



Department of
Mechanical &
Aerospace
Engineering

Laboratory Safety Manual

IMPORTANT PHONE NUMBERS

EMERGENCY

(MEDICAL, POLICE, OR FIRE)

DIAL 911

**General Safety
Information
and
Hazardous Waste
Disposal Information**

Environmental Health & Safety
108 Campus Support Facility
Phone: (573) 341-4305
<http://ehs.mst.edu>

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Officer**

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Other Links:

Environmental Health and Safety Manual: <http://ehs.mst.edu/ehsmanual/index.html>

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I INTRODUCTION

Safety in the laboratory requires the same kind of continuing attention and effort that is given to research and teaching. The use of new and/or different techniques, chemicals, and equipment requires careful preparation. Reading, instruction, and supervision may be required, possibly in consultation with other people who have special knowledge or experience. Everyone who works in a laboratory has a responsibility to learn the health and safety hazards associated with the materials to be used or produced, and with the equipment to be employed.

It is important for you to know what is expected of you and what your responsibilities are regarding safety to yourself, your colleagues and our environment. In addition, there are safety practices and safety equipment with which you must be thoroughly familiar if you are to work safely in the laboratory. This manual should be used as a guide to the general types of hazards and a reference source for more specific information pertinent to each individual project.

II FIVE PRINCIPLES OF SAFETY

The Mechanical and Aerospace Engineering Safety Program incorporates a few essential principles. These principles are: 1) practice safety, 2) be concerned about the safety of others, 3) understand the hazards associated with your particular experiment, 4) know what to do in an emergency, and 5) report hazards or hazardous conditions.

1) Practice Safety

In order to have an effective safety program, some common ground rules must be established. This is the main purpose of this Safety Manual. Some of the more basic safety practices that you are expected to follow are:

- a) Do not perform unauthorized experiments.
- b) Upon entering the laboratory, note the location of the closest fire extinguisher, and the first aid kit.
- c) Do not work alone in a laboratory; it is unsafe and not recommended.
- d) Eating, drinking, and smoking are prohibited in all laboratories.
- e) Wear appropriate eye protection whenever working with any potential eye hazards.
- f) Use a hood for hazardous, volatile, and noxious chemicals. When conducting a procedure that may result in a violent reaction, use an American National Standard Institute (ANSI)

approved face shield that is large enough to protect the neck area. GOGGLES ARE ALSO REQUIRED.

- g) Label an experiment to show its associated dangers and the persons to contact in case of a problem. There should also be up-to-date information posted visibly outside each room listing the responsible persons to call in the event of problems in the room.
- h) You are further expected to secure all gas cylinders, **to label all containers**, to observe posted signs, and so on.
- i) It is the individual's and their advisor's responsibility to provide safety equipment in the laboratories.
- j) ***Keep your work area clean and properly dispose of used materials when you have completed your assignment or work.***
- k) Visitors must be accompanied by a university staff member or graduate student at all times. No children or pets are allowed in the laboratories.
- l) Each situation requires its own safety practices, which you are expected to know or find out before doing an experiment.

2) Be Concerned About the Safety of Others

Your concern for safety must include the people around you. Your experiment must be safely maintained so that everyone in the area is amply protected and warned of inherent dangers. In addition, this principle of looking out for the other persons should include the practice of pointing out unsafe procedures to those people committing the unsafe act. This practice could involve something as simple as reminding a friend to wear safety glasses. Another aspect of this second principle involves alerting those around you of an accident. It is your responsibility to alert personnel in the immediate vicinity of a fire or an emergency.

3) Understand the Hazards Associated with Your Particular Experiment

Prevention is the key to safety. Prior to designing any experiment, using a new piece of equipment, or handling chemicals in the laboratory, it is wise to consider the potential hazards and safety precautions involved in the work. Hazards may include toxic substances, electrical circuits, mechanical equipment, and waste chemicals. Safety precautions should include correct materials storage, proper ventilation, proper grounding of equipment, and training sessions when necessary. Whenever possible, information about the unique hazards and precautions necessary for any type of work should be prepared and made available to everyone working in the lab. **Material Safety Data Sheets (MSDS)** and equipment manuals are

important sources of information. Prior to starting any experiments, a MSDS which includes toxicological information and special handling requirements should be obtained and read for each chemical to be used. Environmental Health & Safety Office personnel are available to review the project safety requirements and potential hazards with you. An example of a MSDS for silica is included in Appendix A.

4) Know what to Do in an Emergency

You must be prepared to respond quickly and precisely to an emergency. You must familiarize yourself with the laboratory you are working in, its exits, and its associated safety equipment: eyewash stations, showers, sinks, fire extinguishers, and spill kits. Just a few moments spent learning the locations and use of these pieces of equipment prior to an emergency could save a life. Further safety equipment which you feel is necessary in your laboratory (masks, spill kits etc.), can be obtained by your advisor or the Department Safety Officer after consultation of the specific need addressed.

If the emergency is of an infiltrating nature, such as a fire, gas leak, release of toxic fumes, or radiation leak, the following procedures should be followed:

- ◆ **Alert personnel in the immediate vicinity**
- ◆ **Confine the fire or emergency, if possible**
- ◆ **Summon aid (Dial 911)**
- ◆ **Evacuate the building**
- ◆ **Report pertinent information to responding emergency personnel**

It is worth commenting on each of these procedures.

Alert personnel in the immediate vicinity - When alerting personnel in the vicinity of a fire or emergency, assign several of them the responsibility of assisting in the remaining procedures. Especially assign someone the task of summoning aid!

Confine the fire or emergency, if possible - Confining fires or other emergencies means taking measures to prevent them from spreading. In case of fire, close doors and windows securely. If the fire is not threatening you, use an appropriate fire extinguisher. Do not waste valuable time trying to confine an emergency when it is beyond your control. This is often a difficult assessment and can only be judged by you. Careful reading of this Safety Manual should better prepare you to make such critical assessments. Follow evacuation procedures.

Evacuate the building - Evacuating the building means sounding the fire alarm system and going to the nearest exit without delay. The elevator should never be used during a fire!

Summon aid (Dial 911) - The Fire Department, the Police Department, and Medical Services can be contacted by dialing 911. When summoning aid, phone from a safe location. You should be prepared to state precisely the location and nature of the emergency. Do not hang up until you have given all the pertinent information and you are instructed to do so by the dispatcher.

Report pertinent information to responding emergency personnel - Meet, or designate someone to meet, responding emergency personnel at a specific location and report pertinent information such as: personnel trapped, specific location of incident, hazardous materials or equipment involved.

If the emergency does not necessitate a confinement or evacuation procedure, such as an individual being injured, you must still be prepared to alert nearby personnel and summon aid. You may also have to administer some emergency treatment yourself. This emergency treatment could involve the use of safety equipment mentioned previously and training such as CPR is highly recommended. Further information regarding local medical and safety training can be obtained from the EHS office (phone: 4305).

5) Report Hazards or Hazardous Conditions

You must report any incidents without delay. A statement of the problem must be made to Environmental Health & Safety by dialing 4305 from any campus phone. The department safety officer and your supervisor/advisor should also be notified.

The remainder of this Safety Manual presents examples of hazards that you are likely to encounter in the laboratory and what you should know about them to minimize their danger to you and to others.

III. EMERGENCIES AND FIRST AID

In a medical emergency, summon professional medical attention immediately by dialing 911 from any university phone. Be prepared to describe accurately the nature of the accident. Provide first aid within the scope of your training while waiting for professional help to arrive. It is important you do not attempt any medical treatments you are unfamiliar with. Report all injuries to your supervisor/advisor.

Use of Emergency Equipment - Everyone working in a lab must know how to use emergency equipment such as fire extinguishers, spill kits, safety showers, and eye wash apparatus. Know where these items are located in your laboratories. Special training on the proper use of all types of emergency equipment is available by the EHS office at the beginning of each fall and spring semester.

