
LABORATORY SAFETY PLAN

Northeastern University
Department of Mechanical and Industrial Engineering

REVISED SEPTEMBER 2012 BY BRIDGET SMYSER, DEPARTMENTAL SAFETY OFFICER

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1.0 EMERGENCY CONTACTS

IN THE EVENT OF AN EMERGENCY CALL NORTHEASTERN UNIVERSITY'S PUBLIC SAFETY DIVISION AT x**3333**

Remember: if you call from an in-house phone you simply dial 3333. If you call from a cell phone dial 1.617.373.3333

Know your location and be specific about the nature of the emergency.

Emergency contact numbers, along with laboratory safety data, are posted on every laboratory door. Table 1 below provides additional contacts at the university and department level.

TABLE 1: UNIVERSITY AND DEPARTMENTAL CONTACTS

NAME	TITLE	EMAIL/PHONE
Brian Burns	Director, Compliance and Risk Services	b.burns@neu.edu 617.373.8668
Jack Price	Director, EH&S	j.price@neu.edu 617.373.2769
Steve Brehio	Assoc. Director, EH&S	s.brehio@neu.edu 617.373.2769
Elham Ghabbour	Senior EH&S Specialist	e.ghabbour@neu.edu 617.373.2769
Bridget Smyser	Laboratory Manager, Departmental Safety Officer, MIE	b.smyser@neu.edu 617.373.5142
Jackie Isaacs	Department Head, MIE	j.isaacs@neu.edu 617.373.3989

2.0 OVERVIEW

The Laboratory Safety Plan (LSP) presented herein is intended to present authorized personnel (laboratory user) within the Department of Mechanical and Industrial Engineering (MIE) at Northeastern University information that will facilitate the safe use of MIE laboratory facilities. Procedures conducted within laboratories vary. Thus, no general statements on the risk associated with working in MIE laboratories are appropriate. Review of the procedures presented in this manual serve as a baseline for all MIE laboratory users.

Many parties work collaboratively to ensure the safe operation of MIE laboratories, including: Department Chair, Principal Investigators (PIs), Faculty Advisors, and the Department Safety Officer (DSO) and/or Department Laboratory Manager. Primary responsibility for laboratory safety rests with the laboratory user. The LSP provides the user with the guidelines necessary, and the resources available, to ensure the user has the means to operate in a safe and efficient manner.

The laboratory user has the following responsibilities:

- To read this LSP in full and complete the MIE Laboratory Access Authorization Form located in Appendix 1 before engaging in any laboratory activities
- Develop good personal laboratory safety habits
- Wear all required personal protective equipment
- Inform appropriate personnel of any lab deficiency that may pose a safety hazard
- Plan and conduct each laboratory operation in accordance with proper laboratory safety procedures and this LSP
- Ensure that your research area is cleaned and all chemicals and laboratory equipment are properly returned at the end of your research activity

3.0 LABORATORY TRAINING AND ACCESS

Every laboratory user is required to receive the appropriate training before they access any laboratory in MIE. Furthermore, prior to assignments involving new lab experiences that may result in new exposure situations; the laboratory user must obtain the appropriate training as determined by the PI and/or the DSO. Each laboratory user is required to submit verification of his/her training to the DSO, who will maintain documentation of such training.

Each laboratory user, in consultation with his/her faculty advisor, must complete the training specific to their use. Laboratory training is conducted through the Office of Environmental Health & Safety (EHS).

3.1 LABORATORY TRAINING – EH&S

- Each laboratory user is required to visit and utilize EHS's website at www.ehs.neu.edu
- Each laboratory user must have an active NUnet account to register for EHS's online training (exceptions may be made for visiting laboratory users).

The user will notice a TRAINING tab in the upper right section of the homepage. When you click on the TRAINING tab EHS's TRAINING page opens. On the right hand column of the TRAINING page the user will notice TRAINING PROFILES. Click on the TRAINING PROFILES tab and a list is generated for the various colleges. Toward the bottom of the page the user will notice Mechanical and Industrial Engineering under ENGINEERING. To the right of the MIE header the user will notice INITIAL and REFRESHER. Every new incoming employee needs to take the appropriate INITIAL online training. Then, annually, every returning laboratory user must take the appropriate online REFRESHER training.

The training courses listed on MIE's TRAINING PROFILE are:

- Hazardous Materials Transportation
- Hazardous Waste
- Laboratory Safety / Chemical Hygiene Training

All of these are available as online training sessions. The certificate of completion should be printed out and a copy given to the DSO.

It is very important to recognize that laboratory users may be required to take training that does not appear in EHS's TRAINING PROFILE for MIE. For example any laboratory user that will utilize an autoclave must take EHS's AUTOCLAVE TRAINING INTRODUCTION, listed in the ONLINE TRAINING page. Also, some personnel working on biomechanical and biomaterials projects may be required to take EHS's BLOODBORNE PATHOGENS AND BIOLOGICAL SAFETY TRAINING.

3.2 LABORATORY ACCESS

Once the laboratory user has read the LSP and submits the signed MIE Lab Access Form (Appendix 1), fulfills his/her training responsibilities, and submits his/her training certificate (copy to the DSO, Bridget Smyser), access is granted and his/her laboratory work may begin.

3.3 VISITING/VOLUNTEER/ UNDERGRADUATE LABORATORY ACCESS

Periodically visiting researchers and undergraduate students become involved in research activities that require access to MIE laboratories. MIE encourages external collaboration and the participation of qualified undergraduate students. As with our employed personnel, any individual accessing MIE laboratories must complete appropriate training. Any laboratory user designated as visitor, volunteer, or undergraduate student must also complete the appropriate forms and training authorization form (Permission for a Visiting Research Experience; Permission for a Volunteer Research Experience; or, Permission for an Undergraduate Research Experience) before accessing or conducting any work in any MIE laboratory.

