emergencies**
If an Injury/Exposure Occurs:

1. **Research Laboratories:** Contact WSU Police Department at (313) 577-2222 immediately in the event of any injury in the laboratory. Call OEHS (313) 577-1200 to investigate the event. **Undergraduate Teaching Laboratory:** Call Science Stores (313) 577-3098, who will contact WSU Police Department and escort them to the teaching laboratory. In the event that Science Stores cannot be reached, call WSU Police Department directly at (313) 577-2222.

2. **Skin Contact:** Immediately flush contaminated area with copious amounts of water after contact with corrosive materials for at least 15 minutes. Remove contaminated clothing and shoes. Remove any jewelry to facilitate removal of chemicals. If there is any doubt about the severity of the injury, seek immediate medical attention. Be prepared to detail what chemicals were involved. *If the incident involves hydrofluoric acid (HF), seek immediate medical attention.*

3. **Eye Contact:** Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention as soon as possible.

4. **Inhalation:** Remove injured person from lab and into fresh air. Seek medical attention if necessary to restore breathing.

Special first aid treatment required by the type of substance handled in the laboratory will be described in the Safety Data Sheet for that material.

If A Chemical Spill Occurs:

1. Small spills should be handled as described in the Safety Data Sheet for the material.

2. **For Assistance with Large Spills (see also S.O.P 3.14):**
   - **Research Laboratories:** Contact WSU Police Department at (313) 577-2222 and OEHS (313) 577-1200.
   - **Undergraduate Teaching Laboratory:** Call Science Stores (313) 577-3098 who will contact WSU Police Department and escort them to the teaching laboratory. In the event that Science Stores cannot be reached, call WSU Police Department directly at (313) 577-2222.

3. Remain calm.

4. Alert persons in immediate area of spill.

5. Without endangering yourself, attend to any injured or contaminated victims:
   - Move victims to fresh air/ safe place.
   - Remove contaminated clothing.
   - Wait for Police Department and emergency responders in a safe area.

6. In the event of chemical spill where you need assistance, but the spill is not an immediate threat to life or health, follow these steps:
   - Confine the spill area: close doors, isolate area, evacuate if necessary.
   - Alert others in the area and tell them to evacuate area if necessary.
   - From safe locations, report the spill to Office of Environmental Health and Safety at (313) 577-1200.
   - Report your name, location and the name of the material spilled.
   - Stay in the area until the emergency responders arrive so that you can answer any additional questions.

7. If the chemical spill is flammable, turn off all ignition and heat sources. Evacuate area if necessary.

If a Fire Occurs:

1. Proceed to nearest fire alarm pull station and activate same.
2. Call WSU Police Department at (313) 577-2222. Undergraduate Teaching Laboratory: Also call Science Stores (313) 577-3098.

3. If you have been properly trained and/or experienced in the use of a portable fire extinguisher and the fire is small, you may proceed to nearest ABC or CO₂ fire extinguisher.

4. Extinguish fire using PASS Method.
   - Pull pin
   - Aim nozzle at base of fire
   - Squeeze lever
   - Sweep extinguisher side to side.

5. If the fire is large and cannot be extinguished with portable fire extinguisher or if the chemical is toxic, evacuate area and close all doors.

   The Office of Risk Management provides fire extinguisher training and evacuation training for all laboratory personnel.

   Make yourself available to give emergency responders information as needed.

   Special first aid treatment required by the type of chemicals material(s) handled in the laboratory can be found in the relevant Safety Data Sheet (formally known as MSDS).
3.4.1. Sample SOP for Hydrofluoric Acid
Laboratory Standard Operating Procedure (SOP) – Precautions for Lab Staff
Read and sign this procedure prior to working with HF.

CHEMICAL HAZARD – Hydrofluoric Acid (HF)

Principal Investigator:  
Lab Building and Room:  

Emergency Contact Name:  
Emergency Contact Phone #:  

**DANGER:** HF is one of the most corrosive and potentially hazardous acids. Skin exposures involving as little as 100 ml or greater than 25 in² of body surface area may be fatal. Also may be fatal if swallowed or inhaled.

HF is highly corrosive. It can penetrate skin, cause severe skin burns, decalcify bones, damage eyes and soft tissue, and cause respiratory irritation. Exposure routes include skin or eye contact, inhalation, and ingestion. Concentrated HF usually causes immediate burns that are extremely painful and slow to heal. In lower concentrations, exposure may not be apparent for several hours, but can cause serious damage if not treated.

First Aid – Emergency Exposure Response:

**Call WSU Police (72222) immediately and request an ambulance for anyone exposed to any amount of HF.**

**Skin Exposure:** In order to prevent cross contamination, the victim should perform the following actions on him/herself (others may help but they must be careful not to contaminate themselves; by wearing HF protective gloves and other safety equipment):

Immediately flush all affected areas with water. While flushing with water, remove all clothing, PPE or jewelry that could trap, or is suspected of contact with HF (remove goggles last: close eyes, face the water flow and pull goggles over your head). After rinsing with water for 5 minutes, apply 2.5% calcium gluconate gel freely and massage it into all affected sites until medical assistance arrives. The affected areas don’t need to be dried prior to applying gel. Reexamine the victim for any exposure / burn sites that have been overlooked. Provide the following information to the EMS team and/or physician:

- The concentration of the HF and its Safety Data Sheet (SDS).
- Body parts exposed, time of exposure, duration of exposure, and how it occurred.
- Summary of first aid measures given, including time when calcium gluconate gel was first applied, and how many times it was applied in total.

**Eye Exposure:** Immediately flush eyes for at least 5 minutes with cool flowing water. Hold the eyelids open and away from the eye during irrigation to allow thorough flushing of the eyes. After flushing with water, use sterile 1% calcium gluconate solution repeatedly to irrigate the eye. Continue to irrigate the eye(s) while transporting to medical facility.

**Inhalation:** Immediately move the victim to fresh air; advise WSU PD where to respond.

**Ingestion:** Drink large amounts of water as quickly as possible to dilute the acid until responders arrive. Do not induce vomiting. Never give anything by mouth to an unconscious person.

Inform your PI or manager, complete WSU’s ‘Report of Injury’ form, and submit to the Office of Risk Management within 24 hours. Dispose of contaminated PPE and other items as hazardous chemical waste.
Laboratory Standard Operating Procedure (SOP) – Precautions for Lab Staff
Read and sign this procedure prior to working with HF.
CHEMICAL HAZARD – Hydrofluoric Acid (HF)

**Engineering Controls:** Handle HF in a certified chemical fume hood (CFH) to protect against inhalation exposure to potentially hazardous airborne aerosols or vapors. Use bench paper to limit potential for contamination of work surfaces in the event of a minor spill.

**Work Practices:** Before working with HF, review the Safety Data Sheet (SDS) and HF emergency response procedures and ensure that an eyewash, safety shower, HF spill kit, and HF first-aid kit, including unexpired, unopened calcium gluconate gel and fresh sterile calcium gluconate eye solution, are immediately available.

Inform others working in the area about the hazards of HF and emergency and first aid procedures. Minimize the volume of HF maintained on site and use the least concentrated solution possible. Do not use glass, metal, or ceramic containers with HF. Use Teflon, polyethylene or other compatible material. Avoid heating HF. Always use secondary containment for all HF containers in the fume hood. Firmly clamp / secure vessels (e.g., graduated cylinders, beakers) when transferring, working with or heating HF. Don’t work alone with HF - work within sight and/or hearing of at least one other person who is familiar with hazards of HF and first aid / emergency response procedures. Never pour water into acid; slowly pour acid into water.

**Personal Protective Equipment:**

Eye protection: Always wear chemical goggles when working in the same lab with HF. In addition, wear a face shield when you are working with, or in the immediate vicinity of HF.

Skin Protection: Wear nitrile (only for dilute solutions), neoprene rubber, butyl rubber, or other gloves that completely cover skin on the hand and wrist. Wear a long sleeved, buttoned lab coat with sleeves fully extended to cover wrists, a chemical resistant apron, long pants or long skirt; and closed-toe shoes.

Respiratory protection: If you feel that your chemical fume hood is not adequate to protect against inhalation hazards, contact OEHS (577-1200) to evaluate your operations. A respiratory protection program that meets MIOSHA requirements must be followed whenever workplace conditions warrant respirator use (see http://oehs.wayne.edu/environmental/respiratoryprotection.php).

Immediately remove any clothing or PPE that is suspected of contact with HF, and treat underlying skin for potential exposure. Dispose of contaminated PPE and other items as hazardous chemical waste.

**Spill Response:** Keep a hydrofluoric acid spill kit nearby, containing personal protection gear (gloves, goggles, shoe covers, etc.) spill containment, cleanup, and disposal items. Evacuate the area and call WSU Police (72222) immediately for large spills. Call OEHS at 577-1200 for assistance with concentrated HF spills, spills of more than 10 ml of dilute HF solution, spills in poorly ventilated areas, or if you are not fully confident that you can safely clean up the spill. Clean up HF by covering with absorbent material (paper towel) and adding limestone (calcium carbonate, CaCO₃), or a commercial HF spill kit. Do NOT use spill kits that contain Floor-Dri, kitty litter, or sand because HF reacts with silica to produce silicon tetrafluoride (a toxic gas). After spill has been completely absorbed, wipe down spill site with 10% sodium carbonate solution.

Dispose of contaminated materials as hazardous chemical waste.
**SOP 3.4**

**Laboratory Standard Operating Procedure (SOP) – Precautions for Lab Staff**

Reading and signing this procedure prior to working with HF.

**CHEMICAL HAZARD – Hydrofluoric Acid (HF)**

<table>
<thead>
<tr>
<th>Daily Clean-Up / Decontamination:</th>
<th>Upon leaving work area where HF is used, remove any personal protective equipment worn, and wash hands, forearms, face, and neck. Areas where HF is used should be cleaned and decontaminated immediately following each task. At the end of each project, thoroughly decontaminate the area before resuming normal laboratory work in the area. Bench tops, CFH interiors, equipment, and laboratory surfaces with potential for HF contamination should be routinely cleaned.</th>
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**Waste Disposal**

Dispose of liquid HF and solutions containing HF as hazardous chemical waste in a tagged, closed, chemically-compatible (do not use glass, metal, or ceramic containers with HF) container in secondary containment. Collect contaminated disposable lab supplies as hazardous chemical waste. Dispose of empty containers as hazardous chemical waste. For more information, see: [http://oehs.wayne.edu/hazardous/chemical-waste.php](http://oehs.wayne.edu/hazardous/chemical-waste.php).

**Additional Precautions:** All containers of HF must be clearly labeled and properly stored in secondary containment, in a corrosive liquid cabinet, away from bases and other incompatibles including metal (unless the metal has a corrosion-proof coating). Transport corrosives in secondary containment, preferably a polyethylene or other non-reactive acid/solvent bottle carrier.

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I have read and understand the above SOP. I agree to contact my Supervisor if I have any questions.

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3.4.2. Sample SOP for Nitric Acid
**Laboratory Standard Operating Procedure (SOP) – Precautions for Lab Staff**

*Read and sign this procedure prior to working with nitric acid (HNO₃).*

## CHEMICAL HAZARD – Nitric Acid

<table>
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<tr>
<th>Principal Investigator:</th>
<th>Emergency Contact Name:</th>
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<tr>
<td>Lab Building and Room:</td>
<td>Emergency Contact Phone #:</td>
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**DANGER: Nitric acid (CAS # 7697-37-2) is an extremely corrosive acid and strong oxidizing agent.** Nitric acid can react explosively with many reducing metallic powders, carbides, cyanides, sulfides, alkalies and turpentine. It can react explosively with many reducing agents and organic materials (e.g. nitrobenzene and methylcyclohexane). Arsine, tetraborane are oxidized explosively with nitric acid. Cesium and rubidium acetylides explode in contact with nitric acid. It is also flammable in the presence of cellulose or other combustible materials. Phosphine, hydrogen sulfide, selenide all ignite when fuming nitric acid is dripped into gas. It may be harmful if inhaled, ingested, or absorbed through the skin. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of the respiratory tract resulting in coughing, choking or shortness of breath. Contact with eyes can cause severe burns and permanent eye damage.

### First Aid – Emergency Exposure Response:

**Notify WSU Police (313-577-2222) immediately.**

**Skin Exposure:** Immediately wash acid off all affected areas with water for at least 15 minutes. While flushing with water, remove all contaminated clothing, jewelry, and shoes (remove goggles last: close eyes, face the water flow and pull goggles over your head). Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

**Eye Exposure:** Check for and remove any contact lenses. Immediately flush eyes for at least 15 minutes with cool flowing water. Hold the eyelids open and away from the eye during irrigation to allow thorough flushing of the eyes. Get medical attention immediately.

**Inhalation:** Immediately move the victim to fresh air. Loosen tight clothing such as a collar, tie, belt or waistband. If not breathing, give artificial respiration. If breathing is difficult give oxygen. Get medical attention immediately.

**Ingestion:** Drink large amounts of water as quickly as possible to dilute the acid until responders arrive. Do not induce vomiting. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Inform your Principal Investigator (PI) or manager, and complete a WSU ‘Report of Injury’ form.

### Engineering Controls:

An eyewash and safety shower must be available in the immediate work area for any work with nitric acid. Handle concentrated HNO₃ in a certified chemical fume hood (CFH) to protect against inhalation exposure to potentially hazardous airborne aerosols or vapors. Always work in a clean hood that contains no organic materials extraneous to the experiment. Work with the sash closed while reactions are in progress to minimize escaping fumes and provide a physical barrier. Always use containers/glassware free from organic materials (and other incompatible materials) for work with nitric acid.
# Laboratory Standard Operating Procedure (SOP) – Precautions for Lab Staff

## CHEMICAL HAZARD – Nitric Acid

**Work Practices:** Before working with HNO$_3$, review the Safety Data Sheet (SDS) and HNO$_3$ emergency response procedures and ensure that an eyewash station and safety shower are immediately available.

Inform others working in the area about the hazards of HNO$_3$ and emergency and first aid procedures. All work with concentrated HNO$_3$ should be done inside a chemical fume hood. Make sure the work area is free of any incompatible materials that may react violently with the acid. Don’t work alone with concentrated HNO$_3$ - work within sight and/or hearing of at least one other person who is familiar with hazards of HNO$_3$ and first aid / emergency response procedures. When diluting HNO$_3$ with water, the concentrated acid should be added slowly to the cooled water to minimize the exothermic nature of the reaction and any dangers from splashing.

## Personal Protective Equipment:

**Eye protection:** Use safety glasses with side shields or tightly fitting safety goggles. Use a face shield (8 inch minimum) over goggles when appropriate. Use equipment for eye protection tested and approved under appropriate government standards such as ANSI Z87.1, NIOSH (US) or EN 16 (EU).

**Hand Protection:** Handle with gloves. Viton gloves, unsupported neoprene and laminate film gloves are recommended for use with concentrated (>70%) nitric acid. Nitrile gloves are not recommended for concentrated nitric acid according to the Ansell Chemical Resistance Guide. Gloves must be inspected prior to use. Use proper glove-removal technique (without touching glove’s outer surface) to avoid skin contact with this material. Wash and dry hands after removing gloves.

**Skin Protection:** Wear a long sleeved, buttoned *flame resistant* lab coat with sleeves fully extended to cover wrists, long pants or long skirt; cotton-based clothing and closed-toe shoes. Use of a safety apron is also recommended for additional protection.

**Respiratory protection:** If you feel that your chemical fume hood is not adequate to protect against inhalation hazards, contact OEHS ((313) 577-1200) to evaluate your operations. A respiratory protection program that meets MIOSHA requirements must be followed whenever workplace conditions warrant respirator use (see [http://oehs.wayne.edu/environmental/respiratoryprotection.php](http://oehs.wayne.edu/environmental/respiratoryprotection.php)). Immediately remove any clothing or PPE that is suspected of contact with HNO$_3$, and treat underlying skin for potential exposure. Dispose of contaminated PPE and other items as hazardous chemical waste.

## Spill Response:

**Call OEHS at 313-577-1200** for assistance with concentrated HNO$_3$ spills, spills of more than 10 mL of dilute HNO$_3$ solution, spills in poorly ventilated areas, or if you are not fully confident that you can safely clean up the spill.

**Small spills:** Clean up HNO$_3$ by absorbing the solution with an *inert* dry material. Place wet absorbent into an appropriate waste container. If necessary, neutralize the residue with a 10% sodium carbonate solution.

**Large spills:** Call OEHS at 313-577-1200 and WSU Public Safety (313-577-2222) for assistance. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside the container. Avoid contact with a combustible material (e.g. wood, paper, oil, clothing).

Dispose of contaminated materials as hazardous chemical waste.
## Laboratory Standard Operating Procedure (SOP) – Precautions for Lab Staff

**CHEMICAL HAZARD – Nitric Acid**

**Daily Clean-Up / Decontamination:** Upon leaving work area where HNO₃ is used, remove any personal protective equipment worn, and wash hands, forearms, face, and neck.Areas where HNO₃ is used should be cleaned and decontaminated immediately following each task. At the end of each project, thoroughly decontaminate the area before resuming normal laboratory work in the area. Bench tops, chemical fume hood interiors, equipment, and laboratory surfaces with potential for HNO₃ contamination should be routinely cleaned.

**Waste Disposal**
Dispose of liquid HNO₃ and solutions containing HNO₃ as hazardous chemical waste in a tagged, closed, chemically-compatible container in secondary containment. Collect contaminated disposable lab supplies as hazardous chemical waste. Dispose of empty containers in the regular trash after they have been triple-rinsed to remove chemical residue and the label has been defaced. For more information, see [http://oehs.wayne.edu/hazardous/chemical-waste.php](http://oehs.wayne.edu/hazardous/chemical-waste.php).

**Additional Precautions:** All containers of HNO₃ must be clearly labeled and properly stored in secondary containment, in a corrosive liquid cabinet, away from bases and other incompatibles including metal (unless the metal has a corrosion-proof coating). Keep container in a cool, well-ventilated area. Do not store above 23 °C. Transport corrosives in secondary containment, preferably a polyethylene or other non-reactive acid/solvent bottle carrier. As an oxidizing agent, HNO₃ should be kept separate from organics that are flammable.