First Aid

There are certain serious injuries in which time is so important that treatment must be started immediately.

A. Stoppage of Breathing

For stoppage of breathing (e.g. from electrical shock or asphyxiation), the mouth-to-mouth method of resuscitation is far superior to any other known. If victim is found unconscious on the floor and not breathing, rescue breathing must be started at once, seconds count. Do not waste time looking around for help, yell for help while resuscitating victim.

B. Severe Bleeding

Severe bleeding can almost always be controlled by firm and direct pressure on the wound with a pad or cloth. The cleaner the cloth, the more desirable; however, in an emergency, use part of the clothing. Protect yourself from direct contact with the victim's blood by wearing clean and impermeable gloves. In addition:

1. Wrap the injured to avoid shock and call immediately for medical attention.
2. Raise the bleeding part higher than the rest of the body and continue to apply direct pressure.
3. Keep victim lying down.
4. Never use a tourniquet.

Cleanup of blood spills. To prevent the spread of the HIV virus a solution of bleach and water should be used to clean up blood spills. Use between 10 and 20% bleach by volume to prepare a cleaning solution. Wear protective clothing.

C. Thermal Burns

1. IF THE SKIN IS NOT BROKEN, submerge the burn area in cold water (do not use ice), for 10 to 20 minutes. IF THE SKIN IS BROKEN do not submerge in water. Loosely place a sterile bandage over the burn. DO NOT apply ointments or other substances to the burn.
2. IN CASE OF A CLOTHING FIRE:

- a. The victim should drop to the floor and roll, not run to a safety shower. A fire blanket, if nearby, should be used to smother the flames.
- b. After flames are extinguished, deluge the injured under a safety shower, removing any clothing contaminated with chemicals.
- c. Keep the water running on the burn for several minutes to remove heat and wash the area.
- d. Place clean, soaking wet, ice-packed cloths on burned areas, and wrap to avoid shock and exposure.
- e. Never use a fire extinguisher on a person with burning clothing.

D. Chemical Burns

1. For chemical burns or splashes, immediately flush with water for at least 10 minutes.
2. Apply a stream of water while removing any clothing that may have been saturated with the chemical.
3. If the splash is in the eye, flush it gently for at least fifteen minutes with clear water. Wash in a direction away from the other eye. Have aid summoned immediately!
4. If the splash is on the body, flood it with plenty of running water for at least 15 minutes. If the exposure is over a small area, have someone drive you to the Emergency Room at the hospital for proper medical attention following the first aid treatment. For large scale exposure have someone call 911 for an ambulance.
5. A safety shower, hose, or faucet should be used in an emergency.
6. For chemicals spilled over a large area, quickly remove contaminated clothing while using the safety shower; treat as directed under the section thermal burns. Seconds count, therefore, no time should be wasted simply for modesty.
7. If safety goggles are worn during a chemical exposure to the face, leave them on until the surrounding area is thoroughly rinsed, they may be the only thing keeping the chemical out of your eyes.

E. Traumatic Shock

In cases of traumatic shock, or where the nature of the injury is not clear, keep the victim warm, lying down and quiet. Wait until medical assistance arrives before moving the victim. One should treat all injuries as potential shock situations, as they may turn into one. Some common symptoms of shock are cold and clammy skin, paleness, delirium, frequent nausea or vomiting and shallow breathing.

F. Head or Back Injuries

DO NOT MOVE someone unless their life is threatened. If you must move someone take special care as all damage to the spinal cord is permanent. The result of nerve damage is paralysis or death. **SEEK IMMEDIATE MEDICAL ATTENTION.**

IV. SAFETY RULES

General Laboratory Practice

Personal Precautions:

1. Working alone is not good laboratory practice. An individual is advised to work only under conditions in which appropriate emergency aid is available when needed. In other words, try and work when others are around to provide help if it is needed. If others are working nearby, let them know where you will be working so that they can occasionally check on you and you can check on them.
2. Eye Protection. In all laboratories where chemicals are used there is the hazard of splashes or dust particles entering the eyes. Pressurized or vacuum vessels may explode or implode sending shrapnel through the lab. While working with electrical wiring there are hazards from molten solder and debris. When testing samples on Instrons or other equipment, pieces can chip and enter the eye. All of these activities, and many others, require the use of either safety glasses, chemical goggles or face shields. Most lab operations simply require the use of safety glasses, however, when any chemicals are being used at least chemical goggles should be used or in some cases a face shield is required. The appropriate eye protection is generally specified on the MSDS. Do not wear contact lenses in the laboratory. Fumes, gases, and vapors can easily be absorbed by the lens or trapped between the lens and eyes resulting in chemical burns or abrasive injury.
3. Ear Protection. The healthy ear can detect sounds ranging from 15 to 20,000 hertz. Temporary exposure to high noise levels will produce a temporary hearing loss. Long term exposure to high noise levels produces permanent hearing loss. There appears to be no hearing hazard (although possible psychological effects) to noise exposure below 80 dB. Exposure above 130 dB is hazardous and should be avoided. Earmuffs offer the highest noise attenuation, and are preferred for levels above 95 dB. Ear plugs are more comfortable and are preferred in the 80-95 dB range.

4. Respiratory Protection. Use only respirators provided and/or recommended by EHS. There are many shapes and sizes of respirators and in order to be effective it must be properly fitted. There are also a variety of cartridges available each having a specific application. The cloth respirators available in the laboratories provide only minimal dust protection and no chemical protection. They should never be used with any toxic material. Respirators should only be used following proper fitting and instruction by EHS personnel.
5. Clothing. In situations where splashing or spills may occur it is wise to protect your body with lab coats, goggles and face shields. Splash aprons and gloves may be needed for chemicals that are corrosive or easily absorb through the skin. In general, shorts, skirts, brief tops, and sandals are not safe. Further clarification of clothing requirements should be directed to the person(s) in charge of the laboratory in which you are working. Do not work in a laboratory wearing loose hair, loose clothing or dangling jewelry.
6. Hand Protection. For any laboratory procedure requiring the use of gloves, make sure you are using gloves made of a material suitable for the operation. Gloves are made of a variety of materials and have specific uses, if used improperly they may not provide the necessary protection. The MSDS should specify the glove type that you should use.
7. Consumption of food and beverages in the labs is not permitted.
8. Wash hands and arms prior to leaving the laboratory.

Laboratory Practice

When working with chemicals you must obtain and read the appropriate MSDS.

A. Hazardous Chemicals

1. All containers must be labeled (including such harmless items as distilled water). The label should contain the proper name of the chemical and, if appropriate, a Hazardous Material Identification Guide (HMIG) sticker with the MSDS information, date of purchase or synthesis, and the name of the user. (SEE APPENDIX C FOR LABEL SAMPLES)
2. Do not use chemicals from unlabeled containers. The need for adequate labeling extends far beyond the immediate requirements of the individual users, since they may not be present in case of fire or explosion, or when containers are broken or spilled. Also, they may no longer be associated with the laboratory years later when containers have deteriorated or otherwise lost their value. Prior to graduation each person must properly dispose of his/her waste or unwanted chemicals. All useful chemicals should be reassigned to another person who will assume responsibility. Proper labeling is extremely important as it is difficult and expensive to dispose of unlabeled chemicals.
3. Do not pipet by mouth. Never taste or smell any chemical.

4. Clean spills immediately! Small spills may be safely handled by lab personnel familiar with handling precautions for that material. If in doubt of your ability to handle the situation, evacuate the lab, close the door, and call 911 and explain the nature of the emergency.
5. Items that might cause thermal burns, such as furnaces or hot plates, must be posted with a "HOT" sign or other warning when in use but not attended.
6. Avoid direct contact with any chemical. What might be considered safe today may eventually be found to be harmful.