These forms have been approved by the University's Chemical Hygiene Committee. Each form requires basic information about type of laboratory use, contact information, and signatures from your Primary Advisor, PI, Department Representative (Lab Director), and the Chemical Hygiene Committee. These forms are available electronically, can be completed electronically, forwarded, and approved electronically. Please contact the Laboratory Director to obtain an electronic version of any one of these forms.

A hard copy of each form is available in Appendix 2 of the LSP. To expedite the approval process the laboratory user should access and process the appropriate form electronically.

NO PERSONNEL WITH ACCESS TO MIE LABORATORIES SHOULD WORK ALONE. IF A SITUATION ARISES WHERE THE LABORATORY USER WILL BE ALONE, IT IS THE POLICY OF MIE THAT THE LABORATORY USER NOTIFIES THE LABORATORY MANAGER, FACULTY ADVISOR, AND/OR A COLLEAGUE OF THEIR WORK AND SCHEDULE.

4.0 CHEMICAL PROCUREMENT & HANDLING PROCEDURES

4.1 GENERAL INFORMATION

Northeastern University's laboratory doors are posted with emergency information to inform occupants and Boston Fire Department personnel of the presence of hazardous materials inside each laboratory. The National Fire Protection Association (NFPA) has developed a system for indicating the health, flammability, reactivity and special hazards for many common chemicals through use of the NFPA 704 Diamond (Figure 1).

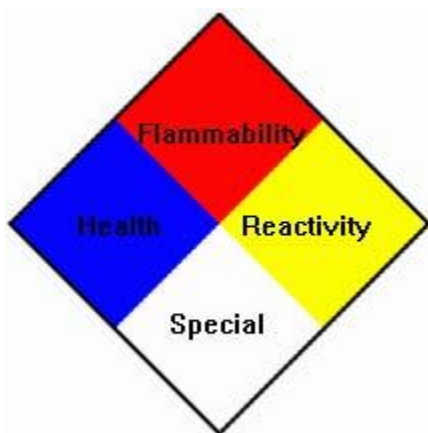


FIGURE 1: NFPA DIAMOND

The hazard rating for the laboratory is determined by the chemicals, gases and other hazards used in each laboratory and establishing a rating for each hazard category based on the criteria described below. The NFPA 704 Hazard Identification System provides:

1. Planning guidance to the fire departments for safe tactical procedures in emergency operations
2. On-the-spot information to safeguard the lives of firefighting personnel and others who may be exposed
3. A means of identifying hazardous materials and areas in which they are stored for students and employees.

It is important to realize that not all chemicals have been rated with the NFPA system. Additionally, the quantity of a chemical can influence the degree of hazard present. The diamond-shaped diagram gives a general idea of the inherent hazards of the chemical, as well as the order of these hazards under emergency conditions such as spills, leaks, and fires.

The diamond is divided into four color-coded quadrants. The top three quadrants of the diamond are labeled with the numbers (0-4) to indicate the degree of hazard for each category: health hazard (blue), fire hazard (red), and instability/reactivity hazard (yellow). The bottom

quadrant (white) is used to indicate special hazards: water reactivity, radioactivity, biohazards, or other hazards. The higher the hazard rating on the NFPA diamond, the higher the hazard. An example of the EHS sign program is located in Figure 2 below (302SN).



FIGURE 2: EXAMPLE OF LABORATORY SIGN

The NFPA system is one component of EHS's program. EHS updates laboratory door signs on an annual basis. The information updated on laboratory signs includes: emergency contact information (Public Safety, x3333), room number, responsible investigator with his/her office location and phone number, and an alternative contact with his/her office location and phone number.

4.2 THE GOAL OF MINIMIZATION

It is the goal of MIE to minimize the use of chemicals whenever practical. As research goals are contemplated, PIs, and laboratory users, should evaluate their processes, taking chemical use into account.

Minimizing chemical use makes sense at all levels since it reduces procurement costs, reduces storage demand, reduces risk, and reduces disposal costs. This means that there is no need to order large quantities of material when a small quantity is all that is needed, even if the price is better for the larger container.

4.3 CHEMICAL PROCUREMENT

Before a new substance that is known or suspected to be hazardous is received, information on proper handling, storage, and disposal should be known to those who will handle it. The necessary information on proper handling of hazardous substances can be obtained from the Material Safety Data Sheets (MSDS) that are provided by the vendor.

4.4 MATERIAL SAFETY DATA SHEETS (MSDS)

The Hazard Communication Standard (HCS), 29 CFR 1910.1200, provisions have been incorporated into the Laboratory Standard, 29 CFR 1910.1450. The purpose of the HCS is to provide workers with information about potential risks due to chemical hazards in the workplace. The HCS created a "right to know" procedure for the worker who handles or is exposed to hazardous chemicals. Among the various topics covered by the HCS are the labeling of containers, availability of material safety data sheets (MSDS), and the education and training of employees.

All students and employees should have access to the MSDS at all times. MSDS should be filed alphabetically in clearly labeled notebooks and updated as new sheets are received. The notebooks must be kept in an area easily accessible to all individuals in the laboratory. Each MSDS is an excellent source of information, including, but not limited to, physical properties, fire and explosion hazards, chemical reactivity, recommended protective equipment, and spill and first aid procedures. Because of this, each student and employee should be familiar with the location and types of information available in MSDS. If there are any questions about the material presented in the MSDS, the laboratory worker should contact their advisor, PI, or Laboratory Director.

Prior to ordering a chemical, the MSDS should be obtained to evaluate potential hazards associated with that chemical and to ensure the proper protective equipment is available for use upon receipt. Chemical substitution should occur if the chemical is determined to be extremely toxic and/or dangerous to handle. If an MSDS is not received with or prior to the shipment, the material should be secured until the MSDS is received. Additionally, each time a substance is reordered an updated MSDS for the material must be obtained and reviewed.

To locate a missing MSDS visit the VWR link at www.vwrsp.com/search/index.cgi?tmpl=msds

4.5 CHEMICAL TRANSFER AND TRANSPORTATION

When hazardous materials are transported or transferred between containers, the potential for an accident increases. The laboratory worker must exercise care when performing these procedures. Appropriate personal protective equipment and other safety equipment should be used during these operations (see Section 5).