I have read and understand the above SOP. I agree to contact my Supervisor if I have any questions.

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3.5. **Flammable Liquids**

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Office of Environmental Health and Safety, (313) 577-1200, or the Principal Investigator/Laboratory Instructor of your laboratory. Specific written procedures are the responsibility of the principal Investigator/Laboratory Instructor.

If compliance with all the requirements of this standard operating procedure is not possible, the principal Investigator/Laboratory Instructor must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

**FLAMMABLE & COMBUSTIBLE LIQUIDS IN THE LABORATORY**

The *flashpoint* of a flammable liquid is the lowest temperature at which it can form an ignitable mixture with air and produce a flame when a source of ignition is present.

Flammable liquids are chemicals that have a flash point below 100 °F (38.7 °C) and a vapor pressure that does not exceed 40 psig at 100 °F.

Flammable liquids are commonly divided into three classes

<table>
<thead>
<tr>
<th>Class</th>
<th>Flash Point</th>
<th>Boiling Point</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA</td>
<td>Below 73°F</td>
<td>Below 100 °F</td>
<td>ethyl ether</td>
</tr>
<tr>
<td>IB</td>
<td>Below 73 °F</td>
<td>At or above 100 °F</td>
<td>acetone, benzene, toluene</td>
</tr>
<tr>
<td>IC</td>
<td>At or above 73°F and below 100°F</td>
<td></td>
<td>hydrazine and styrene</td>
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</tbody>
</table>

Combustible liquids are divided into three classes

<table>
<thead>
<tr>
<th>Class</th>
<th>Flash Point</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>100-139 °F</td>
<td>acetic acid, naptha and stoddard solvent</td>
</tr>
<tr>
<td>IIIA</td>
<td>140-199 °F</td>
<td>cyclohexanol, formic acid and nitrobenzene</td>
</tr>
<tr>
<td>IIIB</td>
<td>200 °F or above</td>
<td>formalin and picric acid</td>
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</tbody>
</table>
**Before you begin**

- **Approvals and Notifications**

  Most flammable liquids can be used by properly-trained individuals in the laboratory environment without the need for specific OEHS approval. Special circumstances, such as abnormally large-scale use may require evaluation. Contact OEHS at (313) 577-1200 for assistance.

- **Training required**

  Any flammable liquids users should have taken an Introduction to Laboratory Safety course as well as any required annual updates.

  Most introductory programs are offered annually. Dates are available on the OEHS website: [http://research.wayne.edu/oehs/training/lab.php#Laboratory%20Safety%20Training](http://research.wayne.edu/oehs/training/lab.php#Laboratory%20Safety%20Training)

  Annual updates of these programs can be completed online. For more information on these programs or to request a training program on safety or health topics for your department, please contact OEHS at (313) 577-1200.

- **Purchasing materials**

  Purchase of any container of flammable liquids with a volume of greater than 5 gallons requires OEHS approval.

- **Hazard Assessment**

  A hazard assessment for work involving flammable liquids should thoroughly address the issues of proper use and handling, fire safety, chemical toxicity, storage, and spill response.

  A hazard assessment should be conducted when a process/reaction/work-up/or purification is changed or when scaling-up any flammable liquids use to more than 10 times the original volume.

  The first time a highly flammable solvent such as diethyl ether or hexane is used for a process, a hazard assessment should be conducted.

**Setting-up**

- **Storage: FLAMMABLE LIQUID STORAGE CABINETS**

  One or more Flammable Liquid Storage Cabinets (FLSC) are required for laboratories which store, use or handle more than 5 gallons of flammable or combustible liquids.

  The storage of flammable and combustible liquids in a laboratory, shop, or building area must be kept to the minimum needed for research and/or operations. FLSC are not intended for the storage of highly toxic materials, acids, bases, compressed gases or pyrophoric chemicals.
In most university laboratories flammable liquids storage is provided under the chemical fume hood. These cabinets are clearly marked “Flammable Storage”. Flammable liquids storage cabinets are constructed to limit the internal temperature when exposed to fire. When additional storage is needed, NFPA 30-4.3.3 approved flammable liquids storage cabinet (FLSC) may be purchased. All containers of flammable liquids must be stored in a FLSC when not in use. The following requirements apply:

**General Requirements**

- Cabinets shall be no larger than 45 gallon capacity
- Cabinets should be located near fume hood alcoves
- Cabinets shall be marked “Flammable-Keep Fire Away”
- Cabinets should be kept in good condition. Doors that do not close and latch must be repaired or the cabinet must be replaced.
- Flammable liquids storage cabinets are equipped with a grounding system that can be connected to a building ground. If you are pouring from a container in the storage cabinet and if the container being poured to is conductive then a bonding strap should be attached between them as explained in ‘PROCEDURES TO AVOID STATIC ELECTRICITY’ found in the “Transferring” section of this SOP.

**Engineering Controls (ventilation, shielding, vacuum protection)**

**Biomedical Laboratories**

Free standing cabinets in biomedical labs shall not be vented. Bungs shall be used to seal vent openings.

**Physical Science Laboratories**

Free standing cabinets may be vented into the fume hood exhaust system or a dedicated system for hazardous materials exhaust if present. Replacement air shall be ducted into the cabinet in such a way as not to compromise the specified performance of the cabinet.

Venting details shall be submitted to the Office of Environmental Health and Safety for approval.

**Safety Shielding:** Shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of flammable liquids which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

**Special Ventilation:** Manipulation of flammable liquids outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to flammable liquids in the laboratory and are the preferred
ventilation control device. Always attempt to handle quantities of flammable liquids greater than 500 mL in a fume hood. If your research does not permit the handling of large quantities of flammable liquids in your fume hood, contact the Office of Environmental Health and Safety to review the adequacy of all special ventilation.

**Vacuum Protection:** Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving flammable liquids must be conducted in a fume hood, glove box or isolated in an acceptable manner. Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood. Vacuum pumps should be rated for use with flammable liquids.

- **Personal Protective Equipment**

  Splash proof goggles in addition to standard laboratory personal protective equipment (PPE) consisting of a lab coat, closed toe shoes and nitrile gloves should be worn when there is a significant risk of splash. Pouring very large volumes may require additional PPE consisting of thicker gloves and an apron.

  Eye protection in the form of safety glasses must be worn at all times when handling flammable liquids. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87.1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

  Gloves should be worn when handling flammable liquids. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. Lab workers should contact OEHS for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated.

  Lab coats, closed toed shoes and long-sleeved clothing should be worn when handling flammable liquids. Additional protective clothing should be worn if the possibility of skin contact is likely. Nomex (fire resistant) lab coats and nomex/leather gloves are available for extra protection during higher hazard flammable liquids handling procedures. More information is available in the Pyrophoric Chemicals SOP (3.14)

- **Emergency Irrigation (Eyewash and safety shower)**

  A safety or drench shower should be available within 10 seconds of travel from where the flammable liquids are used.

  Safety showers are tested annually by OEHS or Facilities Planning and Management (FP&M).
Where the eyes or body of any person may be exposed to flammable liquids, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Eyewashes must be activated weekly by laboratory workers to ensure proper function of equipment and to flush the plumbing.

**Carrying-out your work**

- **Transferring/Dispensing**

**STATIC ELECTRICITY HAZARDS IN THE LABORATORY**

The flow of flammable and combustible liquids can cause the buildup of static electricity. When enough of a charge is built up a spark can result and potentially cause a fire or explosion. The likelihood of this happening is dependent upon how well the liquid conducts electricity, the flash point and the capacity to generate static electricity.

Static electricity can be generated when liquid is transferred from one metal container to another. Liquids have the ability to generate static electricity when they move in contact with other materials during pouring, pumping or agitating. The build up of this static electricity can cause a spark to form where the solvent exits the container. This could result in a fire or explosion.

**PROCEDURES TO AVOID STATIC ELECTRICITY**

To avoid the buildup of static electricity that may cause a spark, it is important to bond and ground metal or special conductive plastic containers. **Bonding** eliminates the electrical potential between two containers therefore eliminating the likelihood of sparks. A bonding wire is connected to two conductive objects as seen in the drums pictured below.
**Grounding** eliminates the difference in static potential charge between the conductive object and ground. Grounding is accomplished by connecting the conductive object directly to the earth, usually using cold water copper pipes, building steel or grounding bus/bar.

Bonding and grounding require good electrical connections. Remove any dirt, paint or rust ensuring **metal to metal** contact.

Bonding and Grounding wires come in a variety of styles and lengths. They can be purchased through safety supply companies such as Fisher Safety, Justrite Manufacturing and through Lab Safety Supply.
Static hazards may also exist in non-metallic plastic or glass containers that cannot be grounded. Static may be generated by the free fall and turbulence of the liquid being poured. To minimize this hazard, pour as slowly as possible and use a grounded nozzle extension that allows filling the container from the bottom.

**DISPENSING FLAMMABLE LIQUIDS FROM 5 GALLON PAIRS**

Manual dispensing pumps for 5-gallon pails/cans are available. These pumps are specifically designed to dispense liquids into small laboratory-size bottles without spilling. If you are pouring into a conductive container, a bonding wire should be attached from the 5-gallon pail to the container being filled. The 5-gallon pail should be grounded.

The dispenser shown in the picture below can be purchased through Fisher Safety. The metal strap in the picture hooks over the bottom of the pail and secures the dispenser while pumping.

Two adapters are provided with the dispensing pump from Fisher (grey and black). Use the appropriate adapter to achieve the correct seal with the solvent container you have. Some solvent containers have a grey fitting at the opening, and others have the black one.

**DISPENSING FLAMMABLES FROM SAFETY CANS**

Safety cans have self-closing air tight lids and a flame arrester that protects the contents from an external ignition source. Bonding and grounding is still required on safety cans since static
electricity generation is possible. The nozzle provides a bonding path to a receiving metallic vessel.

If either of the containers are non-metallic (conductive) it is still important to follow the limited velocity and grounded nozzle extension information given previously.

Safety cans do not offer protection from heat when exposed to fire and should be stored in a flammable liquids storage cabinet when not in use.

- **Labeling**

  All flammable liquids must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

  The label on any containers of flammable liquids should say “Flammable” and include any other hazard information, such as “Corrosive” or “Toxic”, as applicable.

- **Heating/Open flame**

  Do not store flammable liquids in chemical fume hoods or allow containers of flammable liquids in proximity to heating mantles, hot plates, or torches.
With the exception of vacuum drying ovens, laboratory ovens rarely have any means of preventing the discharge of material volatilized within them. Thus it should be assumed that these substances will escape into the laboratory atmosphere, but may also be present in sufficient concentration to form explosive mixtures within the oven itself. Venting the oven to an exhausted system will reduce this hazard.

Drying ovens should not be used to dry glassware that has been rinsed with organic solvents until the majority of the solvent has had the opportunity to drain or evaporate at room temperature.

Do not use mercury thermometers to monitor oven temperatures. Accidental breakage of the thermometer will cause a serious hazard since uncontained mercury will volatilize very rapidly.

**Cleaning-up**

- **Small spills**
  
  Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Safety Data Sheet. This should occur prior to the use of any flammable liquids. Spill supplies for flammable liquids are designed to control the liquid portion of the spill and minimize the production of flammable vapors. Never use paper towels on large spills of flammable liquids because it exacerbates vapor production.

  In the event of a spill all personnel in the area should be alerted. Turn off all sources of ignition.

- **Waste disposal**
  
  Flammable liquids are hazardous wastes. Questions regarding waste disposal should be directed to the Office of Environmental Health and Safety.

**Emergencies**

If an Injury/Exposure Occurs:

1. **Research Laboratories:** Contact WSU Police Department at (313) 577-2222 immediately in the event of any injury in the laboratory. Call OEHS (313) 577-1200 to investigate the event.

2. **Undergraduate Teaching Laboratory:** Call Science Stores (313) 577-3098, who will contact WSU Police Department and escort them to the teaching laboratory. In the event that Science Stores cannot be reached, call WSU Police Department directly at (313) 577-2222

3. **Skin Contact:** Immediately flush contaminated area with copious amounts of water after contact with flammable materials for at least 15 minutes. Remove contaminated clothing and shoes. Remove any jewelry to facilitate removal of chemicals. If there is any doubt about the severity of the injury, seek immediate medical attention. Be prepared to detail what chemicals were involved.

4. **Eye Contact:** Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention as soon as possible.

5. **Inhalation:** Remove injured person from lab and into fresh air. Seek medical attention if necessary to restore breathing.
Special first aid treatment required by the type of substance handled in the laboratory will be described in the Safety Data Sheet for that material.

If A Chemical Spill Occurs:
1. Small spills should be handled as described in the Safety Data Sheet for the material.
2. For Assistance with Large Spills (see also S.O.P 3.14):
   - **Research Laboratories:** Contact WSU Police Department at (313) 577-2222 and OEHS (313) 577-1200.
   - **Undergraduate Teaching Laboratory:** Call Science Stores ((313) 577-3098) who will contact WSU Police Department and escort them to the teaching laboratory. In the event that Science Stores cannot be reached, call WSU Police Department directly at (313) 577-2222.
3. Remain calm.
4. Alert persons in immediate area of spill.
5. Without endangering yourself, attend to any injured or contaminated victims:
   - Move victims to fresh air/safe place.
   - Remove contaminated clothing.
   - Wait for Police Department and emergency responders in a safe area.
6. In the event of chemical spill where you need assistance, but the spill is not an immediate threat to life or health, follow these steps:
   - Confine the spill area: close doors, isolate area, evacuate if necessary.
   - Alert others in the area and tell them to evacuate area if necessary.
   - From safe locations, report the spill to Office of Environmental Health and Safety at (313) 577-1200.
   - Report your name, location and the name of the material spilled.
   - Stay in the area until the emergency responders arrive so that you can answer any additional questions.
7. If the chemical spill is flammable, turn off all ignition and heat sources. Evacuate area if necessary.

If a Fire Occurs:
6. Proceed to nearest fire alarm pull station and activate same.
7. Call WSU Police Department at (313) 577-2222. Undergraduate Teaching Laboratory: Also call Science Stores ((313) 577-3098)
8. If you have been properly trained and/or experienced in the use of a portable fire extinguisher and fire is small, you may proceed to nearest ABC or CO₂ fire extinguisher.
   - Pull pin
   - Aim nozzle at base of fire
   - Squeeze lever
   - Sweep extinguisher side to side.
10. If the fire is large and cannot be extinguished with portable fire extinguisher or if the chemical is toxic, evacuate area and close all doors.

The Office of Risk Management provides fire extinguisher training and evacuation training for all laboratory personnel.

Make yourself available to give emergency responders information as needed.
Special first aid treatment required by the type of chemicals material(s) handled in the laboratory can be found in the relevant Safety Data Sheet (formally known as MSDS).
3.6. Oxidizing Chemicals

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Office of Environmental Health and Safety ((313) 577-1200) or the Principal Investigator/Laboratory Instructor. Specific written procedures are the responsibility of the principal investigator/laboratory instructor.

If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator/laboratory instructor must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Oxidizing chemicals are materials that spontaneously evolve oxygen at room temperature or with slight heating or promote combustion. This class of chemicals includes peroxides, chlorates, perchlorates, nitrates, and permanganates. Strong oxidizers are capable of forming explosive mixtures when mixed with combustible, organic or easily oxidized materials. Examples of strong oxidizers are listed at the end of this SOP.

- **Securing of gas cylinders**
  
  Not applicable

- **Decontamination procedures**

  **Personnel:** Wash hands and arms with soap and water immediately after handling oxidizing chemicals.

  **Area:** Carefully clean work area after use. Paper towels or similar materials contaminated with strong oxidizing chemicals may pose a fire risk.

- **Designated area**

  Not applicable

- **Emergency procedure**

  **If an Injury/Exposure Occurs:**
  1. **Research Laboratories:** Contact WSU Police Department at (313) 577-2222 immediately in the event of any injury in the laboratory. Call OEHS (313) 577-1200 to investigate the event.
Undergraduate Teaching Laboratory: Call Science Stores ((313) 577-3098) who will contact WSU Police Department and escort them to the teaching laboratory. In the event that Science Stores cannot be reached, call WSU Police Department directly at (313) 577-2222.

2. **Skin Contact**: Immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. If there is any doubt about the severity of the injury, seek immediate medical attention.

3. **Eye Contact**: Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention as soon as possible.

4. **Inhalation**: Remove injured person from lab and into fresh air. Seek medical attention if necessary to restore breathing.

Special first aid treatment required by the type of substance handled in the laboratory will be described in the Safety Data Sheet for that material.

**If A Chemical Spill Occurs:**

8. Small spills should be handled as described in the Safety Data Sheet for the material.

9. **For Assistance with Large Spills:**
   - **Research Laboratories**: Contact OEHS (313) 577-1200 and WSU Police Department at (313) 577-2222.
   - **Undergraduate Teaching Laboratory**: Call Science Stores ((313) 577-3098) who will contact WSU Police Department and escort them to the teaching laboratory. In the event that Science Stores cannot be reached, call WSU Police Department directly at (313) 577-2222.

10. Remain calm.

11. Alert persons in immediate area of spill.

12. Without endangering yourself, attend to any injured or contaminated victims:
   - Move victims to fresh air/ safe place.
   - Remove contaminated clothing.
   - Wait for Police Department and emergency responders in a safe area.

13. In the event of chemical spill where you need assistance, but the spill is not an immediate threat to life or health, follow these steps:
   - Confine the spill area: close doors, isolate area, evacuate if necessary.
   - Alert others in the area and tell them to evacuate area if necessary.
   - From safe locations, report the spill to Office of Environmental Health and Safety at (313) 577-1200.
   - Report your name, location and the name of the material spilled.
   - Stay in the area until the emergency responders arrive so that you can answer any additional questions.

14. If the chemical spill is flammable, turn off all ignition and heat sources. Evacuate area if necessary.

**If a Fire Occurs:**

11. Proceed to nearest fire alarm pull station and activate same.

12. Call WSU Police Department at (313) 577-2222. Undergraduate Teaching Laboratory: Also call Science Stores ((313) 577-3098).

13. If you have been properly trained and/or experienced in the use of a portable fire extinguisher and fire is small, you may proceed to nearest ABC or CO₂ fire extinguisher.