B. Chemical Spills

In the case of a chemical spill the following procedures should be followed:

1. Alert personnel in the immediate vicinity.
2. Put on personal protective equipment: gloves, goggles, and special clothing.
3. Quickly contain the spill using an appropriate chemical spill kit.
4. Ventilate spill area as much as possible.
5. Clean spills immediately! Small spills may be safely handled by lab personnel familiar with handling precautions for that material. If in doubt of your ability to handle the situation, evacuate the lab, close the door, and call for assistance. Use the following cleanup guidelines for specific types of chemicals:

Acids

Neutralize acid with spill cleanup kit or commercial absorbent materials (dry sand can be used, but is less effective). Pour neutralizer around the perimeter of the spill and proceed toward the center. After absorption has occurred, place mixture in a container and properly dispose of the waste.

Caustics

Absorb liquid and reduce vaporization using a caustic spill cleanup kit or commercial absorbent. Pour neutralizer around the perimeter of the spill and proceed toward the center. After absorption has occurred, place mixture in a container and properly dispose of the waste.

Flammable Liquids

Eliminate all sources of ignition immediately. Turn off flames and spark-producing equipment. Absorb liquid and reduce vaporization using a flammable spill cleanup kit. SAND SHOULD NOT BE USED. Pour absorbent around the perimeter of the spill and proceed toward the center. After absorption has occurred, place mixture in a container and properly dispose of the waste.

Mercury

If spill occurs and the mercury is exposed to elevated temperatures, e.g., spill onto a hot plate, leave the area immediately and deny entry into the lab. Summon the appropriate personnel in charge of hazardous materials. For small spills or well contained spills, gather mercury and put in a closed

container (wear gloves). Sulfur is not recommended for spill cleanup. Never use a regular vacuum, the mercury will contaminate the vacuum and release large quantities of Hg vapor whenever it is used.

C. Transporting Chemicals

When chemicals are carried by hand, they should be placed in a carrying container or acid-carrying bucket to protect against breakage and spillage. When they are transported on a wheeled cart, the cart should be stable under the load and have wheels large enough to negotiate uneven surfaces without tipping or stopping suddenly. Provisions for the safe transport of small quantities of flammable liquids include: a) use of rugged pressure-resistant, non-venting containers, b) storage during transport in a well-ventilated vehicle, and c) elimination of potential ignition sources. Chemicals should not be carried in open containers in hallways or elevators where they may be spilled.

D. Chemical Storage

Every chemical should have an assigned storage space, and **they must stay there** (chemicals cannot be moved to another room because of the Missouri S&T Chemical Track Inventory System---please check with the department safety officer before moving chemicals). They should not be stored on counter tops where they can be knocked over or in hoods where they interfere with proper air flow. Flammable liquids should be stored in ventilated storage cabinets. Flammable liquids should not be stored near ignition sources or in areas where accidental contact with strong oxidizing agents is possible. Oxidizing agents include: chromic acid, permanganates, chlorates, perchlorates, and peroxides. All chemicals must be properly labeled giving the chemical name, name of owner, date of purchase, type of hazard and any emergency procedures. **Every stored chemical container must have a barcode.** Procedures for chemical maintenance can be found at <http://ehs.mst.edu/labsafety/chemicalsafety/index.html>. The department safety officer can provide assistance with chemical inventory.

Any oxide containing the O₂ group and two atoms of oxygen linked by a single bond can be extremely volatile. Furthermore, do not store liquid or specific solutions of a peroxide at temperatures where there is freezing or precipitation. These forms are extremely sensitive to shock and heat. Use of polyethylene bottles is acceptable. Many ethers or similar compounds tend to react with oxygen in the air, forming unstable peroxides that can explode.

E. Glassware

1. Use only Pyrex or other shatterproof glassware.
2. Never use cracked or chipped glassware.

3. Insert tubing properly into stoppers (i.e., use lubricants such as a few drops of glycerin and always wear gloves).
4. Each laboratory with glassware should have its own container for broken glass only. Broken glass that is contaminated with harmful materials must be disposed of separately: consult the department safety officer or the EHS office for the proper procedure. Broken glass thermometers containing mercury should be treated in the same way as a mercury spill. These should never be thrown in the broken glass container or trash receptacle.

F. Equipment

1. Before using an instrument or machine, be sure you have been instructed and authorized by the person responsible for the equipment. Become familiar with potential hazards associated with the equipment, and emergency shutdown procedures, as well as the operating procedures.
2. Check all electrical connections and mounting bolts before each use.
3. Check that all rotating parts are free to turn, and that there are no mechanical obstructions before starting. Disconnect the electrical power before removing any obstruction.
4. Attach an "Emergency Shutdown Card" to any piece of equipment left operating unattended outside normal working hours. This card should contain your phone number and all information that would be required by anyone who might be faced with the need to shut down the equipment.
5. DO NOT TOUCH MOVING COMPONENTS while the machine is in operation.

a. Gas Cylinders

1. Always secure gas cylinders with a strap or chain to a stable object (preferably a wall or a heavy lab bench), whether or not they are in use. Always leave the cap on when the tank is not being used.
2. Transport gas cylinders, with cap on, and use a proper cart.
3. Do not use an open flame near gas cylinders.
4. Never use grease or other lubricants on gauges or connections (This may form explosive mixtures with oxidizing gases).
5. Before using gas in an experiment, be sure there are no leaks in the system.
6. Learn directions for closing and opening valves. (All main valves close clockwise). Before connecting a non-toxic gas cylinder to a system, remove the valve cap and open the valve for an

instant to clear the opening of particles or dirt. To turn on a system, open the main cylinder valve completely and open remaining valves successively further from the main cylinder. To shut down a system close the main cylinder first and close remaining valves in the order in which they were opened to avoid storing high pressure in the system.

7. Do not use adaptors to connect regulators. Use only regulators specified for the particular gas. Have all regulators inspected and serviced regularly. Regulators open by turning the handle clockwise; this increases the pressure in the system.
8. Only use regulators, pipes, and fittings specified for the type of gas you will be using. Hydrogen embrittlement may lead to leaks or ruptures. Acetylene can form explosive compounds when in contact with copper or brass.
9. Do not locate gas cylinders near heat sources, like furnaces, where they may heat up and explode.
10. Familiarize yourself with the toxic properties and safety hazards of each gas you work with. Post any safety information that may pertain to others working in the lab.
11. Store oxygen cylinders and combustible gases separately.

b. Vacuum Systems

Mechanical vacuum pumps used in laboratories poses common hazards. These are the mechanical hazards associated with any moving parts and the chemical hazards of contaminating the pump oil with volatile substances and subsequently releasing them into the lab. A few guidelines will help in the safe use of these devices. If a vacuum pump is required for lower pressures, the pump must be fitted with a cold trap to condense the volatiles. The output of the pumps should be vented to a hood or alternate exhaust system. The pump oil should also be replaced when it becomes contaminated.

1. Be certain that your vacuum system has a trap.
2. Use only containers that can withstand evacuation. When possible, tape containers to be evacuated and use a standing shield to guard against implosion.
3. Always close the valve between the vacuum vessel and the pump before shutting off the pump to avoid sucking vacuum oil into the system.
4. All moving belts on mechanical pumps must have a safety cover.

c. Drying Ovens

Electric ovens are often used in laboratories for removing solvents or water from samples and to dry laboratory glassware. These ovens if not properly vented or used in a hood, discharge the volatile substances into the laboratory atmosphere which can accumulate in toxic concentrations. Small amounts of vapor can accumulate inside the oven and mix with the air to form explosive mixtures.

Ovens should not be used to dry any chemical known to possess toxic vapors or that might volatilize and pose an explosion hazard or acute chemical hazard unless special precautions have been taken to ensure continuous venting to a hood. Organic compounds should not be dried in ovens whose heating elements or temperature controls (which may produce sparks) are exposed to the interior atmospheres. It is recommended to have blow out panels in the rear of a drying oven so that an explosion will not blow the door and contents into the lab. Bimetallic strip or alcohol thermometers rather than mercury thermometers should be used in ovens.