When working with flammable and combustible materials, the laboratory worker should first

ensure that no sources of ignition are present in the area. An exhaust hood should be used whenever flammables and combustibles are transferred from one container to another. In addition, when transferring flammable or combustible materials the containers should be bonded and grounded.

It is essential that there be sufficient expansion space within the container being filled. Overfilling a container can result in pressure great enough to cause leakage or rupture. The laboratory worker should be especially conscious of temperature changes that will affect the pressure. For example, a glass bottle with a screw cap lid can rupture if it is filled full to the top with a cold liquid and then stored in a warm or hot area.

Pipetting of liquids should be performed using a laboratory safety pipette bulb or pump. Automatic burettes or pipettes may also be used for the transfer and dispensing of some liquids.

The transport of chemicals should always be handled in such a way to ensure the safety of all laboratory personnel. Carts used for transport should be sturdy and have a substantial rim around the edge. Carts should also have wheels large enough to negotiate uneven surfaces, such as expansion joints or floor drain depressions, without tipping or stopping.

4.6 CLASSIFICATION OF CHEMICALS

There are many ways to classify chemicals. Understanding these classes can further aid in determining the safe handling, storage, and disposal techniques to employ for specific chemicals. Some chemicals may actually fall into more than one class.

Flammables and Combustibles

Flammable substances are those that readily catch fire and burn. It is the vapors from a flammable liquid that burn, not the liquid itself. Flammable liquids are those that have a flash point below 100 ° F (37.8 °C) and a vapor pressure that does not exceed 40 pounds per square inch (psi) at 100 °F. A combustible liquid has a flash point at or above 100 °F (37.8 °C). Many organic acids are combustible materials. In addition to liquids, the Department of Transportation (DOT) also classifies flammable substances as solids and gases. Examples of flammable gases are acetylene, ethylene oxide, and hydrogen. Flammable solids are those that: a) are capable of producing fire as a result of friction or heat retained from production or, b) if ignited, produce a serious transportation hazard.

Explosives

Explosive gases and solids are also part of the flammable and combustible group. Mechanical shock, heat, and certain catalysts can act as initiators of explosive reactions. One example of an explosive mixture is a suspension of oxidizable particles, such as magnesium powder or zinc dust, in air. Explosives include nitrates, chlorates, perchlorates, and picrates.

Pyrophorics

Pyrophoric chemicals are those substances that react so rapidly with air and its moisture that the ensuing oxidation and/or hydrolysis lead to ignition. Ignition may be instantaneous, delayed,

or occur only if the material is finely divided or spread in a diffuse layer. Some examples are:

- Finely divided metals, such as calcium, magnesium, and zirconium.
- Metal or non-metal hydrides, such as germanium and diborane.

Water-Reactive Substances

Water-reactive compounds react exothermically and violently with water, particularly if the water is present in limited quantities, since no significant cooling effect will occur. The following are examples of water-reactive substances:

- Alkali and alkaline earth metals, such as potassium and calcium
- Anhydrous metal oxides and halides, such as calcium oxide and aluminum bromide.

Peroxidizable Substances

Peroxidizable substances slowly react under ambient conditions with atmospheric oxygen to initially form peroxides. The shelf life varies among the various compounds in this group.

Corrosives

Corrosives include strong acids, strong bases, dehydrating agents, and oxidizing agents. These chemicals erode the skin and respiratory epithelium, damage the eye and cause severe bronchial irritation.

Acids

All concentrated acids can damage the skin and eyes. Nitric, chromic, and hydrofluoric acids are particularly damaging because of the types of chemical burns they inflict. When handling these chemicals appropriate gloves, aprons, and face shields must be used.

Bases

Common bases include sodium hydroxide, potassium hydroxide and ammonia. Metal hydroxides are extremely damaging to the eyes. When handling these chemicals appropriate gloves, aprons and face shields must be used.

Oxidizers

Oxidizers are any material that readily yields oxygen or other oxidizing gas, or that readily reacts to promote or initiate combustion of combustible materials. Examples of oxidizers include: hydrogen peroxide, permanganate, and chromic acid.

4.7 CHEMICAL STORAGE

Proper storage of chemicals is important for the health and safety of the entire laboratory staff. Improper storage can result in hazardous situations that can endanger laboratory workers and

physical property.

The following is a list of important safety rules for the storage of chemicals:

- **Never** store chemicals in alphabetical order. Segregate all chemicals according to hazard class then place alphabetically
- **Avoid** storing chemicals in a fume hood;
- Return all chemicals to their appropriate storage areas at the end of the day;
- Flammable chemicals that need to be refrigerated must be stored in an approved explosion-resistant refrigerator that has been labeled as such;
- Never stack bottles on top of each other;
- Store chemicals only on sturdy shelving;
- Bottles of flammable liquids should not be stored near combustible materials.

Keep the following in mind when storing and using chemicals. In general:

- Segregate REACTIVES from IGNITABLES
- Segregate ACIDS from CAUSTICS
- Segregate CORROSIVES from FLAMMABLES
- Segregate strong OXIDIZERS from EVERYTHING
- Most ORGANIC REACTIVES must be segregated from INORGANIC REACTIVES (metals)

Some hazardous combinations:

- Acid + Oil or Grease = Fire
- Flammable Liquid + Hydrogen Peroxide = Fire/Explosion
- Acid + Caustic = Heat/Spattering
- Aluminum Powder + Ammonium Nitrate = Explosion
- Caustics + Epoxies = Extreme Heat
- Sodium Cyanide + Sulfuric Acid = Lethal Hydrogen Cyanide
- Chlorine Gas + Acetylene = Explosion
- Ammonia + Bleach (or other Chlorine source) = Toxic Chloramine (i.e., Mustard Gas)

If the laboratory user needs more information about chemical compatibility please refer to the compatibility chart on Cole-Parmer's website at www.coleparmer.com/techinfo/chemcomp.asp

Separate hazardous chemicals in storage as show in Table 2 below:

TABLE 2: SEPARATING HAZARDOUS CHEMICALS IN STORAGE

SOLIDS		
Oxidizers	Flammable Solids	Water Reactives
LIQUIDS		
Acids	Flammables	Caustics
GASES		
Toxic	Oxidizers	Flammable

Once separated into the above hazard classes, chemicals may be stored alphabetically. Use approved storage containers and safety cans for flammable liquids. Flammable chemicals are stored in flammable storage cabinets. MIE has flammable storage cabinets in many labs.