   - Pull pin
15. If the fire is large and cannot be extinguished with portable fire extinguisher or if the chemical is toxic, evacuate area and close all doors.

The Office of Risk Management provides fire extinguisher training and evacuation training for all laboratory personnel.

Make yourself available to give emergency responders information as needed.

Special first aid treatment required by the type of oxidizing chemicals material(s) handled in the laboratory can be found in the relevant Safety Data Sheet (formally known as MSDS).

- **Eye protection**

Eye protection in the form of safety glasses must be worn at all times when handling oxidizing chemicals. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

- **Eyewash**

Where the eyes or body of any person may be exposed to oxidizing chemicals, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

- **Fume hood**

The use of certain concentrations of perchloric acid must be performed in a fume hood equipped with wash down facilities. Contact the Office of Environmental Health and Safety (OEHS) for fume hood requirements.

- **Glove (dry) box**

Not applicable

- **Gloves**

Gloves should be worn when handling oxidizing chemicals. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. Lab workers should contact OEHS for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated.
• **Hazard assessment**

Hazard assessment should address proper use and handling techniques, fire safety, storage, and waste disposal issues.

• **OEHS Notification**

You should notify the Office of Environmental Health and Safety prior to the initial use of the following oxidizers: perchloric acid.

• **Protective apparel**

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling oxidizing chemicals. Additional protective clothing should be worn if the possibility of skin contact is likely.

• **Safety shielding**

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of oxidizing chemicals which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants are acceptable.

• **Safety shower**

A safety or drench shower should be available in a nearby location where the oxidizing chemicals are used.

• **Signs and labels**

**Containers:** All oxidizing chemicals must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

• **Special storage**

Oxidizers should be stored in a cool and dry location. Keep oxidizers segregated from all other chemicals in the laboratory. Minimize the quantities of strong oxidizers stored in the laboratory.

Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container which may cause a fire or explosion.

• **Special ventilation**

The use of certain concentrations of perchloric acid must be performed in a fume hood equipped with wash down facilities. Contact the Office of Environmental Health and Safety for fume hood requirements.
• **Spill response**

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Safety Data Sheet. This should occur prior to the use of any oxidizing chemicals. Spill control materials for oxidizers are designed to be inert and will not react with the reagent. Never use paper towels or other inappropriate materials which are combustible. The waste materials generated during spill cleanup may pose a flammability risk and should not remain in the laboratory overnight unless it is stored in an appropriate container.

In the event of a spill, alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of oxidizing chemicals. Vacate the laboratory immediately and call for assistance.

Office of Environmental Health & Safety, (313) 577-1200

Science Stores, (313) 577-3098 (Chemistry Undergraduate Teaching Labs only)

University Police Department, (313) 577-2222. This is a 24 hour service.

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

• **Vacuum protection**

Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving oxidizing chemicals must be conducted in a fume hood, glove box or isolated in an acceptable manner.

Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood.

• **Waste disposal**

All materials contaminated with oxidizing chemicals pose a fire hazard and should be disposed of as hazardous waste. Alert the Office of Environmental Health and Safety if you generate wastes contaminated by oxidizers. Do not let contaminated wastes remain in the laboratory overnight unless proper containers are provided.

• **Examples of Strong Oxidizers**

<table>
<thead>
<tr>
<th>Ammonium perchlorate</th>
<th>Ammonium permanganate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barium peroxide</td>
<td>Bromine</td>
</tr>
<tr>
<td>Calcium chlorate</td>
<td>Calcium hypochlorite</td>
</tr>
<tr>
<td>Chlorine trifluoride</td>
<td>Chromium anhydride</td>
</tr>
<tr>
<td>Chromic acid</td>
<td>Dibenzoyl peroxide</td>
</tr>
<tr>
<td>Fluorine</td>
<td>Hydrogen peroxide</td>
</tr>
<tr>
<td>Magnesium peroxide</td>
<td>Nitrogen trioxide</td>
</tr>
<tr>
<td>Perchloric acid</td>
<td>Potassium bromate</td>
</tr>
<tr>
<td>Reactant</td>
<td>Product</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Potassium chlorate</td>
<td>Potassium peroxide</td>
</tr>
<tr>
<td>Propyl nitrate</td>
<td>Sodium chlorate</td>
</tr>
<tr>
<td>Sodium chlorite</td>
<td>Sodium perchlorate</td>
</tr>
<tr>
<td>Sodium peroxide</td>
<td></td>
</tr>
</tbody>
</table>

Source: CRC Handbook of Laboratory Safety, 3rd edition.
3.7. Reactive Materials

3.7.1. Reactive Liquids

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Office of Environmental Health and Safety ((313) 577-1200) or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the principal investigator.

If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Reactive liquids are chemicals that react vigorously with moisture or oxygen or other substances.

- **Securing of gas cylinders**

  Not applicable

- **Decontamination procedures**

  **Personnel:** Wash hands and arms with soap and water immediately after handling reactive liquids.

  **Area:** Carefully clean work area after use.

  **Equipment:** Decontaminate vacuum pumps or other contaminated equipment (glassware) before removing them from the designated area.

- **Designated area**

  Not applicable

- **Emergency procedure**

  **If an Injury/Exposure Occurs:**
  1. **Research Laboratories:** Contact WSU Police Department at (313) 577-2222 immediately in the event of any injury in the laboratory. Call OEHS (313) 577-1200 to investigate the event.
Undergraduate Teaching Laboratory: Call Science Stores ((313) 577-3098) who will contact WSU Police Department and escort them to the teaching laboratory. In the event that Science Stores cannot be reached, call WSU Police Department directly at (313) 577-2222.

2. Skin Contact: Immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. If there is any doubt about the severity of the injury, seek immediate medical attention.

3. Eye Contact: Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention as soon as possible.

4. Inhalation: Remove injured person from lab and into fresh air. Seek medical attention if necessary to restore breathing.

Special first aid treatment required by the type of substance handled in the laboratory will be described in the Safety Data Sheet for that material.

If a Fire Occurs:

1. Proceed to nearest fire alarm pull station and activate same.
2. Call WSU Police Department at (313) 577-2222. Undergraduate Teaching Laboratory: Also call Science Stores ((313) 577-3098).
3. If you have been properly trained and/or experienced in the use of a portable fire extinguisher and fire is small, you may proceed to nearest ABC or CO2 fire extinguisher.
4. Extinguish fire using PASS Method.
   - Pull pin
   - Aim nozzle at base of fire
   - Squeeze lever
   - Sweep extinguisher side to side.
5. If the fire is large and cannot be extinguished with portable fire extinguisher or if the chemical is toxic, evacuate area and close all doors.

The Office of Risk Management provides fire extinguisher training and evacuation training for all laboratory personnel.

Make yourself available to give emergency responders information as needed.

Special first aid treatment required by the type of reactive liquids handled in the laboratory can be found in the Safety Data Sheets located in the laboratory.

- Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling reactive liquids. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87.1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.
• **Eyewash**

Where the eyes or body of any person may be exposed to reactive liquids, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

• **Fume hood**

Many reactive liquids will ignite or liberate combustible gas when exposed to water vapor or air. The use of a fume hood is recommended to prevent the buildup of flammable gases.

• **Glove (dry) box**

A glove box may be used to handle reactive liquids if an inert or dry atmosphere is required.

• **Gloves**

Gloves should be worn when handling reactive liquids. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. Lab workers should contact OEHS for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated.

• **Hazard assessment**

Hazard assessment of work involving reactive liquids should address proper use and handling techniques, fire safety (including the need for Class D fire extinguishers), storage, the specific reactive nature of the material (such as water and air reactivity), and waste disposal issues.

• **OEHS Notification**

Not applicable.

• **Protective apparel**

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling reactive liquids. Additional protective clothing should be worn if the possibility of skin contact is likely.

• **Safety shielding**

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of reactive liquids that pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants are acceptable.

• **Safety shower**

A safety or drench shower should be available in a nearby location where the reactive liquids are used.
• **Signs and labels**

**Containers:** All reactive liquids must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

• **Special storage**

Reactive liquids should be stored in a cool and dry location. Keep reactive liquids segregated from all other chemicals in the laboratory. Minimize the quantities of reactive liquids stored in the laboratory.

Date all containers upon receipt. Examine storage containers frequently. Dispose of any container that exhibits salt build up on its exterior. Dispose of all reactive liquids whenever they are no longer required for current research.

Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container that may cause a fire or explosion.

• **Special ventilation**

Special ventilation may be required if these materials are used outside a fume hood. If your research does not permit the handling of reactive liquids in a fume hood you must contact the Office of Environmental Health and Safety to review the adequacy of all special ventilation.

• **Spill response (see also S.O.P. 3.15)**

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Safety Data Sheet. This should occur prior to the use of any reactive liquids. Spill control materials for reactive liquids are designed to be inert and will not react with the reagent.

In the event of a spill, alert personnel in the area that a spill has occurred. Do not attempt to handle a spill of reactive liquids. Turn off all ignition sources and vacate the laboratory immediately. Call for assistance.

University Police Department, (313) 577-2222 This is a 24 hour service.
Office of Environmental Health & Safety (313) 577-1200
Science Stores, (313) 577-3098 (Undergraduate Teaching Laboratories only)

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

• **Vacuum protection**

Not applicable
• **Waste disposal**

All materials contaminated with reactive liquids should be disposed of as hazardous waste. Alert the Office of Environmental Health and Safety (OEHS) if you generate wastes contaminated by reactive liquids. These wastes may pose a flammability risk and you should consult OEHS for further storage and disposal instructions.
3.7.2. Reactive Solids

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Office of Environmental Health and Safety ((313) 577-1200) or the Principal Investigator/Laboratory Instructor of your laboratory. Specific written procedures are the responsibility of the principal investigator/laboratory instructor.

If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator/laboratory instructor must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Reactive solids are chemicals that react vigorously with moisture and other substances. The most common reactive solids include sodium, potassium and lithium metals; acid anhydrides and acid chlorides.

- **Securing of gas cylinders**
  
  Not applicable

- **Decontamination procedures**

  **Personnel:** Wash hands and arms with soap and water immediately after handling reactive solids.

  **Area:** Carefully clean work area after use.

- **Designated area**
  
  Not applicable

- **Emergency procedure**

  **If an Injury/Exposure Occurs:**

  1. **Research Laboratories:** Contact WSU Police Department at (313) 577-2222 immediately in the event of any injury in the laboratory. Call OEHS (313) 577-1200 to investigate the event.

  **Undergraduate Teaching Laboratory:** Call Science Stores ((313) 577-3098) who will contact WSU Police Department and escort them to the teaching laboratory. In the event that Science Stores cannot be reached, call WSU Police Department directly at (313) 577-2222

  2. **Skin Contact:** Immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. If there is any doubt about the severity of the injury, seek immediate medical attention.
3. **Eye Contact:** Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention as soon as possible.

4. **Inhalation:** Remove injured person from lab and into fresh air. Seek medical attention if necessary to restore breathing.

Special first aid treatment required by the type of substance handled in the laboratory will be described in the Safety Data Sheet for that material.

**If a Fire Occurs:**
1. Proceed to nearest fire alarm pull station and activate same.
2. Call WSU Police Department at (313) 577-2222. Undergraduate Teaching Laboratory: Also call Science Stores ((313) 577-3098)
3. If you have been properly trained and/or experienced in the use of a portable fire extinguisher and fire is small, you may proceed to nearest ABC or CO₂ fire extinguisher.
4. Extinguish fire using PASS Method.
   - Pull pin
   - Aim nozzle at base of fire
   - Squeeze lever
   - Sweep extinguisher side to side.
5. If the fire is large and cannot be extinguished with portable fire extinguisher or if the chemical is toxic, evacuate area and close all doors.

The Office of Risk Management provides fire extinguisher training and evacuation training for all laboratory personnel.

Make yourself available to give emergency responders information as needed.

Special first aid treatment required by the type of reactive solids material(s) handled in the laboratory can be found in the Safety Data Sheets located in the laboratory.

- **Eye protection**

Eye protection in the form of safety glasses must be worn at all times when handling reactive solids. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87.1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

- **Eyewash**

Where the eyes or body of any person may be exposed to reactive solids, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.
- **Fume hood**
  Many reactive solids will liberate hydrogen when they react with water. The use of a fume hood is recommended to prevent the buildup of combustible gases.

- **Glove (dry) box**
  Glove boxes may be used to handle reactive solids if inert or dry atmospheres are required.

- **Gloves**
  Gloves should be worn when handling reactive solids. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. Lab workers should contact OEHS for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated.

- **Hazard assessment**
  Hazard assessment of work involving reactive solids should address proper use and handling techniques, fire safety (including the need for Class D fire extinguishers), storage, potential peroxide formation, water and air reactivity, and waste disposal issues.

- **OEHS Notification**
  Not applicable.

- **Protective apparel**
  Lab coats, closed toed shoes and long sleeved clothing should be worn when handling reactive solids. Additional protective clothing should be worn if the possibility of skin contact is likely.

- **Safety shielding**
  Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of reactive solids which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

- **Safety shower**
  A safety or drench shower should be available in a nearby location where the reactive solids is used.

- **Signs and labels**
  **Containers:** All reactive solids must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.
• **Special storage**

Reactive solids should be stored in a cool and dry location. Keep reactive solids segregated from all other chemicals in the laboratory. Minimize the quantities of reactive solids stored in the laboratory.

Date all containers upon receipt. Potassium will form peroxides and superoxides when stored under oil at room temperature. Examine storage containers frequently. Dispose of any container that exhibits salt build up on its exterior. Dispose of all reactive solids whenever they are no longer required for current research.

Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container which may cause a fire or explosion.

• **Special ventilation**

Special ventilation is required if these materials are used outside of a fume hood or glove box. If your research does not permit the handling of reactive solids in a fume hood or glove box you must contact the Office of Environmental Health and Safety to review the adequacy of all special ventilation.

• **Spill response (see also S.O.P. 3.15)**

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Safety Data Sheet. This should occur prior to the use of any reactive solids. Spill control materials for reactive solids are designed to be inert and will not react with the reagent.

In the event of a spill, alert personnel in the area that a spill has occurred. Do not attempt to handle a spill of reactive solids. Turn off all ignition sources and vacate the laboratory immediately. Call for assistance.

University Police Department  (313) 577-2222 This is a 24 hour service.
Office of Environmental Health & Safety (313) 577-1200
Science Stores (313) 577-3098 (Undergraduate Teaching Laboratories only)

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

• **Vacuum protection**

Not applicable

• **Waste disposal**

All materials contaminated with reactive solids should be disposed of as hazardous waste. Alert the Office of Environmental Health and Safety if you generate wastes contaminated by reactive
solids. These wastes may pose a flammability risk and you should contact OEHS for further instructions.
3.8. Carcinogens

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any items listed in this procedure contact the Office of Environmental Health and Safety ((313) 577-1200) or the Principal Investigator of your research laboratory or Principal Instructor of your laboratory class. Specific written procedures are the responsibility of the principal investigator/instructor.

If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator/instructor must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety (OEHS) is available to provide guidance during the development of alternate procedures.

A carcinogen commonly describes any agent that can initiate or speed the development of malignant or potentially malignant tumors, malignant neoplastic proliferation of cells, or cells that possess such material. A listing of carcinogenic materials can be found in the OEHS Chemical Hygiene Plan (Appendix IV) [link to OEHS Chemical Hygiene Plan].

- **Securing of gas cylinders**
  
  Not applicable

- **Decontamination procedures**
  
  **Personnel:** Wash hands and arms with soap and water immediately after handling carcinogens.

  **Area:** Decontamination procedures vary depending on the material being handled. The toxicity of some materials can be neutralized with other reagents. All surfaces should be wiped with the appropriate cleaning agent following dispensing or handling. Waste materials generated should be treated as a hazardous waste.

  **Equipment:** Decontaminate vacuum pumps or other contaminated equipment (glassware) before removing them from the designated area.

- **Designated area**
  
  The room sign for the laboratory must contain a “Designated Areas Within” identifier.

  All locations within the laboratory where carcinogens are handled should be demarcated with designated area caution tape (available from OEHS, the cell center, or chemistry stockroom) and/or posted with designated area caution signs. This includes all fume hoods and bench tops where the carcinogens are handled.
Where feasible, carcinogens should be manipulated over plastic-backed disposable paper work surfaces. These disposable work surfaces minimize work area contamination and simplify clean up.

- Emergency procedure

**If an Injury/Exposure Occurs:**

1. **Research Laboratories:** Contact WSU Police Department at (313) 577-2222 immediately in the event of any injury in the laboratory. OEHS should then be called to investigate the event.

2. **Emergency Laboratory:** Call Science Stores ((313) 577-3098) who will contact WSU Police Department and escort them to the teaching laboratory. In the event that Science Stores cannot be reached, call WSU Police Department directly at (313) 577-2222.

3. **Skin Contact:** Immediately flush skin with plenty of water for at least 15 minutes. Injured person should remove contaminated clothing and shoes. Injured person should be instructed to wash their clothing before reuse.

4. **Eye Contact:** Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention as soon as possible.

5. **Inhalation:** Remove injured person from lab and into fresh air. Seek medical attention if necessary to restore breathing.

Special first aid treatment required by the type of carcinogens handled in the laboratory will be outlined in the Safety Data Sheet for that specific compound.

**If a Fire Occurs:**

1. Proceed to nearest fire alarm pull station and activate same.

2. Call WSU Police Department at (313) 577-2222. Undergraduate Teaching Laboratory: Also call Science Stores ((313) 577-3098).

3. If you have been properly trained and/or experienced in the use of a portable fire extinguisher and fire is small, you may proceed to nearest ABC or CO2 fire extinguisher.

4. Extinguish fire using PASS Method.
   - Pull pin
   - Aim nozzle at base of fire
   - Squeeze lever
   - Sweep extinguisher side to side.

5. If chemical is toxic and cannot be extinguished with portable fire extinguisher, evacuate area and close all doors.

The Office of Risk Management provides fire extinguisher training and evacuation training for all laboratory personnel.

- Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling carcinogens. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87.1 1989) and must be equipped with side shields. Safety glasses with
side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

- **Eyewash**

Research Laboratories: Where the eyes or body of any person may be exposed to carcinogens, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Eyewash stations should be located in accessible areas within each undergraduate teaching laboratory.