J. Welding and Joining

General requirements for protection of personnel involved in the welding are covered by American National Standards Institute (ANSI) standard publications Z49.1, "Safety in Welding and Cutting".

1. The eyes, face, and neck should be protected at all times through the use of helmets, face shields, goggles, or shields. Recommended lens shades for arc-welding are:

Shade No.	Welding Current, Amperes
6	Up to 30
8	30 to 75
10	75 to 200

2. Wear protective clothing that is flame retardant and protects against ultraviolet or infrared radiation. High grade denim clothing will provide sufficient protection against ultraviolet or infrared radiation and occasional spatter or sparks. Loose pocket flaps and open shirt collars are potential hazards.
3. Vapors of some cleaning solvents will break down into toxic vapors when in the presence of a welding arc. In the case of dizziness or nausea remove the person to fresh air and call for emergency help.

V. CHEMICAL HAZARDS AND SAFETY PROCEDURES

The first step in using any chemical is to be familiar with the proper emergency procedures recommended for the chemical in case of accidental exposure. This can be accomplished by reviewing the material safety data sheet (MSDS) that is supplied by the manufacturer. Pay specific attention to the potential hazards and safety equipment required for working with the material.

A. Unattended Chemical Reactions

Take great care in setting up chemical reactions that are to be left unattended for any period of time. Note that unattended operation should be avoided if at all possible. The possible hazards that might arise from failure of a heating mantle (overheating), failure of a water-cooling system (hose becoming disconnected or bursting), and failure of an exhaust (if flammable solvents or toxic gases are involved), are obvious points to check before leaving a reaction unattended. Any reaction that is left unattended should be clearly labeled as to the nature of the reaction and its components, the possible hazards (i.e., poisonous vapors), and the name and phone number of the experimenter. A notice describing the nature of the unattended experiment, emergency procedures, and who to contact in case of emergencies should be posted on the outside of the door to the laboratory in which the experiment is being conducted. **Unlabeled experiments will be terminated immediately and the user's lab privileges may be suspended.**

Before beginning a chemical reaction, the experimenter should have an idea of how it will proceed. Thus, ice baths can be ready if it is exothermic, a vent is available if gases are generated, and automatic shutdown is incorporated in the event of loss of electrical power, cooling water, etc. The experimenter should also notify his/her advisor that the experiment will be running unattended.

B. Toxic Hazards

Researchers should be aware of the toxic hazards of the materials they are using, and those being used by others in their vicinity. Toxic materials may enter the body through the skin, inhalation, and/or ingestion. Care should be taken to prevent these means of entrance when handling toxic materials. A large number of common substances are acute respiratory hazards and should not be used in a confined area in large amounts. They should be used only in a hood. Some of these include; ammonium hydroxide, carbon monoxide, chlorine, fluorine, hydrochloric acid, hydrogen sulfide, and sulfur dioxide. These may form as by-products of certain reactions. Control of these by-products should be part of the experimental procedure.

C. Acids and Bases

Acids and bases are found in most laboratories since there are a variety of applications for them. Three important hazards are associated with acids and bases: chemical burns suffered from spills,

inhalation of caustic vapors, and fires or explosions caused by strongly exothermic reactions occurring when strong acids are rapidly diluted. Strong bases may often cause more severe burns than acids as they don't often provide a warning, such as a burning sensation until damage to the skin has already occurred.

1. Always dilute acids by adding them to water and not vice versa.
2. Use diluted acids and bases whenever possible.
3. Keep bottles of strong acids and bases closed when not in use since they can react with moisture in the air to form caustic fumes.
4. If acids or bases are accidentally splashed in the eye or on the skin, flush with water immediately, continue flushing for 15 minutes, and call for help.
5. Never store acids and bases together. Use secondary containment when storing liquid chemicals.

Hydrofluoric Acid: Hydrogen fluoride (HF) is a very serious hazard since both its gas and solutions are extremely toxic and it is rapidly absorbed through the skin without immediate warning (such as a burning sensation), but causes excruciating pain and burns which take a long time to heal. Prompt removal of contaminated clothing while the injured person is being flushed with water is essential. Continuous flushing with cool water is vital until any whitening of the tissue has disappeared. Cover the exposed area with wet, iced cloths and get immediate medical help. Do not apply any ointments. In all cases of contact with HF obtain medical aid. Simple flushing with water does not remove HF deep in the tissues and additional treatment is required.

D. Organic Solvents

Many organic solvents possess harmful vapors or pose health hazards because they can be easily absorbed through the skin. Most solvents are quite volatile and the vapors are flammable. Always refer to the MSDS of a solvent before using it to become aware of the hazards, safety precautions, and emergency procedures associated with that specific solvent. Always store them according to the guidelines for storage of flammable liquids. A few examples of the hazards of some common solvents are provided below, but this list is by no means complete. A more comprehensive list is obtained in the Missouri S&T Hazardous Waste Management Handbook, which is available from EHS at 4305 or <http://ehs.mst.edu>.

Acetone Possesses toxic and flammable vapors. Use proper ventilation, safety glasses, and gloves. Store in a flammable liquids storage area.

- Methanol** Possesses harmful vapors that can cause dizziness, central nervous system depression, and shortness of breath. Severe exposure can lead to coma and eventually death. Less severe exposure can cause blurring of vision, conjunctivitis, headaches, gastrointestinal disturbances, and definite eye lesions. Methanol should be used in a ventilation hood and neoprene gloves should be worn.
- Benzene** Carcinogenic. Chronic poisoning can occur by inhalation of relatively small amounts over a long time; can also be absorbed through the skin. Vapors are flammable and it should be stored in a flammable liquids storage area.
- Ethers** Ethyl ether, isopropyl ether, dioxane, tetrahydrofuran and many other ethers tend to absorb and react with oxygen from the air to form unstable peroxides which may detonate with extreme violence when they become concentrated by evaporation or distillation, when combined with other compounds that give a mixture that can be detonated, or when disturbed by unusual heat, shock or friction (sometimes as little as unscrewing the bottle cap). This class of compounds should be avoided if there is a safer alternative. It is generally recommended that ethers which will form peroxides should be stored in full, airtight, amber glass bottles, preferably in the dark, or in metal containers. Although ethyl ether is frequently stored under refrigeration (explosion proof), there is no evidence that refrigerated storage will prevent formation of peroxides. Furthermore, leaks can result in explosive mixtures even in refrigerators, since the flash point of ethyl ether is -45°C (-49°F).

E. High Energy Oxidizers

Very small amount of strong oxidizers (0.25g) can result in severe explosions and must be handled with the proper protective equipment, such as: protective clothing, leather gloves and face shields. Larger amounts require special procedures involving explosion barriers. Specific procedures should be included in the MSDS for the chemical.

F. Powders

Most ceramic materials are considered inert with the human body, however, submicron particles in the lungs may cause respiratory irritation. Whenever working with fine powders correct respiratory protection is recommended. Cloth dust masks are not appropriate for work with extremely fine powders. Some powders, such as SiO_2 , cause lung diseases (silicosis). BeO and PbO are considered extremely toxic and must be handled with great care. If possible, use powders in a hood so as to not contaminate the

laboratory. The specific requirements for each powder are generally listed on the MSDS. Some fine powders are pyrophoric and may explode when dispersed in air.

G. Whiskers and Fibers

Since the cancer-causing nature of asbestos was discovered, other mineral and ceramic fibers are under suspicion for their health hazards. It is not well known whether this health risk involves a chemical or physical reaction in the body. Fibers and whiskers must be handled with care so that they may not be inhaled or brought into contact with the skin.

H. Metals

Caution should be exercised when handling heavy metals such as Pb and In since these metals can be absorbed through skin contact. Absorption is increased when contacted in combination with a mineral oil. In the case of indium severe kidney ailments can result. Always handle these materials using protective gloves. Wash you hands thoroughly after handling these materials.