Other rules for chemical storage:

- Do not store chemicals on bench tops or in hoods.
- Liquids (particularly corrosives or solvents) should not be stored above eye level.
- Use secondary containers (one inside the other) for especially hazardous chemicals (carcinogens, etc.).
- Use spill trays under containers of strong reagents.
- Avoid exposure of chemicals while in storage to heat sources (especially open flames) and direct sunlight.

4.8 CHEMICAL SPILL PLAN

Every MIE laboratory user should try to anticipate the types of chemical spills that can occur, familiarize themselves with minor chemical spill clean-up procedures, and ensure the necessary equipment (spill kits and personal protective equipment) to respond to a minor spill is readily available. MSDS contain special spill clean-up information and should also be consulted.

If the spill is too large for you to handle, is a threat to health, safety or the environment, or involves a highly toxic or reactive chemical, call for assistance immediately:

Environmental Health and Safety, x2769 (8:30 a.m. to 4:30 p.m.)

Public Safety, x3333 (24/7).

MINOR SPILLS - If you are cleaning up a small spill (<100ml) yourself, make sure that you are aware of the hazards associated with the materials spilled, have adequate ventilation (chemical fume hood on) and proper personal protective equipment (gloves, goggles, lab coat, and respirator if necessary). Consider all residual chemical and cleanup materials (adsorbent, gloves, etc.) as hazardous waste. Place these materials in a sealed container (plastic bags) and store in a chemical fume hood. Contact the Office of Environmental Health and Safety for disposal instructions.

If a spill occurs:

- Alert people in immediate area of spill;
- Increase ventilation in area of spill (turn on hoods);
- Always wear proper personal protective equipment;
- Avoid breathing vapors from spill;
- Use appropriate kit to neutralize and absorb inorganic acids and bases. Collect residue, place in container, and dispose as hazardous chemical waste;
- Clean spill area with soap and water.

LARGER SPILLS – When it is determined that a larger spill (>100ml) can be safely remediated by the laboratory user the same method outlined above may be used. In the event of a larger chemical spill the likelihood increases that absorbent may be used. The same disposal methods outlined above should be followed.

If a chemical spill threatens the health or safety of any laboratory personnel:

- Attend to injured or contaminated person(s) and remove them from exposure;
- Alert people in the laboratory to evacuate;
- If spilled material is flammable, turn off ignition and heat sources. Place another device (plastic bag) over spilled material to keep substance from volatilizing;
- Call **Emergency Response** number x3333;
- Close doors to affected area;
- Have a person with knowledge of the incident and laboratory available to answer questions from responding emergency personnel.

Laboratory hazardous chemical waste must be disposed of in accordance with local, state, federal and Northeastern University requirements. These waste management practices are designed to ensure maintenance of a safe and healthy environment for laboratory employees and the surrounding community without adversely affecting the environment. This is accomplished through regular removal of hazardous waste and disposal of these wastes in compliance with all regulations and policies. Every MIE laboratory user should become familiar with the Hazardous Waste Management section on the EHS website, accessible at: www.ehs.neu.edu/hazardous_waste/

Remember:

- Hazardous waste must be disposed of in a timely manner.
- Hazardous waste containers must be closed at all times during storage, except when waste is being added or removed.
- All hazardous waste must be properly labeled at the time the waste is first placed in the container.
- Hazardous waste should be accumulated in a designated storage area consistent with applicable regulations.
- Hazardous waste regulations require separate training of personnel who generate or handle hazardous waste.
- Generators of hazardous waste are required to incorporate waste minimization into any process that generates hazardous waste.
- DO NOT use sinks for hazardous waste disposal.

As professionals in the field, and stewards of the environment, it is imperative that proper hazardous waste disposal practices be followed.

4.10 HAZARDOUS WASTE COLLECTION

EHS requires departments to have designated "Satellite Accumulation Areas." According to EHS these designated areas must:

"... be at or near the point of generation. This area can be established on a bench top, fume hood, shelving unit or cabinet. If the material is flammable or combustible, this waste should be stored in a flammable storage cabinet to keep within fire code restrictions. It is recommended that hazardous waste, like other chemicals, should not be stored on the floor unless there is secondary containment, and they are away from exits and egresses. If a leak of hazardous waste could lead to a release into a floor drain or sink, then secondary containment will be required in all cases. Designated storage areas must be inspected by the generator of the waste on a weekly basis. One or more persons must be assigned to make these inspections and be identified on the "Satellite Accumulation Area" posting."

Most large MIE laboratories have Satellite Accumulation Areas. If your lab does not, there is one

in 016 FR (the Machine Shop). Contact Jonathan Doughty (x2980) for more information.

Once hazardous waste is deposited in the Satellite Accumulation Area the laboratory user is required to request pick-up online through EHS's website. In the Hazardous Waste Management section of the EHS website the laboratory user can access an on-line Hazardous Waste Disposal Request Form. Filled or unwanted wastes should be removed from the laboratory within three days so it is important the laboratory user make the pick-up request in a timely fashion.

4.11 HAZARDOUS WASTE LABELING

All wastes that are hazardous must be clearly identified as "hazardous waste" on the label. In addition, the label should also show the physical hazards of the waste (e.g. corrosive), as well as an identification of the chemicals or chemical mixtures. The label should be dated when the container is full and/or ready for pick-up. Hazardous waste disposal labels are on file in 408SN and available from the Laboratory Manager and should be used when declaring a material a hazardous waste. A copy of the hazardous waste label is detailed below.