- **Fume hood**

Manipulation of carcinogens should be carried out in a fume hood. If the use of a fume hood proves impractical refer to the section on special ventilation.

All areas where carcinogens are stored or manipulated must be labeled as a designated area.

- **Glove (dry) box**

Certain carcinogens must be handled in a glove box rather than a fume hood. The Office of Environmental Health and Safety ((313) 577-1200) or the Principal Investigator/Instructor will determine if this is required.

- **Gloves**

Gloves should be worn when handling carcinogens. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. Lab workers should contact OEHS for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated.

- **Hazard assessment**

Hazard assessment should focus on proper use and handling techniques, and education of laboratory workers concerning the health risks posed by carcinogens, and the demarcation of designated areas.

- **OEHS Notification**

You should notify the Office of Environmental Health and Safety prior to the initial use of carcinogens. Notification is also required following significant changes in procedures or the quantity of materials used.
• **Protective apparel**

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling carcinogens. Additional protective clothing should be worn if the possibility of skin contact is likely.

• **Safety shielding**

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of carcinogens which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

• **Safety shower**

A safety or drench shower should be available in a nearby location where the carcinogens are used.

• **Signs and labels**

  **Doorways:** The room sign must contain a “Designated Area Within” caution where carcinogens, reproductive hazards, and/or acutely toxic chemicals are stored or used.

  **Containers:** All containers of carcinogens must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

• **Special storage**

Carcinogens must be stored in a designated area.

• **Special ventilation**

Manipulation of carcinogens outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to carcinogens in the laboratory and are the preferred ventilation control device. When possible, handle carcinogens in a fume hood. If the use of a fume hood proves impractical, attempt to work in a glove box or on an isolated area on the bench top.

If available, consider using a Biological Safety Cabinet. The biological safety cabinet is designed to remove particulates (the carcinogen) before the air is discharged into the environment. Carcinogens that are volatile must not be used in a biological safety cabinet unless the cabinet is vented to the outdoors.

If your research does not permit the handling of carcinogens in a fume hood, biological safety cabinet, or glove box, you must contact the Office of Environmental Health and Safety.
All areas where carcinogens are stored or manipulated must be labeled as a designated area.

- **Spill response (see also S.O.P. 3.15)**

  Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Safety Data Sheet. This should occur prior to the use of any carcinogen. The range and quantity of hazardous substances used in WSU laboratories require pre-planning to respond safely to a chemical spill.

  **If A Chemical Spill Occurs (see also S.O.P. 3.15):**
  1. **Research Laboratories:** Contact WSU Police Department at (313) 577-2222 and then OEHS at (313) 577-1200.
     
     **Undergraduate Teaching Laboratory:** Call Science Stores ((313) 577-3098) who will contact WSU Police Department and escort them to the teaching laboratory. In the event that Science Stores cannot be reached, call WSU Police Department directly at (313) 577-2222
  2. Remain calm.
  3. Alert persons in immediate area of spill.
  4. Without endangering yourself, attend to any injured or contaminated victims:
     - Move victims to fresh air/ safe place.
     - Remove contaminated clothing.
     - Wait for Police Department and emergency responders in a safe area.
  5. In the event of chemical spill where you need assistance, but the spill is not an immediate threat to life or health, follow these steps:
     - Confine the spill area: close doors, isolate area, evacuate if necessary.
     - Alert others in the area and tell them to evacuate area if necessary.
     - From safe locations, report the spill to Office of Environmental Health and Safety at (313) 577-1200.
     - Report your name, location and the name of the material spilled.
     - Stay in the area until the emergency responders arrive so that you can answer any additional questions.
  6. If the chemical spill is flammable, turn off all ignition and heat sources. Evacuate area if necessary.

- **Vacuum protection**

  Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving carcinogens must be conducted in a fume hood, glove box or isolated in an acceptable manner.

  Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood.

- **Waste disposal**

  All materials contaminated with carcinogens should be disposed of as hazardous waste. Wherever possible, attempt to design research in a manner that reduces the quantity of waste generated.
Questions regarding waste pick up should be directed to the Office of Environmental Health and Safety. This office can also assist you in minimizing waste generation.
3.9. **Compressed Gases**

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Office of Environmental Health and Safety ((313) 577-1200) or the Principal Investigator/Instructor of your laboratory. Specific written procedures are the responsibility of the principal investigator/instructor.

If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator/instructor must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety (OEHS) is available to provide guidance during the development of alternate procedures.

Additional requirements may apply if the material is an acutely toxic compressed gas. Please refer to the SOP for acutely toxic gases if applicable.

- **Securing of gas cylinders**

  Cylinders of compressed gases must be handled as high energy sources. They pose a serious hazard if the cylinder valve is dislodged. When storing or moving a cylinder, have the cap securely in place to protect the stem. Use suitable racks, straps, chains or stands to support cylinders.

  Do not store cylinders or lecture bottles with the regulator in place. If the regulator fails, the entire contents of the gas cylinder may be discharged.

- **Decontamination procedures**

  Not Applicable

- **Designated area**

  Compressed gas cylinders which contain acutely toxic gases must be stored in a designated area. See the SOP for acutely toxic compressed gases.

- **Emergency procedure**

  **If an Injury/Exposure Occurs:**

  1. **Research Laboratories:** Contact WSU Police Department at (313) 577-2222 immediately in the event of any injury in the laboratory. OEHS should then be called to investigate the event.

  **Undergraduate Teaching Laboratory:** Call Science Stores ((313) 577-3098) who will contact WSU Police Department and escort them to the teaching laboratory. In the event
that Science Stores cannot be reached, call WSU Police Department directly at (313) 577-2222
2. **Skin Contact:** Immediately flush skin with plenty of water for at least 15 minutes. Injured person should remove contaminated clothing and shoes. Injured person should be instructed to wash their clothing before reuse.
3. **Eye Contact:** Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention as soon as possible.
4. **Inhalation:** Remove injured person from lab and into fresh air. Seek medical attention if necessary to restore breathing.

Special first aid treatment required by the type of compressed gas handled in the laboratory will be described in the Safety Data Sheet for that material.

**If a Fire Occurs:**
1. Proceed to nearest fire alarm pull station and activate same.
2. Call WSU Police Department at (313) 577-2222. Undergraduate Teaching Laboratory: Also call Science Stores ((313) 577-3098)
3. If you have been properly trained and/or experienced in the use of a portable fire extinguisher and fire is small, you may proceed to nearest ABC or CO2 fire extinguisher.
4. Extinguish fire using PASS Method.
   - Pull pin
   - Aim nozzle at base of fire
   - Squeeze lever
   - Sweep extinguisher side to side.
5. If chemical is toxic and cannot be extinguished with portable fire extinguisher, evacuate area and close all doors.

The Office of Risk Management provides fire extinguisher training and evacuation training for all laboratory personnel.

Make yourself available to give emergency responders information as needed.

- **Eye protection**

Eye protection in the form of safety glasses must be worn at all times when handling compressed gases. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87.1 1989) and must be equipped with side shields.

- **Eyewash**

Not applicable.
- **Fume hood**
  Manipulation of compressed gases should typically be carried out in a fume hood if the compressed gas is an irritant, oxidizer, asphyxiant, or has other hazardous properties.

- **Glove (dry) box**
  Not applicable

- **Gloves**
  Not applicable

- **Hazard assessment**
  Hazard assessment for work with compressed gases should assure that all staff understand proper use and handling precautions; that all pressurized equipment is properly shielded; regulators are not interchanged between different gas types; all hose connections are properly secured and are appropriate for the pressure(s) used.

- **OEHS Notification**
  Not applicable

- **Protective apparel**
  Lab coats, closed toed shoes and long sleeved clothing should be worn when handling compressed gases.

- **Safety shielding**
  Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of compressed gases which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants are acceptable.

- **Safety shower**
  Not applicable

- **Signs and labels**
  **Containers:** All compressed gases must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; **chemical formulas and structural formulas are not acceptable**. The compressed gas cylinder should be labeled to indicate if the container is full or empty.
**Special storage**

Cylinders should be stored in an upright position and secured to a wall or laboratory bench through the use of chains or straps. Cylinder caps should remain on the cylinder at all times unless a regulator is in place. Cylinders should be stored in areas where they will not become overheated. Avoid storage near radiators, areas in direct sunlight, steam pipes and heat releasing equipment such as sterilizers.

Transport compressed gas cylinders on equipment designed for this function. Never carry or "walk" cylinders by hand.

- **Special ventilation**

  Manipulation of compressed gas that is an irritant, oxidizer, asphyxiant, or has other hazardous properties outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to compressed gases in the laboratory and are the preferred ventilation control device. If you have questions contact the Office of Environmental Health and Safety to review the adequacy of all special ventilation.

- **Spill response (see also S.O.P. 3.15)**

  In the event of a spill of a compressed gas that is an irritant, oxidizer, asphyxiant, or has other hazardous properties all personnel in the area should be alerted. Vacate the laboratory immediately and call for assistance.

  University Police Department  (313) 577-2222. This is a 24 hour service.
  
  Office of Environmental Health & Safety, (313) 577-1200
  
  Science Stores, (313) 577-3098 (Chemistry Undergraduate Teaching Laboratories only)

  Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

- **Vacuum protection**

  Not applicable

- **Waste disposal**

  All empty or partially filled compressed gas cylinders should be returned to the supplier. If the supplier does not accept empty or partially filled cylinders, contact the Office of Environmental Health and Safety concerning disposal.
3.10.  Cryogenic Liquids & Dry-Ice

- **Definitions**

  **Cryogen**: A liquefied gas with a boiling point typically below 77 K (-196 °C). The most commonly cryogens used at WSU are liquid nitrogen and liquid helium.

  **Dewar**: an insulated container used to store and transport liquefied gases. It is insulated by a vacuum between its two walls and is equipped with pressure relief device(s).

  **Dry Ice**: Frozen carbon dioxide. Dry ice sublimes from a solid to a gas at room temperature.

  **Pressure-relief devices**: Devices on cryogenic systems in place to relieve pressure build up. These devices may be: (1) valves which open to relieve pressure, (2) bursting discs that break to relieve pressure and must be replaced or (3) loose-fitting lids on Dewar flasks.

- **Hazards Associated with Cryogens & Dry Ice**

  1. **Burns**: Skin contact with a cryogen, dry ice or non-insulated equipment parts can cause cold burn and frostbite. Eye contact with a cryogen or dry ice can cause permanent damage. Always wear the proper PPE when working with or around cryogens and dry-ice.

  2. **Asphyxiation**: NMR magnet quenching (the loss of superconductivity followed by the rapid release of gaseous cryogens) can result in an oxygen deficient atmosphere. The volumetric expansion rate from the liquid to gaseous phase ranges between 690 to 750 times. The use of dry ice in cold rooms can cause increased breathing, headache, dizziness, nausea and visual disturbances due to elevated carbon dioxide concentrations in the air. Dry ice can also cause asphyxiation in confined spaces.

    **Remember: You cannot detect oxygen deficiency or over exposure to carbon dioxide.**

    Always work with cryogens and dry ice in well ventilated spaces especially when filling dewars. If you are working in a small space, open a door to increase ventilation. Do not work with or store large quantities of dry ice in cold rooms.

  3. **Fire and Explosion Hazards**: Liquid nitrogen and helium are not flammable. However they are capable of condensing oxygen out of the air creating an oxygen-rich environment. Flammable materials can ignite in the presence of condensed oxygen.

  4. **Vacuum System and Over-pressurization Hazards**: Cryogenic systems must be equipped with pressure-relief devices. Never use a system that does not have pressure-relief devices in place.

  5. **Dewars** have an insulating vacuum space in between its double walls. If a dewar becomes damaged air or liquid can leak into the vacuum space. This will reduce its insulating properties and can greatly increase the pressure inside the dewar.
Dewars and storage vessels are equipped with pressure-relief devices that prevent high pressure from developing (liquid nitrogen dewars have one valve and one bursting disc; liquid helium dewars have two valves and one disc, dewar flasks are equipped with loose-fitting lids or specially vented stoppers.)

Air or liquid that leaks into a vacuum space can freeze. If the space is rapidly warmed after starting a transfer the pressure-relief valve will vent the gas that is generated, preventing an explosion. Never cover a pressure relief valve that is venting.

6. **Cyrotubes stored in liquid nitrogen may “explode” when removed from the dewar.**
   Cyrotubes are not guaranteed to be leak tight if stored in liquid nitrogen. Because of the “super fluidity” of liquid nitrogen it can leak into sealed cyrotubes. When removed from the dewar the liquid nitrogen that leaked into the cryotube expands causing the tube to “explode”. If you must store samples in liquid nitrogen wear cryogloves, face shield and safety glasses when removing samples.

7. **Property Damage:** Cryogens can damage rubber tubing and crack floor tiles if spilled. Special care should be taken to avoid spilling any cryogens. Cracked floor tiles may also present a tripping hazard to other workers. Notify your Building Administrator of any floor tiles that require repair.

- **Personal Protective Equipment (PPE)**

Laboratory personnel must always wear safety glasses and lab coats when working with cryogens, dry ice or around dispensing lines where cold burns may occur.

The following PPE must be worn when filling dewars or removing specimens or samples from a dewar

1. Cryo-gloves
2. Face Shield
3. Safety goggles
4. Lab coat
5. Long pants
6. Closed toe shoes

The following must be worn when handling dry ice:

1. Cyro gloves
2. Lab Coat
3. Long Pants
4. Closed toe shoes

**Filling Dewars or Other Storage Vessels**

1. Dewars and other storage vessels (e.g. cylinders) are available in a variety of shapes and sizes. Always use a dewar or storage vessel rated for the cryogen you are refilling or transporting. (Do not use styrofoam containers or thermos bottles for holding and transporting liquid nitrogen).
2. Remove all metal jewelry from wrists and hands (a spill/splash could freeze the jewelry to your skin).
3. Always wear cryo-gloves when dispensing a cryogenic liquid. Available from Fisher Scientific; Catalog # 11-394-305. Note: Cryo-gloves only provide short-term protection against accidental skin exposures and are no designed to protect skin against prolonged contact.
4. Only fill a dewar from a transfer line that has a phase separator attached to the end of the line. Phase separators separate gas from liquid preventing an overabundance of gas from surrounding the end of the transfer line and allow only liquid nitrogen to fall into the dewar.
5. When filling a dewar flask at a filling station, place the phase separator so that it rests on the bottom of the dewar. Do not allow the cryogen to splash into the dewar.
6. Dispense directly into the dewar. Never use a funnel in the dispensing process. The funnel can freeze creating a splash hazard.
7. Use stainless steel tubing to transfer cryogens. Never use rubber or plastic tubing. The temperature can cause rubber or plastic tubing to become brittle and crack, spraying the liquid onto surrounding surfaces. Never fill a dewar or storage vessel if the tubing is damaged. (Liquid helium must be transferred through a vacuum insulated tube because of its extremely low heat of vaporization.)
8. Never overfill a dewar. This may cause liquid nitrogen to leak into the cryotubes stored in the dewar. Upon removal from the dewar, cryotubes may explode when the liquid nitrogen inside is warmed and expands.

**Additional Safety Precautions**

1. When cooling objects with liquid nitrogen lower them very slowly into the liquid using tongs to prevent boiling and splashing.
2. Always use a CryoClaw to retrieve samples that have fallen into a dewar. (CryoClaw available from Fisher Scientific; Catalog # 11-675-95).
3. Be sure that all cryogen containers are clearly labeled with a cryogen warning and the cryogen’s name.
4. Always use appropriate glassware rated for use with cryogens.
5. Do not overfill the dewar. Where possible only store cryogenic vials in the vapor phase of liquid nitrogen (above the liquefied gas). Do not store vials in the liquid phase.
6. Always use an appropriate wheeled cart to transport a dewar or storage vessel. Never pull, push or roll a dewar or storage vessel.

7. For more information on using dry ice for shipping laboratory specimens contact OEHS (313) 577-1200.

8. Training and special packaging is required when shipping samples on dry ice. Contact OEHS for more information.

9. Always read the Safety Data Sheet (formally called MSDS) for a cryogenic substance prior to working with it.

10. If you work in an NMR laboratory and would like to receive more information on cryogens and high field magnet systems, please contact OEHS: (313) 577-1200

11. Notify your supervisor and proceed immediately to Occupational Medicine or Student Health, accordingly.

- **Emergencies**

  **If an Injury/Exposure Occurs:**

  1. **Research Laboratories:** Contact WSU Police Department at (313) 577-2222 immediately in the event of any injury in the laboratory. OEHS should then be called to investigate the event.

  2. **Undergraduate Teaching Laboratory:** Call Science Stores ((313) 577-3098) who will contact WSU Police Department and escort them to the teaching laboratory. In the event that Science Stores cannot be reached, call WSU Police Department directly at (313) 577-2222.

  3. **Skin Contact:** If skin comes in contact with a cryogen or dry ice, run the area of skin under cool or warm water for fifteen minutes (do not use hot or cold water). If your finger is burned do not place it in your mouth. This could burn your mouth. Do not rub the area; rubbing can cause further tissue damage.

  4. **Eye Contact:** Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention as soon as possible.

  5. **Inhalation:** Remove injured person from lab and into fresh air. Seek medical attention if necessary to restore breathing.

Special first aid treatment required by the type of substance handled in the laboratory will be described in the Safety Data Sheet for that material.

**If a Spill Occurs (see also S.O.P. 3.15):**

1. Do not attempt to clean up a spilled cryogen. If a large volume of gas is released, leave the area immediately and call WSU Police Department (313) 577-2222 and then OEHS at (313) 577-1200. **Undergraduate Teaching Laboratory:** also call Science Stores ((313) 577-3098) who will escort WSU Police Department to the teaching laboratory.

2. In the event that OEHS or Science Stores cannot be reached, call WSU Police Department at (313) 577-2222.

**If a Fire Occurs:**

1. Proceed to nearest fire alarm pull station and activate same.
2. Call WSU Police Department at (313) 577-2222. Undergraduate Teaching Laboratory: Also call Science Stores ((313) 577-3098)

3. If you have been properly trained and/or experienced in the use of a portable fire extinguisher and fire is small, you may proceed to nearest ABC or CO₂ fire extinguisher.