Some people will have allergic reactions to certain metals. Two common metals that produce allergic reactions are Ni and Co. Dermatitis and rashes are common allergic reactions and are most frequently encountered during metallographic polishing.

VI. CHEMICAL WASTE DISPOSAL

Each individual has the responsibility for seeing that laboratory waste chemicals are safely collected, identified, stored for disposal, and that anyone involved is fully advised of the need for any special methods or facilities for proper disposal. The following is Missouri S&T's official hazardous waste disposal policy.

The University has a disposal program for hazardous waste. The Environmental Health & Safety Office coordinates the program. **Contact the Department Safety Officer to request chemical waste disposal.**

University policy prohibits indiscriminate disposal of chemical waste down the drain to the sanitary sewer systems. Material flushed to the sewer can be dangerous to maintenance personnel and the public. Chemical vapors and odors can recirculate back into buildings. People who perform maintenance can contact the material. Explosive atmospheres may form in the sewer system with certain solvents. If

the water treatment plant cannot remove the chemical from the waste stream, then it will enter the environment.

Each administrative unit has different procedures for coordinating shipment of waste. When picked up or received by EHS each container is checked against the pick-up sheet. The container is assigned an identification number for tracking. Each container must be properly labeled and listed in the pick-up. For commercial products disposed of as hazardous waste, the ingredients and concentrations are usually listed on the Material Safety Data Sheet.

When collecting compatible solvents into the same container, do not mix halogenated and non-halogenated solvents. The container must have all the ingredients and concentrations listed on the outside (a sample of the form is shown in Appendix B. Please Note: Used oil is not treated as chemical waste unless it has been contaminated. For questions concerning chemical waste and its disposal contact the Department Safety Officer or call the EHS office at 4305 or visit their website at <http://ehs.mst.edu/index.html>.

VII. RADIATION HAZARDS

A number of acute and long term effects on humans have been related to exposure from various types of ionizing radiation. Radiation hazards arise when using radio-isotopes, lasers, x-ray generators and plasma torches. Each is hazardous in a unique way. A thorough knowledge of the device or the isotope which is to be used is mandatory. The precautions vary widely. Information pertaining to the particular hazard should be obtained from the faculty or research staff member or technician in charge of the equipment prior to use. However, several precautionary procedures should always be followed:

A. Radioactive Materials

1. The MAE Department does not have any radioactive materials at this time.

B. X-ray Equipment

1. The MAE Department does not have any radioactive materials at this time.

C. Lasers

There are many types and intensities of lasers and therefore only general guidelines are given. A more complete discussion can be found in American National Standards Institute (ANSI) standard publication, ANSI Z136.1, "Safe Use of Lasers".

1. Never look directly at the beam or pump source.

2. Never view the beam pattern directly; use an image converter or other safe, indirect means. To decrease reflection hazard, do not aim by looking along the beam.
3. Do not allow any object which could cause specular reflections in or along the beam such as spherical buttons, screw heads, and jewelry.
4. Keep a high general illumination level where lasers are in operation to cause contraction of pupils and reduced hazard.
5. Always wear goggles that offer protection against specific wavelength of the laser in use.
6. Post warning signs outside and inside the laboratory to warn of potential hazards. Clearly mark any areas where laser beams are in use.

D. Ultraviolet Lamps

1. All radiation of wavelengths shorter than 3500 Å should be considered dangerous.
2. Protective safety glasses with UV absorbing lenses should be worn when the eyes may be accidentally exposed.
3. Skin exposed to UV radiation can receive painful burns, analogous to sunburns, and should be protected.

VIII. ELECTRICAL HAZARDS AND SAFETY PROCEDURES

While electricity is in constant use by the researcher, both within and outside the laboratory, significant physical harm or death may result from its misuse. With direct current, a man can detect a "tingling" feeling at 1 mA and the median "let-go" threshold (the current at which he cannot release the conductor) is 76 mA. For 60 Hertz alternating current, the values are 0.4 mA and 16 mA, respectively. Women are more sensitive to the effects of electrical current; approximately 2/3 of the current is needed to produce the same effect. Higher currents produce respiratory inhibition, then ventricular fibrillation, and ultimately cardiac arrest.

If an electrical hazard is suspected, the device in question should be disconnected immediately and the cause ascertained by a person competent in such matters. Work on electrical devices should be done only after the power has been shut off in such a manner that it cannot be turned on accidentally. Since malfunctioning equipment may contain shorts, merely turning off the equipment is not sufficient to prevent accidents. Equipment should be unplugged before being inspected or the circuit the equipment is wired to should be deactivated by putting the circuit breaker in the "off" position or removing the fuse. Equipment wired to a safety switch should be turned off at the safety switch. Internal current-carrying devices such as capacitors must be discharged.

The following are a list of rules for working with electrical equipment:

1. Electrical work and inspections should be done by trained personnel.
2. Use only tools and equipment with non-conducting handles when working with electrical devices.
3. All current transmitting parts of any electrical devices must be enclosed.
4. When checking an operating circuit, keep one hand either in a pocket or behind your back to avoid making a closed circuit through the body.
5. Maintain a work space clear of extraneous material such as books, papers, and clothes.
6. Never change wiring with circuit plugged into power source.
7. Never plug leads into power source unless they are connected to an established circuit.
8. Avoid contacting circuits with wet hands or wet materials.
9. Wet cells should be placed on a piece of non-conducting material.
10. Check circuits for proper grounding with respect to the power source.
11. Do not insert another fuse of larger capacity if an instrument keeps blowing fuses - this is a symptom requiring expert repairs. If a fuse blows, find the cause of the problem before putting in another one.
12. Keep the use of extension cords to a minimum and cords as short as possible. Tie off excess cord out of pathways to avoid trip hazards.
13. Do not use or store highly flammable solvents near electrical equipment.
14. Multi-strip outlets (cube taps) should not be used in place of permanently installed receptacles.
15. Keep access to electrical panels and disconnect switches clear and unobstructed. A minimum of 3 ft. width, floor to ceiling is required by NEC in front of electrical panels and disconnect switches.

A. Static Electricity and Spark Hazards

Sparks may result in explosions in areas where flammable liquids are being used and therefore proper grounding of equipment and containers is necessary. Some common potential sources of sparks are:

1. The making and braking of an electrical circuit when the circuit is energized.
2. Metal tanks and containers.
3. Plastic lab aprons.
4. Metal clamps, nipples, or wire used with non-conducting hoses.
5. High pressure gas cylinders upon discharge.

IX. CRYOGENIC SAFETY

An excellent reference which is strongly recommended for anyone working with cryogenic materials is: Safety with Cryogenic Fluids, Michael G. Zabetakis, Plenum Press, New York, NY, 1967.

The following is a partial list of safety rules.

1. When using a liquid nitrogen cold trap, charge the trap only after the system is pumped down. Since the boiling point of liquid nitrogen is -196°C and the boiling point of liquid oxygen is -183°C , liquid oxygen as well as volatile organic substances could condense in the cold traps. These mixtures may explode. When shutting down a system, charge the lines with nitrogen gas to prevent oxygen from entering the system.
2. Do not mix any organic material with liquid nitrogen for the reasons explained above. Wood and asphalt saturated with liquid oxygen have been known to explode when subjected to mechanical shock.
3. Handle any liquefied gas carefully: at extremely low temperatures it can produce an effect on the skin similar to a burn caused by a hot object. Eyes should be protected with a face shield or safety glasses. Gloves should be worn.
4. Stand clear of the boiling and splashing liquid and its issuing gas. Should any liquefied gas contact the skin or eyes, immediately flood that area of the body with large quantities of unheated water and then apply cold compresses.
5. Large quantities of liquid nitrogen can condense oxygen and thus remove it from the air. Use liquid nitrogen only in a well ventilated area so that the ambient oxygen concentration does not drop lower than 16% (the same applies to liquid helium).
6. High pressure gas hazards are always present when cryogenic fluids are used as they are usually stored at their boiling point. Never obstruct the vent valve on cryogenic containers.