DO NOT ABBREVIATE ON HAZARDOUS WASTE LABELS.

5.0 PERSONAL PROTECTIVE EQUIPMENT

5.1 EYE PROTECTION

Eye protection is required for all personnel and any visitors present in locations where chemicals are handled and a chemical splash hazard exists. Safety glasses, goggles and goggles with face shield should be worn in the laboratory based upon the physical state, the operation or the level of toxicity of the chemical used. Safety glasses effectively protect the eye from solid materials (dusts and flying objects) but are less effective at protecting the eyes from chemical splash to the face. Goggles should be worn in situations where bulk quantities of chemicals are handled and chemical splashes to the face are possible. Goggles form a liquid-proof seal around the eyes, protecting them from a splash. When handling highly reactive substances or large quantities of hazardous chemicals, corrosives, poisons and hot chemicals, goggles with face shield should be worn.

Contact lenses can increase the risk of eye injury if worn in the laboratory - particularly if they are of the gas permeable variety. Gases and vapors can be concentrated under such lenses and cause permanent eye damage. Chemical splashes to the eye can get behind all types of lenses. Once behind a lens the chemical is difficult to remove with a typical eye wash. For these reasons it is recommended that contact lenses not be worn in laboratories.

MIE has safety glasses, goggles, and face shields available in most labs. MIE will purchase any personal protective equipment requested for any MIE laboratory user; any such request should be made to the Laboratory Director.

5.2 RESPIRATORY PROTECTION

Inhalation hazards can be controlled using ventilation or respiratory protection. Check the label and MSDS for information on a substance's inhalation hazard and special ventilation requirements. When a potential inhalation hazard exists, a substance's label or MSDS contains warnings such as:

- Use with adequate ventilation
- Avoid inhalation of vapors;
- Use in a fume hood; and
- Provide local ventilation

Take appropriate precautions before using these substances. Controlling inhalation exposures via engineering controls (ventilation) is always preferred.

Use of Respirators

Respirators are designed to protect against specific types of substances in limited concentration ranges. Respirators must be selected based on the specific type of hazard (toxic chemical, oxygen deficiency, etc.), the contaminant's anticipated airborne concentration, and required

protection factors.

Types of respiratory protective equipment include:

- Particle-removing air purifying respirators
- Gas and vapor-removing air purifying respirators
- Atmosphere supplying respirators

Respirators are not to be used except in conjunction with a complete respiratory protection program as required by OSHA. If your work requires the use of a respirator contact EHS and the Laboratory Director.

5.3 CLOTHING AND GLOVES

Personnel are urged to dress with potential laboratory hazards in mind. Clothing should protect as much of the body as possible.

Shoes that cover the entire foot must be worn whenever in the laboratory. Sandals, flip-flops, or other abbreviated footwear are prohibited in MIE laboratories.

Laboratory aprons or lab coats can be worn to provide protection from accidents and spills. MIE will provide laboratory users with lab coats upon request. Any request should be made with the Lab Director. Contaminated and/or soiled lab coats should be discarded and replaced.

Loose fitting clothes, easily combustible clothes, long unrestrained hair, neckties, necklaces, and other such ornamental or pendant items are all fire and accident hazards, and are not appropriate in the laboratory.

Decisions regarding the need to wear gloves and, secondly, the appropriate gloves are dependent on the hazard of the chemical, potential for contamination during the experiment and dexterity requirements. These decisions are made by the laboratory user's advisor.

Proper glove selection is a function of the specific chemical resistance of the material as measured by permeation rate and breakthrough time. Disposable latex gloves have limited resistance to many commonly used laboratory chemicals. They should not be used in operations where contamination is anticipated and must be removed immediately and the hands washed should they become contaminated.

It is university policy that laboratory gloves be removed before exiting any department laboratory. Gloves should not be worn in common areas and should be removed before operating specific laboratory equipment (common controls, computers, etc.) Gloves should be washed prior to removal whenever possible to prevent skin contamination.

Non-disposable gloves should be replaced periodically, depending on frequency of use and their resistance to the substances handled.

More resistant gloves include natural rubber, neoprene, nitrile, butyl, Viton, and polyvinyl chloride. Recommendation of the glove manufacturer and the Material Safety Data Sheet for

the particular chemical should be used in choosing the appropriate gloves.

5.4 SAFETY SHOWERS

The purpose of a safety shower is to provide a high volume of water for rapidly rinsing a chemical off of a person's skin and clothing. Anytime a person has spilled a chemical on themselves and the chemical is of a nature that it must be removed rapidly the person should use the nearest safety shower. An example of this would be a large acid spill with acid over a large part of the body. Of course, small spills can be handled by running water over the affected area using any of the numerous sinks located in the laboratory.

5.5 EYE WASH STATIONS

Eye wash stations provide a high flow of water, which can be used to flush a chemical from eyes. If there is any question about whether an eye-wash is necessary after a spill or splash, then the eye wash should be used without delay.

Eye wash fountains should provide a gentle flow of clean tempered aerated water for an extended period of at least 15 minutes with the eye(s) held open. Use of the hands should not be required to maintain the water flow. MIE has eye wash stations at each safety shower.

5.6 FIRE AND FIRE RELATED EMERGENCIES

If you discover a fire or fire-related emergency such as abnormal heating of material, a flammable gas leak, a flammable liquid spill, smoke, or odor of burning, immediately follow these procedures:

- Notify the Fire Department through the Division of Public Safety (x3333).
- Activate the building alarm (fire pull station). Isolate the area by closing windows and doors and evacuate the building.
- Shut down equipment in the immediate area, if possible.
- Use a portable fire extinguisher to:
 - assist oneself to evacuate;
 - assist another to evacuate; and
 - control a small fire, if possible.

There are fire extinguishers located in every MIE lab. All fire extinguishers are maintained and inspected by the university's Public Safety Division. If a fire extinguisher is used, or discharges accidentally, notify the Laboratory Director immediately.

Provide the fire/police teams with the details of the problem upon their arrival. Special hazard information you might know is essential for the safety of the emergency responders.