4. Extinguish fire using PASS Method.
   - Pull pin
   - Aim nozzle at base of fire
   - Squeeze lever
   - Sweep extinguisher side to side.

5. If the fire is large and cannot be extinguished with portable fire extinguisher or if the chemical is toxic, evacuate area and close all doors.

   The Office of Risk Management provides fire extinguisher training and evacuation training for all laboratory personnel.

   Make yourself available to give emergency responders information as needed.
3.11. Electrical Safety in Laboratories

• **Application**

This SOP applies to equipment and appliances used in a laboratory. It does not address computers or other office equipment used in non-laboratory settings.

• **Extension Cords**

Use extension cords for temporary (less than three months) use. Situations that require extension cords for greater than three months are considered permanent installations and must be addressed through upgrades to building wiring systems. Extension cords should be no less than 16 gauge.

Do not place extension cords in foot traffic areas or under equipment. Length shall be the minimum required for the specific application but shall not exceed 15 feet. Ground wires are required for all extension cords (i.e., the cord should have three prongs).

• **Single Conductor Wires**

Single conductors shall not conduct greater than 24 volts. Code single conductors red or black and keep them as short as possible. Single conductors shall be a single continuous length of wire unless spliced or joined in a grounded electrical box that provides appropriate strain-relief. Wire nut or other connections that are not housed in a grounded electrical box are not permitted.

• **Terminal Connections**

All electrical connections at the supply end (bus bars) for 24 volt or greater services shall have strain relief and be enclosed. Label the enclosure with the voltage.

Plug style connections are permitted if the conductor is fully insulated and the conducting wire is not exposed when disconnected.

When possible enclose electrical connections in a protective housing. Insulate high temperature (>1808 °C) connections, such as furnaces, with 3M 69 Class "H" glass cloth tape (call Science Stores to check on cost and availability at (313) 577-3098).
3.12. Lecture Bottle Safety

- Description

Lecture bottles are small compressed gas cylinders, typically 12-18 inches long and 2-3 inches in diameter.

- Lecture Bottle Use

Inspect the lecture bottle and regulator prior to use. Never use lecture bottles or regulators that are damaged or corroded. (See the Disposal Section for disposal of damaged lecture bottles.)

![Corroded valve on a hydrogen chloride lecture bottle.](image)

Only use regulators and tubing that are appropriate for the gas. For example, stainless steel regulators and tubing must be used for corrosive gases. Using the wrong regulator can compromise the gas purity, cause equipment failure and cause injury to laboratory personnel.

Lecture bottles must be properly secured during use and lecture bottles containing hazardous gases (corrosive or poison) must be used in a fume hood or gas cabinet.
Lecture bottle stand available from Sigma Aldrich.

- **Lecture Bottle Storage**

  Lecture bottles must be stored in an upright position. Lecture bottles stored on their side are more susceptible to damage, corrosion and leaks.

  Segregate incompatible gases, such as flammable and oxidizing gases.

  Store poisonous gases in a fume hood or a ventilated gas cabinet.

  Regulators must be removed during storage. It is a good idea to label the regulator with the gas it is used for to prevent accidental misuse in the future.

  Lecture bottles must be properly labeled. Re-label the lecture bottle if the label becomes illegible or falls off.

  **Example of proper lecture bottle storage:**

Lecture bottle holder available from Fisher Scientific or Sigma Aldrich.
Examples of improper lecture bottle storage:

- **Lecture Bottle Purchase and Disposal**

Unlike other gas cylinders, lecture bottles are not refillable and are purchased outright by the laboratory. Most gas manufacturers do not take back lecture bottles.
It is costly to dispose of lecture bottles. Costs for disposal can range from $100 for a non-hazardous, properly labeled lecture bottle to over $1000 for a hazardous or unlabeled lecture bottle. Contact OEHS for disposal of old or unneeded lecture bottles.

- **Emergency Procedures**

Contact OEHS immediately if there is a leak involving a hazardous lecture bottle. Evacuate the laboratory if the lecture bottle is not in a fume hood or gas cabinet.

OEHS can be reached at (313) 577-1200 between 8:30AM and 5PM. Outside of those hours, contact WSU Police at (313) 577-2222.

- **Safety Alert Concerning Anhydrous Hydrogen Fluoride**

Anhydrous hydrogen fluoride reacts over time with the iron in the steel to form iron fluoride and hydrogen. The hydrogen pressure can build up to the point where it ruptures the cylinder.

Anhydrous hydrogen fluoride lecture bottles must be disposed of within 2 years of purchase.

Anhydrous hydrogen fluoride lecture bottle exploded in a chemistry laboratory. Photo courtesy UC Santa Barbara.
3.13. Acutely Toxic Chemicals

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any items listed in this procedure contact the Office of Environmental Health and Safety ((313) 577-1200) or the Principal Investigator or Principal Laboratory Instructor of your laboratory. Specific written procedures are the responsibility of the Principal Investigator or Principal Laboratory Instructor.

If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety (OEHS) is available to provide guidance during the development of alternate procedures.

Select Agents and Toxins can be found at https://research.wayne.edu/oehs/index.php, keyword search “select agent”. The purchase or possession of Select Agent toxins requires registration.

- **Securing of gas cylinders**
  
  Not applicable

- **Decontamination procedures**

  **Personnel:** Wash hands and arms with soap and water immediately after handling acutely toxic chemicals.

  **Area:** Decontamination procedures vary depending on the material being handled. Refer to the Safety Data Sheets for the material for additional information. The toxicity of some materials can be neutralized with other reagents. All surfaces should be wiped with the appropriate cleaning agent following dispensing or handling. Waste materials generated should be treated as a hazardous waste.

  **Equipment:** Decontaminate vacuum pumps or other contaminated equipment (glassware) before removing them from the designated area.

- **Designated area**

  The room sign for the laboratory must contain a “Designated Areas Within” identifier.

  All locations within the laboratory where acutely toxic chemicals are handled should be demarcated with designated area caution tape and/or posted with designated area caution signs. This includes all fume hoods and bench tops where the acutely toxic chemicals are handled.
Where feasible acutely toxic chemicals should be manipulated over plastic-backed disposable paper work surfaces. These disposable work surfaces minimize work area contamination and simplify clean up.

- **Destruction of Select Agents**

  Contact OEHS, (313) 577-1200 for directions

- **Emergency procedure**

  **If an Injury/Exposure Occurs:**
  1. **Research Laboratories:** Contact WSU Police Department at (313) 577-2222 immediately in the event of any injury in the laboratory. OEHS should then be called to investigate the incident.

  **Undergraduate Teaching Laboratory:** Call Science Stores ((313) 577-3098) who will contact WSU Police Department and escort them to the teaching laboratory. In the event that Science Stores cannot be reached, call WSU Police Department directly at (313) 577-2222.

  2. **Skin Contact:** Immediately flush skin with plenty of water for at least 15 minutes. Injured person should remove contaminated clothing and shoes. Injured person should be instructed to wash their clothing before reuse.

  3. **Eye Contact:** Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention as soon as possible.

  4. **Inhalation:** Remove injured person from lab and into fresh air. Seek medical attention if necessary to restore breathing.

  **If A Chemical Fire Occurs:**
  1. Proceed to nearest fire alarm pull station and activate same.

  2. Call WSU Police Department at 577-2222. Undergraduate Teaching Laboratory: Also call Science Stores ((313) 577-3098)

  3. If you have been properly trained and/or experienced in the use of a portable fire extinguisher and fire is small, you may proceed to nearest ABC or CO₂ fire extinguisher.

  4. Extinguish fire using PASS Method.
     - Pull pin
     - Aim nozzle at base of fire
     - Squeeze lever
     - Sweep extinguisher side to side.

  5. If chemical is toxic and cannot be extinguished with portable fire extinguisher, evacuate area and close all doors.

  The Office of Risk Management provides fire extinguisher training and evacuation training for all laboratory personnel.

- **Eye protection**

  Eye protection in the form of safety glasses must be worn at all times when handling acutely toxic chemicals. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye
and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes, therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

- **Eyewash**

  Research Laboratories: Where the eyes or body of any person may be exposed to acutely toxic chemicals, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

  Eyewash stations should be located in accessible areas within each undergraduate teaching laboratory.

- **Fume hood**

  Manipulation of acutely toxic chemicals should be carried out in a fume hood. If the use of a fume hood proves impractical refer to the section on special ventilation.

  All areas where acutely toxic chemicals are stored or manipulated must be labeled as a designated area.

- **Glove (dry) box**

  Certain acutely toxic chemicals must be handled in a glove box rather than a fume hood. The Office of Environmental Health and Safety ((313) 577-1200) or the Principal Investigator or Principal Laboratory Instructor will determine if this is required.

- **Gloves**

  Gloves should be worn when handling acutely toxic chemicals. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. However, the handling of some acutely toxic chemicals will require chemical resistant gloves. Lab workers should review the SDS for the acutely toxic agent and contact OEHS for advice on glove selection.

- **Hazard assessment**

  Hazard assessment should focus on proper use and handling procedures, the education of employees concerning the health risk posed by acutely toxic materials, and on the demarcation of designated areas.

- **OEHS Notification**

  You should notify the Office of Environmental Health and Safety prior to the initial use of acutely toxic substances. Notification is also required following significant changes in procedures or the quantity of materials used.
• **Protective apparel**

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling acutely toxic chemicals. Additional protective clothing should be worn if the possibility of skin contact is likely.

• **Safety shielding**

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of acutely toxic chemicals which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

• **Safety shower**

A safety or drench shower should be available in a nearby location where the acutely toxic chemicals are used.

• **Signs and labels**

**Doorways:** The room sign must contain a *Designated Area Within Caution* where carcinogens, reproductive hazards, and/or acutely toxic chemicals are stored or used.

**Containers:** All acutely toxic chemicals must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable. Contact OEHS (313) 577-1200 for more information.

• **Special storage**

Acutely toxic chemicals must be stored in a designated area.

• **Special ventilation**

Manipulation of acutely toxic chemicals outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to acutely toxic chemicals in the laboratory and are the preferred ventilation control device. Where possible handle acutely toxic chemicals in a fume hood. If the use of a fume hood proves impractical, attempt to work in a glove box or in an isolated area on the laboratory bench top.

If available, consider using a Biological Safety Cabinet. The biological safety cabinet is designed to remove the acutely toxic chemicals before the air is discharged into the environment. Acutely toxic chemicals that are volatile must not be used in a biological safety cabinet unless the cabinet is vented to the outdoors.
If your experiment does not permit the handing of acutely toxic chemicals in a fume hood, biological safety cabinet, or glove box, you must contact the Office of Environmental Health and Safety.

All areas where acutely toxic chemicals are stored or manipulated must be labeled as a designated area.

- **Spill response**

  **Chemical Spills/Chemical Fires (see also S.O.P. 3.15)**

  The range and quantity of hazardous substances used in WSU laboratories require pre-planning to respond safely to a chemical spill. Call WSU Police Department at (313) 577-2222 for any chemical spill. If you have a doubt whether a spill can be safely and effectively cleaned up by staff in the lab, call the Office of Environmental Health and Safety at (313) 577-1200.

  **If A Chemical Spill Occurs:**

  1. **Research Laboratories:** Contact WSU Police Department at (313) 577-2222 then OEHS at (313) 577-1200.

     **Undergraduate Teaching Laboratory:** Call Science Stores ((313) 577-3098) who will contact WSU Police Department and escort them to the teaching laboratory. In the event that Science Stores cannot be reached, call WSU Police Department directly at (313) 577-2222.

  2. Remain calm.

  3. Alert persons in immediate area of spill.

  4. Without endangering yourself, attend to any injured or contaminated victims:

     - Move victims to fresh air/safe place.
     - Remove contaminated clothing.
     - Wait for Police Department and emergency responders in a safe area.

  5. In the event of chemical spill where you need assistance, but the spill is not an immediate threat to life or health, follow these steps:

     - Confine the spill area: close doors, isolate area, evacuate if necessary.
     - Alert others in the area and tell them to evacuate area if necessary.
     - From safe locations, report the spill to Office of Environmental Health and Safety at (313) 577-1200.
     - Report your name, location and the name of the material spilled.
     - Stay in the area until the emergency responders arrive so that you can answer any additional questions.

  6. If the chemical spill is flammable, turn off all ignition and heat sources. Evacuate area if necessary.

- **Vacuum protection**

  Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving acutely toxic chemicals must be conducted in a fume hood, glove box or isolated in an acceptable manner.

  Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood.
Waste disposal

All materials contaminated with acutely toxic chemicals should be disposed of as a hazardous waste. Wherever possible, attempt to design research in a manner that reduces the quantity of waste generated.

Questions regarding waste pick up should be directed to the Office of Environmental Health and Safety. This office can also assist you in minimizing waste generation. "Select Agent Toxins" (see attached list) must be destroyed prior to waste disposal.
HHS AND USDA SELECT AGENTS AND TOXINS
7 CFR Part 331, 9 CFR Part 121, and 42 CFR Part 73

HHS AND USDA SELECT AGENTS AND TOXINS
Abrin
Botulinum neurotoxins*
Botulinum neurotoxin producing species of Clostridium*
Conotoxins (Short, paralytic alpha conotoxins containing the following amino acid sequence X1CCX2PACGX3X4X5X6CX7)
Coxiella burnetii
Crimean-Congo haemorrhagic fever virus
Diacetoxyiscirpenol
Eastern Equine Encephalitis virus1
Ebola virus*
Francisella tularensis*
Lassa fever virus
Lujo virus
Marburg virus*
Monkeypox virus1
Reconstructed replication competent forms of the 1918 pandemic influenza virus containing any portion of the coding regions of all eight gene segments (Reconstructed 1918 Influenza virus)
Ricin
Rickettsia prowazekii
SARS-associated coronavirus (SARS-CoV)
Saxitoxin
South American Haemorrhagic Fever viruses: Chapare, Guanarito, Junin, Machupo, Sabia
Staphylococcal enterotoxins A,B,C,D,E subtypes T-2 toxin
Tetrodotoxin
Tick-borne encephalitis complex (flavi) viruses:
  Far Eastern subtype
  Siberian subtype
Kyasanur Forest disease virus
Omsk hemorrhagic fever virus
Variola major virus (Smallpox virus)*
Variola minor virus (Alastrim)*
Yersinia pestis*

OVERLAP SELECT AGENTS AND TOXINS
Bacillus anthracis *
Bacillus anthracis Pasteur strain
Brucella abortus
Brucella melitensis
Brucella suis
Burkholderia mallei*
Burkholderia pseudomallei*
Hendra virus
Nipah virus
Rift Valley fever virus
Venezuelan equine encephalitis virus1

USDA SELECT AGENTS AND TOXINS
African horse sickness virus
African swine fever virus
Avian influenza virus1
Classical swine fever virus
Foot-and-mouth disease virus*
Goat pox virus
Lumpy skin disease virus
Mycoplasma capricolum1
Mycoplasma mycoides1
Newcastle disease virus1,2
Peste des petits ruminants virus
Rinderpest virus*
Sheep pox virus
Swine vesicular disease virus

USDA PLANT PROTECTION AND QUARANTINE (PPQ) SELECT AGENTS AND TOXINS
Peronosclerospora philippinensis (Peronosclerospora sacchari)
Phoma glycinicola (formerly Pyrenochaeta glycines)
Ralstonia solanacearum
Rathayibacter toxicus
Sclerophthora verrucaria
Synchytrium endobioticum
Xanthomonas oryzae

*Denotes Tier 1 Agent

1 Select agents that meet any of the following criteria are excluded from the requirements of this part: Any low pathogenic strains of avian influenza virus, South American genotype of eastern equine encephalitis virus, west African clade of Monkeypox viruses, any strain of Newcastle disease virus which does not meet the criteria for virulent Newcastle disease virus, all subspecies Mycoplasma capricolum except subspecies capripneumoniae (contagious caprine pleuropneumonia), all subspecies Mycoplasma mycoides except subspecies mycoides small colony (Mmm SC) (contagious bovine pleuropneumonia), any subtypes of Venezuelan equine encephalitis virus except for Subtypes IAB or IC, and Vesicular stomatitis virus (exotic): Indiana subtypes VSV-IN2, VSV-IN3, provided that the individual or entity can verify that the agent is within the exclusion category.

2 A virulent Newcastle disease virus (avian paramyxovirus serotype 1) has an intracerebral pathogenicity index in day-old chicks (Gallus gallus) of 0.7 or greater or has an amino acid sequence at the fusion (F) protein cleavage site that is consistent with virulent strains of Newcastle disease virus. A failure to detect a cleavage site that is consistent with virulent strains does not confirm the absence of a virulent virus.

*Denotes Tier 1 Agent

1 Select agents that meet any of the following criteria are excluded from the requirements of this part: Any low pathogenic strains of avian influenza virus, South American genotype of eastern equine encephalitis virus, west African clade of Monkeypox viruses, any strain of Newcastle disease virus which does not meet the criteria for virulent Newcastle disease virus, all subspecies Mycoplasma capricolum except subspecies capripneumoniae (contagious caprine pleuropneumonia), all subspecies Mycoplasma mycoides except subspecies mycoides small colony (Mmm SC) (contagious bovine pleuropneumonia), any subtypes of Venezuelan equine encephalitis virus except for Subtypes IAB or IC, and Vesicular stomatitis virus (exotic): Indiana subtypes VSV-IN2, VSV-IN3, provided that the individual or entity can verify that the agent is within the exclusion category.

2 A virulent Newcastle disease virus (avian paramyxovirus serotype 1) has an intracerebral pathogenicity index in day-old chicks (Gallus gallus) of 0.7 or greater or has an amino acid sequence at the fusion (F) protein cleavage site that is consistent with virulent strains of Newcastle disease virus. A failure to detect a cleavage site that is consistent with virulent strains does not confirm the absence of a virulent virus.
3.14. Pyrophoric Chemicals

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Office of Environmental Health and Safety ((313) 577-1200) or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the principal investigator.

If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Radiation Safety is available to provide guidance during the development of alternate procedures.

Pyrophoric chemicals are liquids, solids, and gases that will ignite spontaneously in air at or below 130 °F.