X. FIRE SAFETY RULES

A. Precautionary Procedures

1. Know the location of fire exits, fire alarms, fire blankets and extinguishers. Each laboratory should be equipped with extinguishers. Fire extinguishers are primarily for use on fires in their incipient stages. Make it your business to learn about the proper use of fire extinguishers. See section XI: Guide to Classes of Fires and Extinguishers.
2. Keep all fire doors closed at all times.
3. Do not block access to fire escape routes.

4. Neatness prevents many fires. Fire spreads much faster when it has cluttered waste materials to feed on. Oily rags, waste or papers improperly stored are common causes of spontaneous combustion. Store these materials in covered metal containers. Overloaded electrical circuits are potential fire hazards. Flammable vapors can ignite far away from their source and thus should be vented properly.

B. Emergency Procedures

1. If a fire starts, activate the nearest fire alarm box then call for assistance from a safe location by dialing 911. If the fire is not too large, confine and try to extinguish it with the proper type of extinguishers in the lab. Never jeopardize your personal safety in trying to extinguish a fire.
2. If there is no injury, and the fire is contained in a vessel, it can usually be suffocated by covering the vessel with a non-flammable object. Do not use towels or clothes. Remove nearby flammable materials to avoid possible spread of fire. If the fire is over an area too large to be suffocated quickly and simply, abandon the fire and call for help.
3. If evacuation is necessary and if time allows, shut off power to any equipment. Shut off gas or other open flames. Turn off hot plates and main gas valves.
4. If your clothes ignite, "stop, drop and roll," to smother the flames. Do not run! Running only intensifies the flames. Call for help. When fire blankets are readily available, use them to wrap around yourself to aid in putting out the fire.
5. Exit from the building via staircases; do not take elevators. Remove any objects that may be obstacles in passageways or to fire doors. Do not return to the building unless permitted to do so by the Fire Department.

Electrical Fires

1. Turn off power source at the breakers or the junction box and unplug.
2. Use CO₂, or dry chemical extinguisher to put out fire. Never use water.
3. When fire is extinguished check circuit to determine cause.
4. Do not turn on circuit until the cause of fire has been established and the fault corrected.
5. Report fire to Safety Office.

XI. GUIDE TO CLASSES OF FIRES AND METHODS OF EXTINGUISHMENT

<i>Class A Fire</i>

Material: Wood, paper, textiles and other ordinary combustible materials.

To extinguish: Pressurized water
Multi-purpose dry chemical
Halon

Class B Fire

Material: Flammable liquids: oils, solvents, grease, paint, etc.

To extinguish: BC dry chemical, regular
Carbon dioxide (if fire is contained in a small area).
Multi-purpose dry chemical
Halon

Class C Fire

Electrical Fires

To extinguish: Carbon dioxide
Halon
BC dry chemical, regular. This is effective, but will destroy electronic gear.
Multi-purpose dry chemical. This is effective, but will destroy electronic gear.

Class D Fire

Material: Metals: Magnesium, Aluminum, Sodium, Potassium, Zirconium, Titanium etc.

To extinguish: Special metal extinguishers.
The ordinary extinguishers found in the building should not be used on metal fires because a violent reaction may result.

APPENDIX A: Example Material Safety Data Sheet (MSDS)**MATERIAL SAFETY DATA SHEET****MATERIAL IDENTITY: SUPERCLEAN TOUGH TASK DEGREASER****SECTION 1 - MANUFACTURER'S INFORMATION**

Manufacturer: SuperClean Brands, LLC
1380 Corporate Center Curve, Suite 107
Eagan, MN 55121

Telephone: (651) 365-7500

Facsimile: (651) 365-7599

Transportation Emergency (for immediate information about a chemical or to seek assistance from a manufacturer): 1-800-535-5053

Date Updated: April 02, 2010

SECTION 2 - HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

Common Name: Cleaner

Product Use: Multi-purpose cleaner/degreaser

Product Identification: Cleaner

NFPA HAZARD RATINGS
HEALTH - 3
FLAMMABILITY - 0
REACTIVITY - 1
OTHER - NOT APPLICABLE

INGREDIENTS - CHEMICAL/COMMON NAME	EXPOSURE LIMITS -TVL	LD 50	LC 50	%
Water [CASRN 7732-18-5]	ND	ND	ND	60-100
2-Butoxyethanol [CASRN 111-76-2]	PEL/TWA: 25 ppm skin (OSHA, ACGIH)	Oral, rabbit: 300 mg/kg Dermal, rabbit: 220 mg/kg Intravenous, rabbit: 252 mg/kg Intraperitoneal, rat: 220 mg/kg	Inhalation, 7 hr. mouse: 700 ppm	5-10
Sodium xylene sulfonate [CASRN 1300-72-7]	ND	ND	ND	1-5
Nonylphenol ethoxylate [CASRN 127087-87-0]	ND	ND	ND	1-5
Sodium hydroxide [CASRN 1310-73-2]	PEL/TWA: 2 mg/m ³ (OSHA, ACGIH), Ceiling	Oral, mouse: 40 mg/kg	ND	1-5
Sodium metasilicate pentahydrate [CASRN 6834-92-0]	ND	Oral, mouse: 770 mg/kg	ND	1-5
Other additives [CASRN, NA]	ND	ND	ND	0.5-1.5
Dye and fragrance [CASRN, NA]	ND	ND	ND	0.1-1

MATERIAL SAFETY DATA SHEET**MATERIAL IDENTITY: SUPERCLEAN TOUGH TASK DEGREASER****SECTION 3 - PHYSICAL/CHEMICAL CHARACTERISTICS**

Boiling Point: ~ (212 F) 100 C	Specific Gravity (Water=1): 1.04
Flash Point (COC): NA	
Vapor Pressure (mm . Hg. @ 25 C): ND	Vapor Density (Air=1): ND
Percent Volatiles: 85-95%	Evaporation Rate (Water=1): 1
Solubility in Water: Complete	Freeze Point: ~28 f (2 c)
pH-Value: Neat -13.0; 2% - 11.7	Viscosity @ 40 °c, cSt: ND
Odor Threshold: NA	Coefficient of Water/Oil Distribution: NA
Appearance, Odor & Physical State: Clear , purple liquid ; lemon odor	

SECTION 4 - FIRE AND EXPLOSION HAZARD DATA

Flammability Yes [] No [X] Aqueous fluid

Fire Point (COC): NA

Autoignition Temperature: NA

Flammability limits in Air, % Vol.: Upper - NA Lower - NA

Extinguishing Media:
Use media appropriate for any surrounding combustible substances (Waterfog, CO2, dry chemical, foam).

Special Firefighting Procedures/Unusual and Explosion Hazards:
Cool fire exposed containers with water. Do not enter confined areas without full protective equipment, including a positive pressure NIOSH approved self-contained breathing apparatus.

EXPLOSION DATA

Sensitivity to Mechanical Impact: NA

Sensitivity to Static Discharge: NA

SECTION 5 - REACTIVITY DATA

Stability: Stable at ambient temperatures

Hazardous Polymerization: Will not occur

Conditions and Materials to Avoid (Incompatibilities):
Strong acids.
Strong oxidizers.
Avoid contact with glass.