If the fire alarm is activated in any research building evacuate the building immediately. Make sure colleagues in your immediate area are aware of the emergency and evacuate as well.

5.7 FIRST AID KITS

Many MIE laboratories have a first aid kit. Laboratory personnel should be aware of these locations. It is the responsibility of MIE laboratory personnel to inform the Laboratory Director of any accidents requiring first aid, and the need to resupply any first aid kit.

6.0 LABORATORY FUME HOODS

Every laboratory ventilation hood used for the control of air contaminants is tested once per year to assure that adequate airflow is being maintained to provide continued protection against employee over-exposure to hazardous materials. The Office of Environmental Health and Safety is responsible for performing this testing. Laboratory hood airflow shall be considered adequate when the average face velocity equals a minimum of a 100 feet/minute and a maximum of 125 feet/minute with the hood sash at a working height (14 to 20 inches).

Every MIE fume hood is equipped with a manual switch. If it is determined that the fume hood is not operating properly the laboratory user shall not use that fume hood and shall notify the Laboratory Director immediately.

GENERAL GUIDELINES FOR FUME HOODS

- With particularly hazardous chemicals or wastes, operations such as unpacking, diluting, packing, or reacting hazardous materials should be performed in the fume hood.
- Never use an inoperative fume hood.
- Chemicals should not be stored in hoods. Chemicals should be returned to their appropriate storage area. Only those items that are essential should be in the hood. Extraneous items may impair the effectiveness of the fume hood. Storing large pieces of equipment in the hood will affect the containment ability of the hood. EHS must be called before storing large equipment in the hood to evaluate the hood performance.
- The hood sash should be kept closed unless manipulations are being performed within the hood. When the hood is being used the sash should be open no more than 18 inches or where your hood sticker has been placed. This is necessary to protect the user's face in the event of an explosion and prevent chemical exposures when the products used are not being contained by the hood.
- Hoods may be turned off when not in use if adequate general laboratory ventilation can be maintained when they are not running. Hoods must be left on if any chemicals are in the hood or if the hood is required to maintain negative room pressure.
- Materials such as paper and dust should not be permitted to enter the exhaust ducts of the hood. They can adversely affect the operation of the hood by lodging in ducts and fans.
- Equipment, such as hot plates and heating mantles, should be placed at least 6 inches from the hood sash. Generally equipment should be placed as far to the back of the hood as practical.

7.0 COMPRESSED GASES

7.1 GENERAL INFORMATION

Compressed gases are unique in that they represent both a physical and a potential chemical hazard (depending on the particular gas). Gases contained in cylinders may be from any of the hazard classes (flammable, reactive, corrosive, or toxic). Because of their gaseous state, concentrations in the laboratory can increase instantaneously if leaks develop at the regulator or piping systems, creating the potential for a toxic chemical exposure or a fire/explosion hazard. Often there is little or no indication that leaks have or are occurring. Finally, the large amount of potential energy resulting from compression of the gas makes a compressed gas cylinder a potential rocket or fragmentation bomb if the tank or valve is physically broken.

7.2 HANDLING PROCEDURES

The following procedures should be followed whenever compressed gas is required in a laboratory.

- The contents of any compressed gas cylinder should be clearly identified. No cylinder should be accepted for use that does not legibly identify its contents by name. Color coding is not a reliable means of identification and labels on caps have no value as caps are interchangeable.
- Carefully read the label before using or storing a compressed gas. The MSDS will provide any special hazard information.
- Transport gas cylinders in carts one or two at a time only while they are secured and capped. MIE has a gas cylinder transport cart typically located in 016FR. When storing or moving a cylinder, the protective cap must be securely in place to protect the valve stem. Never move a cylinder with a regulator attached.
- All gas cylinders should be capped and secured when stored.
- Use suitable racks, straps, chains or stands to support cylinders. All cylinders, full or empty, must be restrained and kept away from heat sources.
- Use only Compressed Gas Association standard combinations of valves and fittings for compressed gas installations. Always use the correct pressure regulator. Do not use a regulator adaptor.
- Place gas cylinders in such a way that the cylinder valve is accessible at all times. The main cylinder valve should be closed as soon as the gas flow is no longer needed. Do not store gas cylinders with pressure on the regulator. Use the wrenches or other tools provided by the cylinder supplier to open a valve if available. In no case should pliers be used to open a cylinder valve.
- Use soapy water (SNOOP) to detect leaks. Leak test the regulator, piping system and other couplings after performing maintenance or modifications, which could affect the

integrity of the system.

- Oil or grease on the high pressure side of an oxygen cylinder can cause an explosion. Do not lubricate an oxygen regulator or use a fuel/gas regulator on an oxygen cylinder.
- Never bleed a cylinder completely empty. Leave a slight pressure to keep contaminants out (172 kPa or 25 psi).
- All gas cylinders should be clearly marked with appropriate tags indicating whether they are full or empty.
- Cylinders of toxic, flammable or reactive gases should be purchased in the smallest quantity possible and stored/used in a fume hood or under local exhaust ventilation. If at all possible, avoid the purchase of lecture bottles. These cylinders are not returnable and it is extremely difficult and costly to dispose of them. Use the smallest returnable sized cylinder.

7.3 SPECIAL PRECAUTIONS FOR HYDROGEN

Hydrogen gas has several unique properties that make it potentially dangerous to work with. It has an extremely wide flammability range (LEL 4%, UEL 74.5%) making it easier to ignite than most other flammable gases. Unlike most other gases, hydrogen's temperature increases during expansion. If a cylinder valve is opened too quickly, the static charge generated by the escaping gas may cause it to ignite. Hydrogen burns with an invisible flame. Caution should therefore be exercised when approaching a suspected hydrogen flame. A piece of paper can be used to tell if the hydrogen is burning. Hydrogen embrittlement can weaken carbon steel, therefore cast iron pipes and fittings must not be used.