Examples of pyrophoric reagents commonly found in laboratories

Liquids/Solutions

<table>
<thead>
<tr>
<th>Organolithiums</th>
<th>Alkyl and Aryl Lithiums</th>
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<tbody>
<tr>
<td></td>
<td>n-butyllithium,</td>
</tr>
<tr>
<td></td>
<td>t-butyllithium</td>
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<tr>
<td></td>
<td>Lithium Amides</td>
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<tr>
<td></td>
<td>Lithium Alkoxides</td>
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<tr>
<td>Organomagnesiums “Grignard Reagents”</td>
<td>Alkyl and Aryl Magnesium Halides</td>
</tr>
<tr>
<td></td>
<td>Methylmagnesium Chloride,</td>
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<tr>
<td></td>
<td>Allylmagnesium Bromide</td>
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<tr>
<td>Organozincs</td>
<td>Diethyl Zinc</td>
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<tr>
<td>Aluminum Alkyls</td>
<td>Trimethylaluminum</td>
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<tr>
<td></td>
<td>Diisobutylaluminum hydride</td>
</tr>
<tr>
<td>Metal Carbonyls</td>
<td>Nickel Carbonyl</td>
</tr>
<tr>
<td></td>
<td>Iron Pentacarbonyl</td>
</tr>
<tr>
<td>Silicon Halides</td>
<td>Dichloromethylsilane</td>
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</table>
Solids (may also come as solutions)

<table>
<thead>
<tr>
<th>Metal Hydrides</th>
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<tbody>
<tr>
<td>Sodium Hydride</td>
<td>Potassium Hydride</td>
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<tr>
<td>Lithium Aluminum Hydride</td>
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</table>

<table>
<thead>
<tr>
<th>Finely Divided Metals</th>
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<tbody>
<tr>
<td>Aluminum</td>
<td>Lithium</td>
</tr>
<tr>
<td>Magnesium</td>
<td>Titanium</td>
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<tr>
<td>Zinc</td>
<td>Zirconium</td>
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<tr>
<td>Sodium</td>
<td>Potassium</td>
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<table>
<thead>
<tr>
<th>Used Hydrogenation Catalysts</th>
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<tbody>
<tr>
<td>Raney Nickel</td>
<td>Palladium on Carbon</td>
</tr>
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</table>

Gases

<p>| |</p>
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<tr>
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</thead>
<tbody>
<tr>
<td>Silane</td>
</tr>
<tr>
<td>Diborane</td>
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<tr>
<td>Phosphine</td>
</tr>
</tbody>
</table>

- **Gas cylinders**

  Cylinders of compressed pyrophoric gases must be handled as high energy sources. When storing or moving a cylinder, have the cap securely in place to protect the stem. Use suitable racks, straps, chains or stands to support cylinders.

  The use of pyrophoric gases requires OEHS approval. If you anticipate the need to use pyrophoric gases in your work contact OEHS at (313) 577-1200 or http://research.wayne.edu/oehs/.

- **Pre-Requisites for Pyrophoric Use**

  **Supervision and Training**

  All users of pyrophoric reagents in the laboratory must receive hands-on instruction from a senior member of the laboratory (Principal Investigator or Post-Doctoral Fellow) and must be closely supervised until safe work practices are consistently demonstrated. This training must be documented so that proof of training is available upon request.
The pyrophoric liquid safety video from UCLA at https://www.youtube.com/watch?v=21iC4YEgOAs is recommended as a training aid; however, it may not be used as a substitute for hands-on demonstration and instruction.

The Sigma-Aldrich Technical Bulletins “Handling of Air-Sensitive Reagents (AL-134)” and “The Aldrich Sure/Pac™ System (AL-136)” provide further guidance.

**Hazard assessment**

Hazard assessment for work involving pyrophoric chemicals should thoroughly address the issue of fire safety (including the need for Class D fire extinguishers), proper use and handling techniques, chemical toxicity, storage, and spill response.

Contact OEHS if you would like assistance in performing a thorough hazard assessment prior to starting your work.

**OEHS Notification**

Provide OEHS advance notice if planning an experiment requiring large quantities (greater than 100 mL of liquid or 10 g of solid) of pyrophoric materials. OEHS should also be notified if a particular laboratory group is planning to use pyrophoric reagents for the first time.

- **Engineering Controls**

  **Ventilation**

  Always handle liquid pyrophoric chemicals in a fume hood or glove box. If your research does not permit the handling of pyrophoric chemicals in a fume hood or glove box you must contact the Office of Environmental Health and Safety to review the adequacy of all special ventilation.

  **Fume hood**

  Many pyrophoric chemicals release noxious or flammable gases and should be handled in a hood. In addition some solid pyrophoric materials are stored under kerosene (or other flammable solvents), therefore the use of a fume hood is required to prevent the release of flammable vapors in the laboratory. Glove boxes may be also be used (see special ventilation).

  **Glove (dry and inert) box**

  Glove boxes must be used to handle pyrophoric chemicals if sufficient inert or dry atmospheres cannot be achieved using a vacuum gas manifold.

  **Gas Cabinet**

  Ventilated compressed gas cylinder storage cabinets may be required for high hazard gases such as pyrophorics. Consult OEHS before purchasing any pyrophoric gases.
**Safety shielding**

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of pyrophoric chemicals which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants are acceptable.

**Vacuum protection**

Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving pyrophoric chemicals must be conducted in a fume hood or isolated in an acceptable manner.

Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood. Vacuum pumps should be rated for use with pyrophoric chemicals.

For more information about vacuum protection contact OEHS at (313) 577-1200.

**Personal Protective Equipment**

**Protective apparel**

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling pyrophoric chemicals. Additional protective clothing should be worn if the possibility of skin contact is likely.

Unless work will be performed in a glove box, it is highly recommended that a Nomex lab coat be worn while manipulating quantities of liquid pyrophorics over 10 mL or solid pyrophorics over 1 gram. Contact Jackie Baldyga ((313) 577-2057 regarding the acquisition of Nomex lab coats.

**Gloves**

Gloves should be worn when handling pyrophoric chemicals. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals, but are highly combustible. Consider the use of Nomex/Leather pilot’s gloves, which provide fire resistance without compromising manual dexterity. The pilot’s gloves should be worn over nitrile gloves and are required during syringe/cannula transfers of pyrophoric liquids.

Lab workers should contact OEHS for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated.
Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling pyrophoric chemicals. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87.1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

- **Emergencies**

  **If an Injury/Exposure Occurs:**
  1. **Research Laboratories**: Contact WSU Police Department at (313) 577-2222 immediately in the event of any injury in the laboratory. Call OEHS (313) 577-1200 to investigate the event.
     **Undergraduate Teaching Laboratory**: Call Science Stores ((313) 577-3098) who will contact WSU Police Department and escort them to the teaching laboratory. In the event that Science Stores cannot be reached, call WSU Police Department directly at (313) 577-2222.
  2. **Skin Contact**: Immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. If there is any doubt about the severity of the injury, seek immediate medical attention.
  3. **Eye Contact**: Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention as soon as possible.
  4. **Inhalation**: Remove injured person from lab and into fresh air. Seek medical attention if necessary to restore breathing.

Special first aid treatment required by the type of substance handled in the laboratory will be described in the Safety Data Sheet for that material.

**If a Fire Occurs:**
  1. Proceed to nearest fire alarm pull station and activate same.
  2. Call WSU Police Department at (313) 577-2222. **Undergraduate Teaching Laboratory**: Also call Science Stores ((313) 577-3098)
  3. If you have been properly trained and/or experienced in the use of a portable fire extinguisher and fire is small, you may proceed to nearest ABC or CO₂ fire extinguisher.
  4. Extinguish fire using PASS Method.
     - Pull pin
     - Aim nozzle at base of fire
     - Squeeze lever
     - Sweep extinguisher side to side.
  5. If the fire is large and cannot be extinguished with portable fire extinguisher or if the chemical is toxic, evacuate area and close all doors.

The Office of Risk Management provides fire extinguisher training and evacuation training for all laboratory personnel.
Make yourself available to give emergency responders information as needed

- **Eyewash**

  Where the eyes or body of any person may be exposed to pyrophoric chemicals, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable. Eyewashes should be activated by lab personnel weekly.

- **Safety shower**

  A safety or drench shower should be available in a nearby location where the pyrophoric chemicals are used. Researchers should familiarize themselves with the location of the two nearest safety showers and eyewash stations both in and outside the lab prior to beginning work with pyrophoric materials.

- **Spill response**

  Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Safety Data Sheet. This should occur prior to the use of any pyrophoric chemicals. Spill control materials for pyrophoric chemicals are designed to be inert and will not react with the reagent.

  Many pyrophoric reagents must not be extinguished using a CO₂ fire extinguisher. Sand or soda ash (powdered lime) should be readily available where work is performed. Also, a small beaker of sand can be used to safely extinguish any small fires occurring at the tips of needles used to transfer liquid pyrophorics.

  **If A Chemical Spill Occurs:**
  1. Small spills should be handled as described in the Safety Data Sheet for the material.
  2. **For Assistance with Large Spills:**
     - **Research Laboratories:** Contact OEHS (313) 577-1200 and WSU Police Department at (313) 577-2222.
     - **Undergraduate Teaching Laboratory:** Call Science Stores ((313) 577-3098) who will contact WSU Police Department and escort them to the teaching laboratory. In the event that Science Stores cannot be reached, call WSU Police Department directly at (313) 577-2222.
  3. Remain calm.
  4. Alert persons in immediate area of spill.
  5. Without endangering yourself, attend to any injured or contaminated victims:
     - Move victims to fresh air/ safe place.
     - Remove contaminated clothing.
     - Wait for Police Department and emergency responders in a safe area.
  6. In the event of chemical spill where you need assistance, but the spill is not an immediate threat to life or health, follow these steps:
     - Confine the spill area: close doors, isolate area, evacuate if necessary.
     - Alert others in the area and tell them to evacuate area if necessary.
• From safe locations, report the spill to Office of Environmental Health and Safety at (313) 577-1200.
• Report your name, location and the name of the material spilled.
• Stay in the area until the emergency responders arrive so that you can answer any additional questions.
• If the chemical spill is flammable, turn off all ignition and heat sources. Evacuate area if necessary.

• **Storage and Disposal**

  **Signs and labels**

  **Containers:** All pyrophoric chemicals must be clearly labeled with the correct chemical name and hazard information. Pyrophoric chemicals should always be stored in their original commercial container.

  **Special storage**

  Pyrophoric chemicals should be stored under an atmosphere of inert gas or under an appropriate liquid. Do not store pyrophoric chemicals with flammable materials or in a flammable-liquids storage cabinet. Store these materials away from sources of ignition. Minimize the quantities of pyrophoric chemicals stored in the laboratory. Store bottles of liquid pyrophorics inside the original metal shipping can, if available, to provide additional protection/secondary containment.

  Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container which may cause a fire or explosion.

  Date containers upon initial receipt and upon opening. Take note of any printed expiration dates on the container label and dispose of them as required. Many pyrophoric reagents become unstable or more dangerous with age.

  Purchase pyrophoric reagents in the minimum quantity required for the work to be performed. Initial cost per volume/weight may be lower when reagents are purchased in bulk, but repeated opening of containers and puncturing of septa leads to product degradation and loss. Wasted material and disposal cost will often offset any initial savings.

• **Designated area**

  Any area where pyrophoric reagents will be handled must be carefully prepared prior to starting work. All equipment and materials needed for the experiment should be readily available, including appropriate extinguishing media. The work area should be clear of reagents and equipment not pertinent to the current experiment, including flammable and combustible reagents and materials.

  Other lab occupants should be made aware when and where work with hazardous materials will be performed.
• **Waste disposal**

Mixtures of chemicals such as reaction mixtures containing pyrophoric reagents should be carefully and completely quenched before combining with waste or packaging for disposal by OEHS.

Empty septa-sealed pyrophoric reagent containers (such as Sure-Seal™ bottles) will be picked-up for disposal by OEHS. There is no need to quench or rinse these containers.

Expired or unused reagent will be picked-up for disposal by OEHS in the original commercial bottle. There is no need to empty, quench, or rinse these containers.

OEHS cannot pick-up empty Sure-Pac™ cylinders (shown below) until they have been *completely* emptied, quenched and rinsed in the lab following the recommendations given in the Aldrich Technical Bulletin AL-136 ([http://www.sigmaaldrich.com/etc/medialib/docs/Aldrich/Bulletin/al_techbull_al136.Par.0001.File.tmp/al_techbull_al136.pdf](http://www.sigmaaldrich.com/etc/medialib/docs/Aldrich/Bulletin/al_techbull_al136.Par.0001.File.tmp/al_techbull_al136.pdf)). After the Sure-Pac™ has been rinsed, write “empty and rinsed” on the label and give to OEHS for disposal.

Sure-Pac™ cylinders that contain more than residual amounts of expired or unused material cannot be treated in the lab and should be given as-is to OEHS for disposal.
3.15. Spill Control and Emergency Procedures

The following plan is a guideline for spill control, evacuation, notification of proper authorities and general emergency procedures in the event of a hazardous materials incident (primarily a chemical spill) at the large quantity generators site, chemical storage areas or laboratories maintained by Wayne State University. Because all emergency situations are different it is important to first protect human life and health.

- **Spill Control Procedures for Low Hazard and High Hazard Incidents**

  **Non-ignitable, low toxicity liquids or solids and not generally dangerous gases (or small spills)** may be handled by first setting up restricted access to the spill area for small spills or evacuating the room/area in the case of large spills. For large spills, the WSU Police and then the Office of Environmental Health and Safety should be called to initiate spill response/clean-up procedures. If the spill or hazard is small, trained campus personnel can initiate the spill clean-up. Chemical aprons, impermeable clothing, multiple cartridge respirators and/or self-contained breathing apparatus should be worn consistent with the associated hazard. It is the emergency coordinator’s responsibility to determine the level of safety equipment required. A minimum of two (2) trained clean-up personnel should always respond to any chemical spill. Further back-up personnel should then be called as required. Inert adsorbents or neutralizing materials may be used to prevent spreading of liquids. The absorbed liquids can then be carefully swept up and placed into plastic pails with covers.

  **Ignit able liquids or solids, highly toxic materials, materials generating dangerous gases and/or reactive materials (or larger spills)** may be handled by first evacuating the room/area in the case of any size spill and if there may be any potential hazard to other areas and people in the building, then the entire building or an extended area of evacuation should be initiated. Wayne State Police Department should be called first, then the Office of Environmental Health and Safety. If the spill or hazard is sufficiently small, trained campus personnel can initiate the spill clean-up. This decision is to be made by the emergency coordinator. If the hazard is determined too great for university personnel to safely handle clean-up procedures, outside agencies/contractors should be called depending on the type of emergency. University spill response personnel are equipped to handle low risk chemical emergencies. Small spills of these types of materials can be handled by at least two (2) university response personnel. Proper safety and clean-up equipment should be used as required by the type of hazard involved. Any major HazMat clean-ups requiring extensive clean-up time (greater than 30 minutes) should be handled by properly equipped clean-up personnel. WSU does not have sufficient emergency equipment to safely respond to a clean-up in an immediately dangerous to life and health alarm.
• **Chemical/ Radioactive/ Biological Spill Countermeasures**

Note: Spills can occur outside your building. Similar emergency response procedures may apply.

A. Site personnel (responding to spills) – could be co-worker, building occupant, Building Coordinator

- Attend to any persons injured or may have been exposed to any hazardous material, without placing yourself in danger (without exposing yourself unnecessarily).
- **Call University Police Department Department (313) 577-2222** and notify persons in the immediate area of the hazard and evacuate the area, if necessary.
- Assess the situation (from a safe distance) as to:
  a. type of spill
  b. size of spill
  c. type of hazard
     - radioactive
     - flammable
     - reactive
     - corrosive
     - toxic
     - biohazard (blood, bacterial or viral culture, etc.)
- **Call the Office of Environmental Health and Safety (313) 577-1200 for assistance. For radioactive spills call OEHS Radiation Safety Staff (313) 577-1200.**
- **DO NOT** attempt clean-up of any hazardous materials without first calling these emergency numbers. Assistance and/or spill response equipment will be provided by the Office of Environmental Health & Safety.

B. On-Scene Coordinator (person responding to spill) – could be WSU Police Department, OEHS, or outside agency (Detroit Fire Department)

- Assess the situation from a safe distance.
- Attend to any injured persons.
- Determine what chemicals are involved.
- Determine the hazard of the chemicals.
- Determine the extent of the hazard.
- Notify the appropriate agencies.
- Set-up restricted area and evacuate the area.
- Stabilize the situation if possible.
- Shut off gas, electric or chemical feed lines.
- Remove hazardous materials from area, if it can be done safely.
- Determine the level of protection required for personnel entering the restricted area.
- Enter spill area, if appropriate, to further assess the situation and rescue victims using the proper level of personnel protection as required by the hazard.
- Initiate and direct clean-up of the area.
- If any residue needs to be processed or treated, do it away from the spill area.
- Dispose of all contaminated materials.
- Perform follow-up analysis of the area.
• Restore area to its original condition.

• **Emergency Building Evacuation Procedures**

  *(Fire, Gas Leak, Hazardous Materials, Fire Alarm)*

Identify the problem by observing the hazardous condition. Instantly, take steps to ensure personal safety by moving away from the hazardous area. Take valuables from the immediate work areas only. Alert other occupants in the building by pulling the fire alarm and telling others of the situation. Evacuate to the outside of the building, keeping clear of driveways and entrances. **Do not use the elevator during an evacuation!** The last person to leave each area should close the doors on the way out to contain the hazard.

Outside spills may require you to evacuate the building or even stay inside. WSU Police Department will assist you with this decision, as circumstances dictate.