Hazardous Combustion or Decomposition Products:
Smoke, fumes, oxides of carbon

MATERIAL SAFETY DATA SHEET**MATERIAL IDENTITY: SUPERCLEAN TOUGH TASK DEGREASER****SECTION 6 - HEALTH HAZARD DATA****Exposure Limits:**

See Section II, Product/Ingredient

PRIMARY ROUTES OF ENTRY:

- ☒ Eye Contact
- ☒ Skin Contact
- ☐ Skin Absorption
- ☒ Inhalation (Acute)
- ☐ Inhalation (Chronic)
- ☐ Ingestion

EFFECTS OF EXPOSURE**Acute – DANGER! CORROSIVE LIQUID****Eyes:** Can cause severe irritation or burns. Avoid contact.**Skin:** Can cause severe irritation or burns. Avoid contact.**Respiratory system:** Can cause irritation or burns following inhalation of mists.**Ingestion:** Can cause severe irritation or burns to digestive tract. Do not swallow.**Chronic:** No chronic effects known.**Medical Conditions Generally Aggravated by Exposure:** Pre-existing skin disorders.**TOXICOLOGY DATA (Product)****Acute Data (Median Lethal Dose -species)**

- Oral LD50-rat: 8.2 g/kg
- Dermal LD50- rabbit: ND
- Inhalation LC 50 - rat : ND

Irritancy Data:

- Eye irritation** - rabbit: ND
- Skin irritation** - rabbit : ND
- Sensitization** - guinea pig: ND

Signs/Symptoms:**Eyes:** Irritation, redness, tearing, pain; Conjunctival swelling, burns.**Skin:** Irritation, redness, extreme dryness and peeling, scarring.**Respiratory system:** Nasal and respiratory irritation, pneumonitis, tissue damage**Eye contact:** Immediately flush with Plenty of clean water for at least 15 minutes. Consult a physician immediately.**Skin contact:** Remove clothing. Immediately flush skin with plenty of clean water for 15 minutes. Call a physician immediately.**Inhalation:** Remove from area of exposure. If breathing is difficult or irritation persists, call a physician.**Ingestion:** Do not induce vomiting. Give plenty of water or milk and call physician immediately. Do not give anything by mouth to an unconscious or convulsing person.

MATERIAL SAFETY DATA SHEET**MATERIAL IDENTITY: SUPERCLEAN TOUGH TASK DEGREASER****SECTION 7 - PRECAUTIONS FOR SAFE HANDLING AND USE**

INFOTRAC EMERGENCY PHONE NUMBER 1-800-535-5053 24 hrs for U.S. transportation related spills, leaks, fire, exposure or accident.

Spill or leak Procedures:

Use best engineering practices when attempting cleanup of a large spill.

Large spills - Wear respirator and appropriate protective clothing. Stop source of leak if possible. Dike, contain spill and recover free liquid. Prevent entry into waterways. Neutralize and/or soak up residue with an inert absorbent such as clay, sand or other suitable materials; Store and dispose of properly. Flush area with water. Where feasible and appropriate, remove contaminated soil.

Small spills - Neutralize and/or soak up spill with an inert absorbent such as clay, sand or other suitable materials; Store in a closed container and dispose of properly.

Regulatory spill reporting requirements may apply; Contact governmental agency or legal counsel for advice.

Waste Disposal Method:

If discarded as supplied, material meets RCRA characteristic definition of corrosivity, 0002. The toxicity characteristic has not been evaluated. Under RCRA, the applicable hazardous waste classification must be evaluated prior to disposal of the material. Use of the product, processing contamination may render the resulting material hazardous or alter waste classification.

All recovered material should be packaged, labeled, transported and disposed of or reclaimed in accordance with local, state and Federal regulations regarding air pollution, water pollution or health.

CAUTION: Improper disposal or reuse of the empty container may be hazardous and illegal. Cutting or welding of empty containers may cause explosion or toxic fumes from residues. Do not pressurize or expose to open flame or heat. Keep container closed and drum bungs in place. RE to applicable governmental regulations.

SECTION 8 - SPECIAL PROTECTION INFORMATION

Ventilation: General ventilation and local exhaust recommended. Build up of mists/vapors in the working atmosphere must be prevented.

PERSONAL PROTECTIVE EQUIPMENT

When Respiratory Respirators should be used when engineering or other controls are not technically feasible.

Protection: required, use only a MSHA/NIOSH approved air supplied respirator or an air-purifying respirator.

Eye: Safety goggles or face shield.

Gloves (specify): Impervious type gloves, such as rubber, neoprene, nitrile, polyethylene.

Clothing: Protective clothing such as a coverall or apron may be used to minimize skin contact.

Footwear: No special requirement.

Other: Eye wash and safety shower recommended in industrial settings

Work/Hygienic Practices: Avoid skin and eye contact. Do not wear contaminated clothing; Launder before re-use or discard. Wash thorough after handling.

Storage/Handling: Maintain ambient temperatures. Avoid prolonged breathing of mists. Use with adequate ventilation. Corrosive to the eyes and skin. Severe internal irritation and damage can result when ingested avoid contact with eyes, skin or clothing

Do not swallow. Keep container tightly closed when not in use.

Keep out of reach of children.

MATERIAL SAFETY DATA SHEET**MATERIAL IDENTITY: SUPERCLEAN TOUGH TASK DEGREASER****SECTION 9 - OTHER HAZARDOUS INFORMATION AND DEFINITIONS**

OSHA PEL: The Occupational Safety and Health Administration's Permissible Exposure Limit, which is defined as the maximum concentration of contaminant to which a normal healthy individual may be exposed 8-hours per day, 40-hours per week, without experiencing adverse health effects over a working lifetime.

ACGIH TLV: American Conference of Governmental Industrial Hygienist's Threshold Limit Value, similar to the OSHA PEL but not considered a legal standard.

SECTION 10 - TRANSPORTATION INFORMATION**TRANSPORTATION**

Special Shipping Information/DOT Proper Shipping Name:

In inner packaging not over 1 L (0.3 gallon)

Proper Shipping Name Limited Quantity ORM-D

Per 49 CFR 173.154 (b) (1)

In inner packaging over 1 L (1 gallon, 2.5 gallon 5 gallon, 30 gallon, & 55 gallon)

Proper Shipping Name UN3266, CORROSIVE LIQUID, BASIC, INORGANIC, N.O.S. (SODIUM HYDROXIDE, SODIUM METASILICATE), 8, PG II

CHEMICAL CONTROL REGULATIONS:

TSCA Status: All components of this material appear on the Toxic Substance Control Act Chemical Substances Inventory.

CEPA Status: All components of this product appear on the Canadian Domestic substances list Canadian Workplace Hazardous Material Identification System (WHMIS) Classification:

Material is a controlled product.

- ☐ Class A - Compressed Gas
- ☐ Class 8-1 - Flammable Gases
- ☐ Class B-2 - Flammable Liquids
- ☐ Class B-3 - Combustible Liquids
- ☐ Class B-4 - Flammable Solids
- ☐ Class 8-5 - Flammable Aerosols
- ☐ Class C -Oxidizing Material
- ☐ Class 8-6 - Reactive Flammable Materials
- Class D, Div.1 - Materials Causing Immediate and Serious Toxic Effects
 - ☐ Class D-1A - Very Toxic Material
 - ☐ Class D-1 B - Toxic Material
- Class D, Div.2 - Materials Causing Other Toxic Effects
 - ☐ Class D-2A - Very Toxic Materials
 - ☒ Class D-2B - Toxic Materials
 - ☒ Class E - Corrosive Material
 - ☐ Class 0-3 - Biohazardous Infectious Material
 - ☐ Class F - Dangerously Reactive Material

EPCRA - Emergency Planning and Community Right to Know Act (SARA Title III):

Section 302/304 Extremely Hazardous Substance: NA

CERCLA Section 102(a) Hazardous Substance:

Sodium hydroxide. Reportable quantity for product=25,000 pounds (11,250 kg).

Section 311 Hazard Category

- ☒ Acute (immediate)
- ☐ Chronic (delayed)
- ☐ Fire
- ☐ Sudden Release of Pressure
- ☐ Reactive
- ☐ Not applicable

MSDS SUPERCLEAN TOUGH TASK DEGREASER

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MATERIAL SAFETY DATA SHEET**MATERIAL IDENTITY: SUPERCLEAN TOUGH TASK DEGREASER****Section 313 Toxic Release Inventory Chemical/Category:**

Glycol Ethers, 3.99% (wt.) max.