APPENDIX 1 – ACCESS REQUEST FORM



Mechanical and Industrial Engineering Department Access Request Form

Today's Date: _____

Faculty Staff Graduate Undergraduate¹
Other _____

Applicant's Name: _____ NU ID number: _____

Preferred Email address: _____

Office Address and phone number: _____

Home Address: _____

Phone Numbers: home: _____ cell: _____

Type of Support: RA _____ TA _____ Other (specify) _____

Program: MS _____ PhD _____ Full time _____ Part time _____

Advisor/Supervisor's Name _____

Access is requested for the following building and room numbers: Building Room Number²

_____	_____
_____	_____

Purpose of access:

Applicant's Signature/Date: _____

Advisor's Signature/Date: _____

Laboratory Director's Signature/Date: _____

Key Manager's Signature/Date: _____

1. Offices only, no labs
2. For laboratory access, applicant must document satisfactory completion of the safety training³ and have the department Laboratory Director's signature before a key will be issued. This applies to the following MIE locations:
Snell: 178, 302, 304
Egan: 157, 161, 161A, 161B, 164, 165, 232, 232A, 235B, 250
Forsyth: 010, 011, 011A, 012A, 012B, 012C, 012D, 012E, 012F, 016, 016A, 016B, 225, 229, 239A, 239C, 239C1, 243A, 243A4, 244, 244A, 244H
3. Go to www.ehs.neu.edu/training, select "Online training" and then "training application". Login using your first and last name. At a minimum, you must complete Chemical Hygiene Parts 1 and 2 and Hazard Communication.

APPENDIX 2 – FORMS FOR VISITING SCHOLARS, UNDERGRADUATE
RESEARCHERS, AND OTHER USERS

PERMISSION FOR A VISITING RESEARCH EXPERIENCE

Fill in this form. Typed-in Signatures and Dates are permitted to save paper.

YOUR PERSONAL SAFETY WHILE WORKING IN NORTHEASTERN RESEARCH AND RELATED LABORATORIES IS OF UPMOST IMPORTANCE TO THE UNIVERSITY COMMUNITY. FOR EXAMPLE, YOU MUST NEVER PERFORM EXPERIMENTS UNSUPERVISED. IN ORDER TO INSURE YOUR COMPLIANCE AND TRAINING, PLEASE COMPLETE THIS FORM, [FILLING IN THE APPROPRIATE FORM FIELDS](#)

RETURN TO RONALD J. WILLEY VIA EMAIL FOR CHEMICAL HYGIENCE COMMITTEE (CHC) APPROVAL
UPON CHC APPROVAL- YOU WILL RECEIVE A CERTIFICATE TO BEGIN YOUR RESEARCH EXPERIENCE
EMAIL TO: r.willev@neu.edu

Visitor Information:

FIRST:	MI:	LAST:	Email	
CAMPUS PHONE:	CELLPHONE			
DEPARTMENT	Beginning Date:	Ending Date:		
LABORATORY NAME:	BUILDING:	Room:		
EMERGENCY CONTACT	NAME:	PHONE:		

Primary laboratory Advisor Information:

FIRST:	MI:	LAST:	Email	@neu.edu
CAMPUS PHONE:	CELLPHONE			

Primary Investigator's Information:

FIRST:	MI:	LAST:	Email	@neu.edu
CAMPUS PHONE:	CELLPHONE			

Description of Research
Type a paragraph description here

You have completed Northeastern Univ. on-line basic safety awareness training? Box 1

No

No addl training is required in mechanical, chemical, biological, or radiation safety? Box 2

No

Else, please review the following list and complete as needed. Click on links for more details

Required?	Completed?	Date			
<input type="checkbox"/>	<input type="checkbox"/>		Bloodborne Pathogens and Biological	<input type="checkbox"/>	Safety
<input type="checkbox"/>	<input type="checkbox"/>		Chemical Hygiene/ Laboratory	<input type="checkbox"/>	Safety
<input type="checkbox"/>	<input type="checkbox"/>		Hazardous	<input type="checkbox"/>	Waste
<input type="checkbox"/>	<input type="checkbox"/>		Laser	<input type="checkbox"/>	Safety
<input type="checkbox"/>	<input type="checkbox"/>		Radiation	<input type="checkbox"/>	Safety

Approval: (Have each person below type in their name and date by opening your document)

Your Primary laboratory Advisor		Date	
Primary Investigator		Date	
Departmental Representative		Date	
CHC Approval		Date	

PLEASE PRINT THIS PAGE, SIGN WHERE APPROPRIATE, AND RETURN VIA CAMPUS MAIL TO RONALD J. WILLEY, 342 SN

I understand that working in active research laboratories poses potential risks of harm; these risks may include damage to property, serious personal injury including chemical burns, and even death. I agree to abide by all applicable policies, rules and regulations. I agree to follow the direction of the lab personnel. I agree that if granted, my approval to work in the labs may be withdrawn at any time at the sole discretion of Northeastern University.

Release of Claims

In consideration of Northeastern University granting _____ (name of person requesting authorization, hereinafter the "participant") permission to work in a University lab, I/We, on behalf of myself/the Participant, the family heirs, personal representatives, guardians, successors, and assigns (all of whom are referred to as "Releasers"), hereby release Northeastern University, its Administrators, Faculty, Trustees, Officers, Directors, Employees, Volunteers, and Agents (all of whom are referred to as "Releasees") from, and agree not to sue Releasees, for any claims that I/we may have arising from, or in connection with, any physical, emotional or mental injury or property damage that Releasers may suffer as a result of my participation in the lab from any cause whatsoever, to the extent permitted by law.

I acknowledge that I am voluntarily executing this agreement of my own free will. After having the opportunity to consult with legal counsel of my own choosing, I acknowledge and understand that this agreement will release Northeastern University and its Releasees from any liability in connection with any injury or damages or losses suffered as a result of the Participant's participation in the lab activity.

I acknowledge that I have been made aware of any and all risks of participation in this Activity, and I hereby approve of the Participant's participation in the Activity.