**Emergency procedure goals:**

• protect life and safety
• stabilize the situation
• protect property
• protect the environment
Wayne State University Emergency Procedures

If you need help, call the WSU Police at 577-2222 – DO NOT CALL 911

Injuries / Exposures Requiring Medical Attention
- Emergencies: Detroit Receiving Emergency Room – 24 hours
- Non-emergencies during business hours M-F 6:30 a.m. – 5 p.m.: 4K University Health Center, 745-4522
- Non-emergencies after hours: Detroit Receiving Emergency Room

Fires
- Pull the closest fire alarm pull station
- Call the WSU Police 577-2222

Hazardous Material Spills
- Emergency chemical spills and after hours incidents: Call WSU Police at 577-2222
- Non-emergency spills M-F 8:30 a.m. to 5 p.m.: Call WSU Office of Environmental Health & Safety at 577-1200
3.16. Handling of Chemical Waste for Undergraduate Teaching Laboratories

Hazardous chemicals should never be dumped down the drain! Hazardous waste training is required of all laboratory personnel annually. Online training is available at [http://research.wayne.edu/oehs/training/lab.php](http://research.wayne.edu/oehs/training/lab.php).

- **Use Proper Containers**
  a) Store liquid wastes in containers that originally held liquids and solids in containers that held solids.
  b) Make sure that all bottles are in good condition and have the original cap.
  c) Collect inorganic (acid/base) wastes in the 5 gallon carboys provided through OEHS.
  d) Secure lids tightly and store glass bottles of waste under a fume hood, in a flammable cabinet or on shelves.
  e) Do not store glass bottles of waste on the floor or in the hallway! Place all waste containers in secondary containers (e.g. the grey plastic tubs provided by OEHS).

- **Segregate Wastes Properly**
  Whenever possible, keep different hazardous wastes separate so that disposal options are clearer and more cost effective. If this isn’t possible, collect waste in compatible containers segregated into these categories:
    a) Halogenated solvents (i.e. methylene chloride, chloroform, carbon tetrachloride)
    b) Non-halogenated solvents (i.e. xylene, toluene, acetone, alcohols)
    c) Acids (e.g. hydrochloric acid)
    d) Bases (e.g. sodium hydroxide)
    e) Heavy Metals (arsenic, cadmium, iron, lead, mercury, aluminum (due to potential link to dementia))
    f) Special Wastes: collect separately (i.e. cyanide, sulfide, oxidizers, organic acids, explosives, peroxides)
    g) Waste Oil: whenever possible do not mix with solvents, PCB’s, etc.

For information on appropriate segregation of waste contact OEHS (313) 577-1200.

- **Label Wastes Correctly and Completely**
  a) Label waste containers with chemical content waste tags.
  b) Date and attach the tags to each bottle of waste as soon as you begin to collect waste.
  c) Write the complete name of each chemical on the tag. NO FORMULAS OR ABBREVIATIONS! Don't forget to include "water" if the waste is an aqueous solution.
  d) Estimate the weight percent of each chemical in the container and write the estimate on the tag in the appropriate column.
  e) Make sure each tag is completely filled out at the end of each experiment. NOTE: OEHS staff may refuse to collect waste that has been improperly collected/labeled or stored.
f) Additional waste tags can be obtained from Science Stores, Scott Hall Receiving, or OEHS.

- **Hazardous Waste Pickup**

  On a regular basis (usually monthly), OEHS will pick up waste containers directly from the laboratories in Science Hall. If the waste containers are full, contact the Solution Prep Room at (313) 577-2573 to request new containers and arrange for a waste pick-up. You can also arrange for pickup of waste at http://research.wayne.edu/oehs/hazardous/index.php.

- **Decontamination procedures**

  **Personnel:** Wash hands and arms with soap and water immediately after handling acutely toxic chemicals.

  **Area:** Decontamination procedures vary depending on the material being handled. Refer to the Safety Data Sheets for the material for additional information. The toxicity of some materials can be neutralized with other reagents. All surfaces should be wiped with the appropriate cleaning agent following dispensing or handling. Waste materials generated should be treated as a hazardous waste.

- **Emergency procedure**

  **Chemical Spills/Chemical Fires**

  The range and quantity of hazardous substances used in WSU laboratories require pre-planning to respond safely to a chemical spill. Call WSU Police Department at (313) 577-2222 for any chemical spill. If you have a doubt whether a spill can be safely and effectively cleaned up by staff in the lab, call the Office of Environmental Health and Safety at (313) 577-1200.

  **If A Chemical Spill Occurs:**

  1. **Research Laboratories:** Contact WSU Police Department at (313) 577-2222.
     **Undergraduate Teaching Laboratory:** Call Science Stores ((313) 577-3098) who will contact WSU Police Department and escort them to the teaching laboratory. In the event that Science Stores cannot be reached, call WSU Police Department directly at (313) 577-2222.
  2. Remain calm.
  3. Alert persons in immediate area of spill.
  4. Without endangering yourself, attend to any injured or contaminated victims:
     - Move victims to fresh air/safe place.
     - Remove contaminated clothing.
     - Wait for Police Department and emergency responders in a safe area.
  5. In the event of chemical spill where you need assistance, but the spill is not an immediate threat to life or health, follow these steps:
     - Confine the spill area: close doors, isolate area, evacuate if necessary.
     - Alert others in the area and tell them to evacuate area if necessary.
     - From safe locations, report the spill to Office of Environmental Health and Safety at (313) 577-1200.
     - Report your name, location, and the name of the material spilled.
     - Stay in the area until the emergency responders arrive so that you can answer any additional questions.
6. If the chemical spill is flammable, turn off all ignition and heat sources. Evacuate area if necessary.

**If A Chemical Fire Occurs:**

1. Proceed to nearest fire alarm pull station and activate same.
2. Call WSU Police Department at (313) 577-2222. Undergraduate Teaching Laboratory: Also call Science Stores ((313) 577-3098)
3. If you have been properly trained and/or experienced in the use of a portable fire extinguisher and fire is small, you may proceed to nearest ABC or CO₂ fire extinguisher.
4. Extinguish fire using PASS Method.
   - Pull pin
   - Aim nozzle at base of fire
   - Squeeze lever
   - Sweep extinguisher side to side.
5. If chemical is toxic and cannot be extinguished with portable fire extinguisher, evacuate area and close all doors.

The Office of Risk Management provides fire extinguisher training and evacuation training for all laboratory personnel.

**If an Injury/Exposure Occurs:**

1. **Research Laboratories:** Contact WSU Police Department at (313) 577-2222 immediately in the event of any injury in the laboratory.
   **Undergraduate Teaching Laboratory:** Call Science Stores ((313) 577-3098) who will come to the lab and if necessary, contact the WSU Police Department. In the event that Science Stores cannot be reached, call WSU Police Department at (313) 577-2222.
2. **Skin Contact:** Immediately flush skin with plenty of water for at least 15 minutes. Injured person should remove contaminated clothing and shoes. Injured person should be instructed to wash their clothing before reuse.
3. **Eye Contact:** Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention as soon as possible.
4. **Inhalation:** Remove injured person from lab and into fresh air. Seek medical attention if necessary to restore breathing.

- **Eye protection**

Eye protection in the form of safety glasses must be worn at all times when handling waste chemicals. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes, therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

- **Eyewash**

Eyewash stations are located in accessible areas within each undergraduate teaching laboratory.
- **Fume hood**
  
  Refer to the Safety Data Sheets for the material being waste-streamed to determine if use of a fume hood is required.

- **Gloves**
  
  Gloves should be worn when handling chemical waste. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. However, the handling of some waste chemicals will require chemical resistant gloves. Lab workers should review the SDS for the materials used in the laboratory and contact OEHS for advice on glove selection.

- **Hazard assessment**
  
  Hazard assessment should focus on proper use and handling procedures, the education of employees concerning the health risk posed by the reagents used in the lab.

- **OEHS Notification**
  
  Not applicable.

- **Protective apparel**
  
  Lab coats, closed toed shoes and long sleeved clothing should be worn when handling hazardous chemical waste. Additional protective clothing should be worn if the possibility of skin contact is likely.

- **Safety shower**
  
  A safety or drench shower should be available in all undergraduate teaching laboratories.

- **Special ventilation**
  
  Refer to the Safety Data Sheets for the material being waste-streamed to determine if special ventilation is required.
3.17. Reporting of Injuries in Undergraduate Teaching Laboratory Classes or Chemistry Research Laboratories

Proper reporting of injuries in undergraduate teaching laboratory classes or chemistry research laboratories will help ensure that experiments are designed and carried out in a safe manner.

Policy for Enrolled students experiencing an injury or non-personal illness

Initial Procedure in a Medical Emergency:

If a student becomes ill or is injured in an undergraduate teaching laboratory and requires medical attention, the Teaching Assistant should immediately contact Science Stores to ask for additional assistance dealing with the medical emergency. This can be done by either using the telephone in the laboratory classroom or by sending another student to Science Stores to request assistance. The Teaching Assistant or a member of Science Stores should:

- Call WSU Police Department ((313) 577-2222) and advise them of the classroom location and the nature of the victim’s illness/injury.
- NOT move the victim unless there is an immediate life-threatening emergency.
- Comfort the victim and reassure them that medical assistance is on the way.
- Remain on the scene to assist WSU Police Department and/or medical service providers with pertinent information about the incident.

After Medical Assistance has been obtained:

The Teaching Assistant and/or a member of Science Stores should:

- Contact the Principal Instructor assigned to the class and the Office of Environmental Health and Safety ((313) 577-1200) and let them know that a student has been injured or has become ill during class.
- Provide them with a brief written summary of the illness or injury, the time, date, and location when/where the illness or injury occurred, the student’s first, middle and last name, the student’s gender, the student’s WSU access ID number, and the laboratory class code and section number. If the injury or illness occurred during the conduct of a chemical experiment, the experiment number and the name of the reagent should also be supplied. The attached form should be used to record the necessary information.
- All student injuries/illnesses must be reported to the Principal Instructor and OEHS within 24 hours (or next business day) of the incident.
Preliminary Report of Student Injury or Illness (non-employee)

<table>
<thead>
<tr>
<th>Name of Student (last, first, middle)</th>
<th>Date of Injury or Illness (MM/DD/YYYY):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student’s WSU Access ID</td>
<td>□ Male</td>
</tr>
<tr>
<td>□ Female</td>
<td></td>
</tr>
<tr>
<td>Course number:</td>
<td>Lab Section Number</td>
</tr>
</tbody>
</table>

Brief Description of Alleged Injury/Illness (include experiment number, reagent name, item that caused the injury, body part involved, events leading up to and including the injury (attach additional pages if necessary):

Witnesses to the injury/incident:

<table>
<thead>
<tr>
<th>Name of Individual Reporting Injury/Illness</th>
<th>Date of Report</th>
</tr>
</thead>
</table>
After a preliminary report of the incident has been reviewed:

The Principal Instructor and/or a member of the Chemistry Department Safety Committee and the Office of Environmental Health and Safety should:

- Conduct an injury/illness analysis and assessment to identify describe the root cause and specific short and long-term corrective actions in an effort to prevent this type of incident from happening again.
WSU APPM POLICY ON STUDENT INJURIES

3.0.17.2 Student Emergency Care for Injury and Illness (as of August 25, 2015)

POLICY
Enrolled students experiencing an injury or non-personal illness (excludes personal illnesses such as, but not limited to, flu, cold/sinus, etc.) on campus or while attending class or participating in University-sponsored activities shall receive initial treatment at a University-authorized medical facility as noted below:

EMERGENCY ISSUES:
- Detroit Receiving Hospital – ER
- Henry Ford Hospital-Detroit ER

NON-EMERGENCY ISSUES:
- University Health Center (UHC)-4K
- Henry Ford Medical Center – Harbortown

Only the initial treatment/visit necessary for an injury or a non-personal illness requiring immediate medical attention will be covered by this policy. The student is responsible for any subsequent treatment.

PROCEDURE

<table>
<thead>
<tr>
<th>Responsibility</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student</td>
<td>Notify Instructor/Administrator and/or WSU Police Department of injury or illness immediately. Report to the appropriate University-authorized medical facility for initial treatment, as noted above. Complete top portion of the Report of Injury form, and sign bottom portion. A WSU Office of Risk Management Report of Injury form can be located at <a href="http://idrm.wayne.edu/risk/student-forms.php">http://idrm.wayne.edu/risk/student-forms.php</a> If the student receives an invoice for initial service, student shall forward the invoice to the Office of Risk Management for payment review. For services/treatment beyond the initial visit, student shall either self-pay directly to the provider or forward the invoice to the personal health insurance carrier.</td>
</tr>
<tr>
<td>Instructor/Administrator</td>
<td>Contact WSU Police Department ((313) 577-2222) to obtain assistance and transportation to the appropriate University-authorized medical facility.</td>
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</tbody>
</table>
Report of Injury

NAME (Last, First, Middle) : 
SOCIAL SECURITY NO: 

RESIDENTIAL ADDRESS (Street Address, City, State, Zip) 
TELEPHONE NO(S): 

DATE OF INJURY: 
TIME OF INJURY: 
A.M. 
P.M. 
WORK START TIME: 
A.M. 
P.M. 

Accident Reported to (name & title): 

Witnesses: 
1. Full Name 
Address (Street, City, State, Zip) 
Telephone No. 

2. 

Treating Physician: Full Name 
Address 

Hospital (if hospitalized): Full Name 
Address 

DESCRIPTION OF ALLEGED INJURY—WHAT ITEM CAUSED THE INJURY, BODY PART, AND EVENTS LEADING UP TO AND INCLUDING THE INJURY (PLEASE ATTACH A SECOND PAGE IF NECESSARY): 

EXACT LOCATION AND/OR BLDG (including floor, room, etc.): 

Birthdate (mm/dd/yy) 
Sex: □ Female 
□ Male 

**Employees MUST also complete the following / Injured Students only complete above this line** 

Tax Filing 
Single 
Married, Filing Jointly 
□ If married, spouse is supported 

Status (circle one): Single, Head of Household 
Married, Filing Separately at least 50% by injured. 

No. of Dependent (under age 16) : _____ Other family members supported at least 50% by injured (specify on line below): 

Lost Day(s) Due to Injury: □ Yes □ No 
Date of Last Day Worked: 
Date returned to work/estimated length of disability: 

Your Classification 
Your Department 
# of Hours Worked Per Week: 
DATE OF HIRE: 

Do you have a SECOND EMPLOYER?: □ Yes □ No 
If yes, Company Name and Complete Address: 

Public Safety Contacted: □ Yes □ No 
Case #: ____________________ 

I Am Currently Enrolled As A Medicare (Not Medicaid) Beneficiary: □ No □ Yes, HCN# ____________ 

Your WSU Supervisor’s Complete Name, Phone Number and E-mail Address: 

Your Complete Campus Address & Campus Phone: 

Employee/Student Signature/Date: 

Supervisor’s Signature/Date: 

INSTRUCTIONS: 
ALL INFORMATION MUST BE COMPLETED AND BOTH SIGNATURES OBTAINED FOR EMPLOYEE INJURIES 
SUBMIT WITHIN 24 HOURS TO WAYNE STATE UNIVERSITY OFFICE OF RISK MANAGEMENT 
5700 Cass Ave., Suite 4622, Detroit, MI 48202 

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Policy for Employees experiencing a work-related injury or illness

The following policy is reproduced from the Office of Risk Management’s website which describes Worker’s Compensation Policies and Responsibilities see: http://idrm.wayne.edu/risk/workers-compensation.php

WORKER’S COMPENSATION POLICIES AND RESPONSIBILITIES

All University employees have the right to report work-related injury and illnesses free from retaliation and all employees are covered by the Michigan Workers Disability Compensation Act, which provides for medical and wage loss payments when an injury or illness arises out of and in the course of employment. Failure to follow the procedures outlined below may jeopardize an employee’s entitlement to benefits under the law, or cause a delay in benefits. The University reserves the right to determine liability for alleged occupational injuries and illnesses. Liability is determined following completion of a Report of Injury, an evaluation by a WSU authorized occupational clinic, and receipt of associated medical reports.

An evaluation by a WSU authorized occupational clinic is required in all instances of occupational injury or illness even if no treatment is necessary. The designated-authorized occupational clinics and ER facilities are:

NON-EMERGENCY ISSUES: University Health Center (UHC)-4K
Henry Ford Medical Center - Harbortown

EMERGENCY ISSUES: Detroit Receiving Hospital – ER
Henry Ford Hospital-Detroit-ER

PROCEDURE

<table>
<thead>
<tr>
<th>Responsibility</th>
<th>Action</th>
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<tbody>
<tr>
<td>Employee</td>
<td>1 Report the injury/illness to supervisor and/or director as reasonably possible after becoming aware of an injury or illness, but in no event later than leaving the campus work site or 8 hours after becoming aware of the injury or illness, whichever is earlier. Obtain authorization form from supervisor/director, unless emergency services required.</td>
</tr>
<tr>
<td></td>
<td>2 Seek medical attention at a WSU authorized occupational clinic (no appointment necessary) during business hours, or designated authorized hospital-ER for emergency or after-hours care. If an ER visit is sought, report to the associated occupational clinic the next business morning (no appointment necessary). (i.e., DRH-ER= UHC 4K; HF Hospital-ER = HF Clinic)</td>
</tr>
<tr>
<td><strong>Responsibility</strong></td>
<td><strong>Action</strong></td>
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<tr>
<td>--------------------</td>
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<tr>
<td>Employee</td>
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<tr>
<td>Supervisor/Director</td>
<td>1</td>
</tr>
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<td></td>
<td>2</td>
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<td>3</td>
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</tbody>
</table>
### Responsibility | Action
--- | ---
Supervisor/Director | 4. Assist employee with completion of the Report of Injury after initial medical treatment has been rendered. Supervisor or director shall sign and date the Report of Injury form at that time and ensure the Report of Injury form is presented to Risk Management immediately upon completion, within 24 hours.

5. Review restrictions and determine if the department can work the employee within the restrictions provided by the occupational clinic. Advise employee and the Office of Risk Management of work status. Continue to keep Risk Management aware of employee’s work status throughout the claim (i.e., off duty, working with restrictions, return to work, etc.)