U.S. STATE RIGHT TO KNOW LAWS

New Jersey Worker and Community Right to Know Act, N.J.A.C. 8:59 -5 Labeling Information:

See Section II.

California Safe Drinking Water Enforcement Act (Proposition 65):

This product contains one or more chemicals known to the State of California to cause cancer or reproductive harm.

ABBREVIATIONS:

NE = NOT ESTABLISHED

> = GREATER THAN

BCF = BIOCONCENTRATION FACTOR

NDA = NO DATA AVAILABLE

<= LESS THAN

ND = NO DATA

The information presented herein is compiled from sources considered to be dependable, believed to be accurate to the best of SuperClean Brands, LLC knowledge and offered in good faith for the purpose of hazard communication. Because product use is beyond our control no warranty is given expressed or implied. SuperClean Brands, LLC cannot assume any liability for the use of information contained herein. To determine applicability or effect of any law or regulation with respect to the product use is beyond our control no warranty is given expressed or implied. SuperClean Brands, LLC cannot assume any liability; user should consult a legal advisor or appropriate governmental agency.

MSDS SUPERCLEAN TOUGH TASK DEGREASER

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APPENDIX B: Pick-Up Request Form for Chemical Materials

**Pick-Up Request Form for Chemical Materials
and
Corresponding Instructions**

Please contact the department safety officer with pick up requests.

A sample of the chemical waste tag is shown below. You can get these tags directly from the Environmental Health & Safety office.

HAZARDOUS WASTE

**FEDERAL LAW PROHIBITS
IMPROPER DISPOSAL**

If found, contact the UMR Police, or the UMR
Department of Environmental Management
Services, or the U.S. Environment Protection
Agency.

Generator: **University of Missouri-Rolla**
Rolla, MO 65401-0249

DATE: _____

GENERATOR: _____

LOCATION: _____

**DESCRIBE CONTENTS, COMPONENTS AND
CONCENTRATIONS:**

CHECK ALL THAT YOU THINK APPLY:

☐ ACID	☐ BURNS READILY
☐ NEUTRAL	☐ EXPLOSIVE
☐ BASIC	☐ REACTIVE
☐ OXIDIZER	☐ BIO HAZARD
☐ REDUCER	☐ CANCER HAZARD

**DO NOT REMOVE THIS LABEL WITHOUT
AUTHORIZATION OF THE DEPARTMENT OF
ENVIRONMENTAL MANAGEMENT SERVICES**

HANDLE WITH CARE!

APPENDIX C: Proper Identification of Materials (Labeling)

SiC
Silicon Carbide
Fisher S130-33
BC: M017760
5/31/26 Joe Miner

Repackaging

This type of label would be used for a smaller secondary container filled from the original. This will identify the material, where it was purchased (with the catalog #) and the “BC” is the bar code from the original container.

Alumina Zirconia Slip
90% 10%
Aqueous w/ PVA binder
5/31/26 Joe Miner

Processing

This type of label would be used for processing containers. A breakdown of the material in bottle is needed for later disposal purposes.

2705VD
Borosilicate glass
#10255 Ni; 5 vol% Ni
5/31/26 Joe Miner

Specimens

This type of label would be used to identify specimens that have been created. It may contain your identification that links it to your lab book. It **must** also contain sufficient chemical composition information that the specimen can be properly disposed of.

Al₂O₃
Alumina
Almatis A-16SG
5/31/26 Joe Miner

General

This type of label would be for any container and may also include a bar code. If available, you need to include the vendor name and catalog #.
This minimal type of label **must** be used (if none of the above labels apply) on everything including distilled water.

If you receive a chemical that has a MSDS with it, the MSDS sheets **must** be kept either close to the chemical or somewhere nearby where it is highly visible.

All labels **must** contain the above information and must be readable.

Any container with material that is not properly labeled will be confiscated & secured. This includes materials that are being processed such as containers on jar mills, materials in or removed from the dryer, in furnaces, stored in cabinets, etc. If you are processing materials, attach a temporary label to the vessel or place an identifying note in the immediate vicinity of the container or equipment. If you are missing material, see the main office.

APPENDIX D: Definitions

ACUTE – An adverse effect on the human body with symptoms of high severity coming quickly to a crisis.

ALLERGIC SENSITIZATION – A condition acquired through exposure to a particular substance; additional exposure causes a more severe reaction.

BRONCHITIS – The inflammation of one or more of the larger passages leading to the lungs.

CARCINOGEN – A substance that has been shown to cause malignant (cancerous) tumors.

CATALYST – An agent which hastens and stimulates a chemical reaction.

CHRONIC – An adverse effect on the human body with symptoms which develop slowly over a long period of time or which frequently recur.

CONJUNCTIVITIS – The inflammation of the delicate membrane lining the eyelids and covering the eyeball.

CYANOSIS – A bluish discoloration of the skin, especially on the face and fingers, indicating a lack of sufficient oxygen in the blood.

DERMATITIS – An inflammation of the skin.

EVAPORATION RATE – A measure of the length of time required for a given amount of a substance to evaporate; normally compared with the time required for an equal amount of ether or butyl acetate to evaporate.

FLAMMABLE LIMITS – (Explosive Limits)

Lower Flammable (Explosive) Limit – The lowest concentration of a combustible or flammable gas or vapor in the air that will produce a flash of fire. Mixtures below this concentration are too “lean” to burn.

Upper Flammable (Explosive) Limit – The highest concentration of a combustible or flammable gas or vapor in air that will produce a flash of fire. Mixtures above this concentration are too “rich” to burn.

FLASH POINT – The lowest temperature, in Fahrenheit, at which a liquid will give off enough flammable vapor to ignite.

INGESTION – The taking in of a substance through the mouth.

INHALATION – The taking in of a substance by breathing.

LAVAGE – The washing or irrigation of an organ.

MUTAGEN – A substance that causes changes in the genetic material in cells. Many carcinogens are also mutagens.

NARCOSIS – An unconscious state caused by a drug.

NEUROTOXIN – A substance which may harm the nervous system.

ORAL DOSE (LD₅₀) – The amount of a substance taken by mouth that would kill within 14 days half (50%) of those exposed. The dose is measured in milligrams per kilogram of body weight.

OXIDIZING AGENT – A chemical which gives off free oxygen in a chemical reaction.

POLYMERIZATION – A chemical reaction in which two or more small molecules combine to form larger molecules. This reaction can release heat, causing a fire or explosion.

PULMONARY EDEMA – An abnormal accumulation of fluid in the lungs.

REACTIVITY – A measure of the tendency of a substance to undergo chemical reaction with the release of energy.

SENSITIZER – See Allergic Sensitization.

SOLUBILITY – A measure of the amount of the substance that will dissolve in a given amount of water or other substance.

STABILITY – A measure of the ability of a substance to be handled and stored without undergoing unwanted chemical changes.

SYSTEMIC – Affecting the body as a whole.

TERATOGEN – A substance which may cause damage to a fetus. Women of child-bearing potential should take care to avoid exposure to substances that are teratogens.

THERMAL DECOMPOSITION – Chemical breakdown of a material brought about by exposure to heat.

THRESHOLD LIMIT VALUE (TLV) – The airborne concentration of a substance which represents conditions under which it is believed that nearly all workers may be repeatedly exposed day after day (up to forty hours a week) without adverse effects.

TOXICITY – The measure of the adverse effect exerted on the human body by a poisonous material.

VAPOR DENSITY – Relates the weight of the vapors from a substance to air. This will inform the user of the substance as to whether the fumes will rise (value less than 1) or sink (value greater than 1).

VAPOR PRESSURE – The pressure of a vapor of a substance against the sides of a closed container. Substances with high vapor pressures will evaporate quickly.

VOLATILE – Evaporates quickly.