If participant is under age 18, complete the following:

I further state that I am the Participant's ___parent/ ___guardian, and am fully competent to sign this agreement; and that I execute this release for full, adequate, and complete consideration fully intending for myself, for the participant, and for the participant's family, estate, heirs, administrators, personal representatives, or assigns to be bound by same.

Participant

Signature: _____ Date: _____
(If over age 18)

Parent/Guardian Name (please print): _____

Relationship: _____

Parent/Guardian Signature: _____ Date: _____

PERMISSION FOR A VOLUNTEERED RESEARCH EXPERIENCE

Fill in this form. Typed in Signatures and dates are permitted to save paper.

YOUR PERSONAL SAFETY WHILE WORKING IN NORTHEASTERN RESEARCH AND RELATED LABORATORIES IS OF UPMOST IMPORTANCE TO THE UNIVERSITY COMMUNITY. FOR EXAMPLE, YOU MUST NEVER PERFORM EXPERIMENTS UNSUPERVISED. IN ORDER TO INSURE YOUR COMPLIANCE AND TRAINING, PLEASE COMPLETE THIS FORM, [FILLING IN THE APPROPRIATE FORM FIELDS](#)

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UPON CHC APPROVAL- YOU WILL RECEIVE A CERTIFICATE TO BEGIN YOUR RESEARCH EXPERIENCE
EMAIL TO: r.willev@neu.edu

Volunteer Information:			
FIRST:	MI:	LAST:	Email
CAMPUS PHONE:		CELLPHONE	
DEPARTMENT		Beginning Date:	Ending Date:
LABORATORY NAME:	BUILDING:	Room:	
EMERGENCY CONTACT	NAME:	PHONE:	
Primary laboratory Advisor Information:			
FIRST:	MI:	LAST:	Email @neu.edu
CAMPUS PHONE:		CELLPHONE	
Primary Investigator's Information:			
FIRST:	MI:	LAST:	Email @neu.edu
CAMPUS PHONE:		CELLPHONE	
Description of Research Type a paragraph description here			
<p>You have completed Northeastern Univ. on-line basic safety awareness training? Box 1</p> <p><input type="checkbox"/> No addl training is required in mechanical, chemical, biological, or radiation safety? Box 2</p> <p><input type="checkbox"/> Else, please review the following list and complete as needed. Click on links for more details</p> <p>Required? Completed? Date</p> <p><input type="checkbox"/> Bloodborne Pathogens and Biological Safety</p> <p><input type="checkbox"/> <input type="checkbox"/> Chemical Hygiene/ Laboratory Safety</p> <p><input type="checkbox"/> <input type="checkbox"/> Hazardous Waste</p> <p><input type="checkbox"/> <input type="checkbox"/> Laser Safety</p> <p><input type="checkbox"/> <input type="checkbox"/> Radiation Safety</p>			
Approval: (Have each person below type in their name and date by opening your document)			
Your Primary laboratory Advisor		Date	
Primary Investigator		Date	
Departmental Representative		Date	
CHC Approval		Date	

ANY QUESTIONS PLEASE CONTACT RON WILLEY, 617-373-3962 OR BY EMAIL AT R.WILLEY@NEU.EDU

PLEASE PRINT THIS PAGE, SIGN WHERE APPROPRIATE, AND RETURN VIA CAMPUS MAIL TO RONALD J. WILLEY, 342 SN

I understand that working in active research laboratories poses potential risks of harm; these risks may include damage to property, serious personal injury including chemical burns, and even death. I agree to abide by all applicable policies, rules and regulations. I agree to follow the direction of the lab personnel. I agree that if granted, my approval to work in the labs may be withdrawn at any time at the sole discretion of Northeastern University.

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I acknowledge that I am voluntarily executing this agreement of my own free will. After having the opportunity to consult with legal counsel of my own choosing, I acknowledge and understand that this agreement will release Northeastern University and its Releasees from any liability in connection with any injury or damages or losses suffered as a result of the Participant's participation in the lab activity.

I acknowledge that I have been made aware of any and all risks of participation in this Activity, and I hereby approve of the Participant's participation in the Activity.

If participant is under age 18, complete the following:

I further state that I am the Participant's ___parent/ ___guardian, and am fully competent to sign this agreement; and that I execute this release for full, adequate, and complete consideration fully intending for myself, for the participant, and for the participant's family, estate, heirs, administrators, personal representatives, or assigns to be bound by same.

Participant

Signature: _____ Date: _____
(If over age 18)

Parent/Guardian Name (please print): _____

Relationship: _____

Parent/Guardian Signature: _____ Date: _____

PERMISSION FOR AN UNDERGRADUATE RESEARCH EXPERIENCE

Fill in this form. Typed in Signatures are permitted to save paper.

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EMAIL TO: r.willev@neu.edu

Undergraduate Information:

FIRST:	MI:	LAST:	Email	
CAMPUS PHONE:		CELLPHONE		
DEPARTMENT		Beginning Date:	Ending Date:	
LABORATORY NAME:	BUILDING:	Room:		
EMERGENCY CONTACT	NAME:	PHONE:		

Primary laboratory Advisor Information:

FIRST:	MI:	LAST:	Email	@neu.edu
CAMPUS PHONE:		CELLPHONE		

Primary Investigator's Information:

FIRST:	MI:	LAST:	Email	@neu.edu
CAMPUS PHONE:		CELLPHONE		

Description of Research

Type a paragraph description here

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No

addl training is required in mechanical, chemical, biological, or radiation safety? Box 2

No

Else, please review the following list and complete as needed. Click on links for more details

Required?

Completed?

Date

Bloodborne Pathogens and Biological Safety

Chemical Hygiene/ Laboratory Safety

Hazardous Waste

Laser Safety

Radiation Safety

Approval: (Have each person below type in their name and date by opening your document)

Your Primary laboratory Advisor		Date	
Primary Investigator		Date	
Departmental Representative		Date	
CHC Approval		Date	

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Participant

Signature: _____ - Date: _____
(If over age 18)

Parent/Guardian Name (please print): _____

Relationship: _____

Parent/Guardian Signature: _____