2. Review and remit payment of properly submitted invoices for authorized medical services per Healthcare Rules.

When submitting a Report of Injury form to the Office of Risk Management, you are indicating that you have sustained an injury/illness for which you feel is work related. Upon acceptance of this claim*, you will be entitled to worker’s compensation benefits, which include medical treatment directly related to injury and applicable wage loss benefits. Please note the policies and your responsibilities below:
REPORT FOR AN OCCUPATIONAL MEDICAL EXAMINATION

If you have not already done so, obtain an Authorization Form for Medical Treatment from your supervisor and report to one of the University-authorized occupational clinics as noted:

- University Health Center, Clinic 4K (UHC-4K)
  4201 St. Antoine, Detroit, MI (between Detroit Receiving Hospital and Scott Hall)
- Henry Ford Health Medical Center, Harbortown
  3300 East Jefferson, Suite 100 Detroit, MI 48207 (Jefferson Avenue just West of Belle Isle)

The clinic will provide a medical and occupational assessment in relation to your worker’s compensation claim.

If you were treated at an emergency room, you must present to the associated occupational clinic the next business day. (i.e., DRH-ER will visit UHC 4K; HFH-ER will visit Henry Ford Center, Harbortown)

REPORT TO SUPERVISOR/DEPARTMENT AFTER EACH MEDICAL ASSESSMENT

After each medical appointment, immediately report to your supervisor/department to submit the work status slip (this is the document given to you upon discharge from the clinic). This will keep your department aware of your current work restrictions or work status (full duty/off duty). Await instruction from your department regarding your work status (i.e., can the department work you within your restrictions, etc.). If you are given a full duty status or restrictions for which the department can work you within, you are to commence work immediately after discharge from the clinic.

MAINTAIN MEDICAL COMPLIANCE

Maintain your scheduled medical and therapy visits on your assigned date and time. Failure to maintain compliance may cease or delay your benefits.

MAINTAIN CONTACT AVAILABILITY

You shall make yourself available for phone calls from clinic, your department, Risk Management and, if applicable, specialist/therapist. Phone messages should be returned immediately to any party involved within your worker’s compensation claim. Ensure you have provided your current phone number to all parties. To avoid any problems, make sure all contact information is current and up to date.
You shall also make yourself available to return to work if you are called in by the University.

PRIOR AUTHORIZATIONS

All medical treatment must have prior authorization from the Office of Risk Management. Providers should contact the Office of Risk Management at (313) 577-3112. The provider will receive written authorization if medical services are authorized. If prior authorization is not obtained, you will be responsible for the invoice. If the invoice for unauthorized services is not paid, your credit record could be affected.

After the first 28 days of medical treatment, you do have the right to seek medical attention from a provider of your choice. However, you are still required to follow-up at the occupational clinic. The employer has the right to utilize the medical of their choice in order to ascertain medical treatment and occupational work status. Medical treatment will not be covered prior to 28 days of treatment if you treat with a facility other than those listed on the Wayne State University injury policy.

If, after 28 days, you choose to seek medical attention from your own physician, you must submit the provider’s complete name, address, fax and phone numbers to the Office of Risk Management. The provider shall contact Risk Management for prior authorization, and then present a dictated, typed medical report to Risk Management for review. Services must be in relation to work-related condition in order to be compensable under worker’s compensation.

The ’28-Day Rule’: The State of Michigan Worker’s Compensation Act mandates that the employer has the right to send the injured employee to a physician of the employer’s choice for the first 28 days of inception of medical care.

PRESCRIPTION REIMBURSEMENT

Prescriptions from initial medical visits are reimbursed if you forward the original receipt and prescription tag that indicates the type of medication, date purchased, and patient’s name, etc. Requests for reimbursement shall be submitted to the Office of Risk Management.

If you continue to receive prescriptions for your injury from an authorized provider directly in relation to your work injury, you will receive a prescription card from the University’s new prescription program, EHIM. This card can be presented to most pharmacies. Additional information will be included upon receipt of the card.
INVOICES

The Office of Risk Management’s address, 5700 Cass Avenue, Suite 4622, Detroit, MI 48202 should be given to the authorized healthcare providers for which you are treating for billing purposes. As the provider should have obtained prior authorization, they should have the billing address in their records. However, If you receive an invoice or credit agency notice for authorized medical services, please forward to the Office of Risk Management for review. Please note that the University may require additional information for review from the physician/facility, so there may be a delay in the payment.

FAILURE TO FOLLOW POLICY

Failure to follow the worker’s compensation policies noted above and in the WSU APPM, Section 10.2.9, can result in denial or delay of benefits, and/or department-issued reprimand.

*As the employee has the right to file for worker’s compensation, your employer, Wayne State University, has the right to investigate and dispute any claim, or portion(s) of claim, for which the University is not voluntarily accepting under worker’s compensation.

March 2011 – Updated October 2016
# Report of Injury

**NAME** (Last, First, Middle) | **SOCIAL SECURITY NO.**
---|---

**RESIDENTIAL ADDRESS** (Street Address, City, State, Zip) | **TELEPHONE NO:**
---|---

<table>
<thead>
<tr>
<th><strong>DATE OF INJURY</strong></th>
<th><strong>TIME OF INJURY</strong></th>
<th><strong>WORK START</strong></th>
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</table>

**Accident Reported to (name & title):**

1. **Witnesses:**
   - **Full Name**
   - **Address (Street, City, State, Zip)**
   - **Telephone No.**

2. **Treating Physician:**
   - **Full Name**
   - **Address**

**Hospital (if hospitalized):**
   - **Full Name**
   - **Address**

**DESCRIPTION OF ALLEGED INJURY — INCLUDE EXACT LOCATION (building name & room, or outside campus location). WHAT ITEM CAUSED THE INJURY, BODY PART, AND EVENTS LEADING UP TO AND INCLUDING THE INJURY (PLEASE ATTACH A SECOND PAGE IF NECESSARY):**

**LOCATION AND/OR BLDG:**

**"Employees MUST also complete the following / Injured Students only complete above this line"**

<table>
<thead>
<tr>
<th><strong>Birthdate (mm/dd/yy)</strong></th>
<th><strong>Sex:</strong> Male</th>
<th><strong>No. of Dependents</strong></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Tax Filing Status</strong> (circle one):</th>
<th><strong>Single</strong></th>
<th><strong>Married, Filing Jointly</strong></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>If married, spouse is supported</strong></th>
<th><strong>Married, Filing Separately</strong></th>
<th><strong>at least 50% by injured</strong></th>
</tr>
</thead>
</table>

**Other family members supported at least 50% by injured (specify):**

<table>
<thead>
<tr>
<th><strong>Lost Day(s) Due to Injury:</strong></th>
<th><strong>Yes</strong></th>
<th><strong>No</strong></th>
<th><strong>Due to Last Day Worked:</strong></th>
<th><strong>Date returned to work/estimated length of disability:</strong></th>
</tr>
</thead>
</table>

**Your Classification:**

<table>
<thead>
<tr>
<th><strong>Your Department</strong></th>
<th><strong># of Hours Worked Per Week:</strong></th>
<th><strong>DATE OF HIRE:</strong></th>
</tr>
</thead>
</table>

**Do you have a SECOND EMPLOYER?:**
   - **Yes** | **No** |

**If yes, Company Name and Complete Address:**

<table>
<thead>
<tr>
<th><strong>Public Safety Contacted:</strong></th>
<th><strong>Yes</strong></th>
<th><strong>No</strong></th>
</tr>
</thead>
</table>

**I Am Currently Enrolled As A Medicare (Not Medicaid) Beneficiary:**
   - **Yes** | **No** |

**Your WSU Supervisor’s Complete Name, Phone Number and E-mail Address:**

<table>
<thead>
<tr>
<th><strong>Your Complete Campus Address &amp; Campus Phone:</strong></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Employee/Student Signature/Date:</strong></th>
</tr>
</thead>
</table>

**INSTRUCTIONS:**

ALL INFORMATION MUST BE COMPLETED AND BOTH SIGNATURES OBTAINED FOR EMPLOYEE INJURIES. SUBMIT WITHIN 24 HOURS TO WAYNE STATE UNIVERSITY OFFICE OF RISK MANAGEMENT 5700 Cass Ave., Suite 1622, Detroit, MI 48202
SUPERVISOR'S INVESTIGATION REPORT
(print clearly or type)

Name of Injured Employee/Banner ID

Date

Job Title and Department

Date and Time of Injury

Type of Injury

When did you first learn of this injury? (Date & Time)

What was the employee doing when injured?

Where did the accident happen (incl floor/ rm no.)?

Was the injury caused by failure of injured to use safety equipment or observe regulations?

Describe what happened:

What corrective steps will be done (or could be done) to prevent recurrence?

Was the employee working at designated job? Yes o No o

Is there any light duty available for the injured worker? Yes o No o

Was WSU Police Department Contacted? Yes o No o (case # ____)

Other Comments (optional):

Supervisor's Signature

Date

Reviewed by Workers' Compensation Coordinator

Date

Return completed form within 48 hours of the injury to Kristin Coles, Office of Risk Management, Suite 4622 AAB.

Page 1 4/27/2011
The "Supervisor's Investigation Report" Form

The purpose of this form is to 1) gather information required in order to process the employee's Workers' Compensation claim; 2) determine what actions are needed to eliminate or control the hazards that have caused the accident. The information gathered will guide our staff in developing safety consciousness and knowledge of safe conditions and safe work methods.

If you are not aware of the circumstances surrounding the injury, please consult with the employee in order to complete the investigation report accurately. The statements made in this report are very important and should not contain phrases such as "Employee should be more careful." As the supervisor, please make the appropriate corrective recommendations for each accident such as "notified the appropriate employee to place caution signs in the area when floors are wet."

After you complete the investigation report, return it to Kristin Coles, Office of Risk Management, within 48 hours of the employee's work related injury.

If you have any questions or concerns, call Kristin Coles, the workers' compensation coordinator at 313-577-3112.
AUTHORIZATION FORM
FOR MEDICAL TREATMENT*

<table>
<thead>
<tr>
<th>Injured Employee’s Name</th>
<th>Department</th>
<th>Date of Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Authorizing Supervisor/signature and print name</th>
<th>Supervisor Phone No.</th>
<th>Date of Signature</th>
</tr>
</thead>
<tbody>
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</table>

Report to a designated Wayne State University workers’ compensation occupational center for injuries that you are claiming are in relation to a work-related injury. When you report to the facility, please take this signed authorization form with you. This will assist the staff in your care and in processing your medical bills correctly.

If you need medical treatment due to a work-related injury or illness, seek treatment at either:

<table>
<thead>
<tr>
<th>HENRY FORD MEDICAL CENTER- HARBORTOWN</th>
<th>UNIVERSITY HEALTH CENTER, CLINIC 4K</th>
</tr>
</thead>
<tbody>
<tr>
<td>3300 East Jefferson, Ste 100</td>
<td>4201 St. Antoine</td>
</tr>
<tr>
<td>Detroit, MI 48207</td>
<td>Detroit, MI 48201</td>
</tr>
<tr>
<td>(313) 656-1618</td>
<td>313-745-4522</td>
</tr>
<tr>
<td>On Jefferson Avenue, just West of Belle Isle</td>
<td>Located between Scott Hall and Detroit Receiving Hospital</td>
</tr>
<tr>
<td>(next door to Henry Ford Health Systems Family Medicine)</td>
<td></td>
</tr>
</tbody>
</table>

For a serious work-related injury or illness (or any treatment that should not wait until clinic hours the next day) seek treatment at**:

<table>
<thead>
<tr>
<th>HENRY FORD HOSPITAL-ER**</th>
<th>DETROIT RECEIVING HOSPITAL-ER**</th>
</tr>
</thead>
<tbody>
<tr>
<td>2799 W. Grand Blvd.</td>
<td>4201 St. Antoine</td>
</tr>
<tr>
<td>Detroit, MI 48202</td>
<td>Detroit, MI 48201</td>
</tr>
<tr>
<td>(313) 916-8742</td>
<td>313-745-3000</td>
</tr>
</tbody>
</table>

**Report to the affiliated occupational clinic the morning of the next business day. If in-patient, contact hospital-affiliated occupational clinic upon in-patient discharge for follow-up reporting instructions.

Please Note

If you have any questions regarding this procedure, please call the workers’ compensation coordinator, Kristin Coles, at 577-3112.

*By supervisor/department authorizing medical visit, it does not ensure that employee’s claim will be automatically compensable under worker’s compensation.
3.18. **Actions to be taken in the event of disruption to water flow in the chemistry department and undergraduate teaching laboratories**

Wayne State University attempts to schedule water service interruptions outside of normal business hours whenever possible. In the event that water service is interrupted during business hours, the following actions should be taken:

**Chemistry Building/Science Hall/Life Sciences Building**

- Chemistry Department staff, faculty, and students will be instructed where the nearest available drinking water and toilet facilities are located.

- If adequate drinking water and toilet facilities are not available within a reasonable proximity, WSU will either (1) provide alternative drinking water and toilet facilities (Porta Johns and bottled water) or (2) relocate or dismiss employees from that location until suitable drinking water and toilet facilities are available.

- Occupants should be informed in advance of the disruption, if possible, so they may prepare by filling drinking water bottles.

- Since heat may not be available in buildings with steam heat, the management of each department may consider, at their discretion, allowing employees to work from another location until repairs are complete.

- *In the event of a water interruption, work with hazardous materials in research and teaching labs must stop as rapidly as safely possible since no water would be available to their eyewashes or safety showers.*

- Lab standard operating procedures for working with hazardous materials should include measures to control all hazards in the event of a failure in power, water, gas and/or other service.

- The Building Coordinators should keep their building occupants informed of the status of repair work.
3.19. **Actions to be taken in the event of a power outage or hood shutdown in the chemistry building or undergraduate teaching laboratories**

Wayne State University attempts to schedule electrical system tests or interruptions outside of normal business hours whenever possible. In the event of a power outage, the following actions should be taken:

**Power Outage: Chemistry Building/Science Hall/Life Sciences Building**

- The Building Coordinators will alert all faculty and staff of scheduled maintenance of electrical systems or generator tests in advance so that proper safeguards for equipment and reactions can be in place.

- *In the event of an unplanned power outage, work with hazardous materials in research and teaching labs must stop as rapidly as possible since no power would be available to their laboratory hood and most laboratory equipment.*

- Lab standard operating procedures for working with hazardous materials should include measures to control all hazards in the event of a failure in power, water, gas and/or other service.

- The Building Coordinators should keep their building occupants informed of the status of the repair work.

**Hood Shutdown: Chemistry Building/Science Hall/Life Sciences Building**

- The Building Coordinators will alert all faculty and staff of scheduled maintenance of the air handling system in advance so that proper safeguards for equipment and reactions can be in place.

- *In the event of an unplanned hood shutdown, an email will be sent to all faculty, staff and graduate students. In addition, as soon as possible, a member of Chemistry Department staff, Science Stores Staff, or WSU Public Safety will be sent around the building to physically let all occupants know that the hoods are not functioning properly.*

- Work with hazardous materials in research and teaching labs must stop as rapidly as safely possible to prevent accidental exposure to hazardous vapors. Hood sashes should be closed and researchers and students should exit the laboratory area until hood function is restored.

- Lab standard operating procedures for working with hazardous materials should include measures to control all hazards in the event of a failure in power, water, gas and/or other service.
The Building Coordinators should keep their building occupants informed of the status of the repair work/shutdown.
3.20. Personal protective equipment to be used in the Lumigen Instrument Center (LIC)

Manager’s Policy for LIC Staff

LIC staff must wear personal protective apparel when working in the Lumigen Instrument Center. Eye protection, lab coat, and appropriate foot protection must be worn at all times. Gloves must be worn when handling chemicals. Gloves should be made of a material known to be resistant to permeation by the chemical in use.

When Safety Policy is violated by a user, manager must make a note in the note section of ILAB. The note needs to contain the violation and the statement, “discussed and corrected”.

Safety Policy for Users in the LIC

Gloves are prohibited when operating the instruments (keyboard, mouse, and computer control panels). Samples and laboratory coats must be transported from the research labs to LIC in secondary containers. Users must provide a brief description of potential chemical or biological risk upon sample submission for analysis.

Users who do not follow the safety policies will be denied access to LIC instruments until the violation has been discussed with a manager and corrected.

Nuclear Magnetic Resonance Spectroscopy Laboratory Safety Policy for Users

Eye protection and appropriate foot protection (closed-toe shoes, no sandals) must be worn at all times. To minimize risk of accidental skin exposure to chemicals in the laboratory, it is essential that researchers wear clothing which to the extent possible, covers all skin surfaces (shorts and short skirts are inappropriate attire for the laboratory).

Unless discussed and approved with the NMR manager, all sample preparation must be performed before entering into the NMR lab. When sample preparation is approved to be performed in the NMR lab, a SOP must be developed by the user and approved by the lab manager prior to any work in the NMR lab. SOP must be placed in the Safety Binder.

Mass Spectrometry Laboratory Safety Policy for Users

Eye protection and appropriate foot protection (closed-toe shoes, no sandals) must be worn at all times. To minimize risk of accidental skin exposure to chemicals in the laboratory, it is essential that users wear clothing which to the extent possible, covers all skin surfaces (shorts and short skirts are inappropriate attire for the laboratory).
Eye protection, laboratory coat, and foot protection (closed-toe shoes, no sandals) must be worn to perform analyses on instruments. Do not use gloves when typing on the keyboards.

When in the designated preparation area, eye protection, lab coat, gloves, and appropriate foot protection (closed-toe shoes, no sandals) must be worn. All samples must be prepared in the designated preparation area. A SOP must be developed by the user and approved by the lab manager prior to any work in the MS laboratory.

**Electron Microscopy Laboratory Safety Policy for Users**

Eye protection and appropriate foot protection (closed-toe shoes, no sandals) must be worn at all times. To minimize risk of accidental skin exposure to chemicals in the laboratory, it is essential that researchers wear clothing which to the extent possible, covers all skin surfaces (shorts and short skirts are inappropriate attire for the laboratory.

When in designated preparation area (sample preparation room and preparation table located in the center of the laboratory), eye protection, lab coat, gloves, and appropriate foot protection (closed-toe shoes, no sandals) must be worn. All samples must be prepared in the designated preparation area.

**X-ray Crystallography Laboratory Safety Policy for Users**

Eye protection and appropriate foot protection (closed-toe shoes, no sandals) must be worn at all times. To minimize risk of accidental skin exposure to chemicals in the laboratory, it is essential that researchers wear clothing which to the extent possible, covers all skin surfaces (shorts and short skirts are inappropriate attire for the laboratory.

Dosimeter rings must be worn.